Hanson Construction Materials Pty Ltd.

Sancrox Quarry Expansion Project

Environmental Impact Statement

ERM Ref: 0418291

October 2019

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CERTIFICATION OF ENVIRONMENTAL IMPACT STATEMENT FOR THE SANCROX QUARRY EXPANSION PROJECT.		
This Environmental Impact Statement (EIS) was prepared by Environmental Resources Management Pty Ltd (ERM) supports an application by Hanson Construction Materials (Hanson) for the Sancrox Expansion under Part 4 of the Environmental Assessment and Planning Act 1979.		
PROPONENT:	Hanson Construction Materials Pty Ltd (Hanson)	
Applicant's Address:	C/o Environmental Resources Management Australia Pty Ltd. Locked Bag 3012, Australia Square NSW 1215	
Proposed Development:	Sancrox Quarry Expansion	
EIS COMPILATION BY:	Thomas Buchan	Murray Curtis
Qualifications:	BEnv.S (ACU)	BEng (UNE)
Address:	Environmental Resources Management Pty Ltd Locked Bag 3012, Australia Square NSW 1215	
CERTIFICATION	We certify that we have prepared the contents of this EIS to the best of our knowledge. The EIS has been prepared in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* and contains all available information that is relevant to the environmental assessment of the development. The EIS draws on the work undertaken by a number of technical specialists engaged as part of the Project Team with the information contained in the EIS neither false nor misleading.	
Signature:		
Name:	**Thomas Buchan**	**Murray Curtis**
Date:	1 October 2019	

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EXECUTIVE SUMMARY

E.1 BACKGROUND

Hanson Construction Materials Pty Ltd (Hanson) currently operates a hard rock quarry, known as Sancrox Quarry, on Sancrox Road, Sancrox, located approximately 8 km west of Port Macquarie. The Sancrox Quarry is within the Port Macquarie Hastings Council (PMHC) local government area on the Mid North Coast of NSW. The current Sancrox Quarry comprises Lot 2 DP 574308, Lot 353 DP 754434, Lot 1 DP 720807 and Lot 1 DP 704890. The quarry is considered a major economic resource for regional and state development.

E.2 PROPOSED ACTIVITY (THE PROJECT)

Hanson proposes to extend the life of the quarry by expanding the approved extraction boundary and increase the annual extraction limit. In addition to the quarry expansion, Hanson also proposes to establish a concrete batching plant, an asphalt production plant and a concrete recycling facility. These proposed activities are herein referenced as 'the Project'. The Project will facilitate the extraction, production and distribution of high quality construction materials for the use in civil infrastructure and road construction projects. A summary of the Project and associated developments is provided in the Project Description Summary (*Table 1*) below.

Table 1 Project Description Summary

Project Components/Aspects	**Currently Approved Sancrox Quarry**	**Proposed Project**
Quarry Life	20 years	30 years
Limits on production	455,000 tpa	750,000 tpa
Quarry Footprint	17.18 ha	48.61 ha
Final Quarry Depth	RL – 14m AHD	RL – 40m AHD
Product Processing Plant and Stockpile Area	Located in north-east corner of site	To be relocated to the south of quarry pit
Site Office, Weighbridge and Workshop	Located near site entrance	To remain in the same location
Water Holding Dams (WHD)	Two located in the south-east corner of site	To remain in same location. Additional WHDs will be constructed throughout the various stages of the Project to manage sediment.
Concrete Batching Plant	Not currently operating	20,000 tpa To be located in north-east corner of site
Concrete Recycling Facility	Not currently operating	20,000 tpa To be located in north-east corner of site
Asphalt Production Plant	Not currently operating	50,000 tpa To be located south of quarry pit

Project Components/Aspects	Currently Approved Sancrox Quarry	Proposed Project
Hours of Operation	Quarry operates: - 7am – 5pm Monday to Friday - 7am – 1pm Saturday Truck movements and equipment loading: - 7am-11pm Monday – Friday -7am – 1pm Saturdays, Sundays and Public Holidays. Operations are permitted between 11:00pm and 7:00am on a maximum of 20 occasions within a year.	Quarry operations (incl. production and maintenance): 24 hours a day, 7 days a week Truck movements and equipment loading: 24 hours 7 days Blasting: 8am – 5pm Monday to Friday
Employee numbers	15 full-time employees (with casual and contractors on an as needed basis)	10 additional full-time employees, resulting in 25 full-time employees.

The proposed quarry expansion will be completed in five separate stages, over the 30 year lifetime of the Project. Existing quarry operations will continue as much as possible during construction of the proposed infrastructure.

It should be noted that during the preparation of this Environmental Impact Statement (EIS) the original quarry footprint that was submitted in the Preliminary Environmental Assessment (Hanson 2015) was modified. The modification was a reduction in the footprint in the north western corner to avoid the risk of flooding, as identified throughout the Hydrology Assessment prepared as part of this EIS. The updated footprint is presented in *Chapter 2* of this EIS. The original proposed footprint and the reduced footprint are demonstrated in *Figure 8.1*. Where potential impacts were considered to be reduced by the decrease in quarry footprint, the assessment retained the original footprint, providing the worst case scenario for the assessment. This worst case approach using the original footprint was utilised in the following assessments:

- Biodiversity;
- Noise and Vibration; and
- Air Quality.

E.3 STRATEGIC JUSTIFICATION/STATUTORY CONTEXT

The Project Proposal is to extract more than 500,000 tonnes of material per year and to access greater than 5M tonnes of reserves. Therefore the development meets the criteria listed by clause 7 (1)(a) and (b), Schedule 1, State Environmental Planning Policy (State and Regional Development) 2011 for assessment as a 'state significant development' (SSD), under section 89C (2) of the Environmental Planning and Assessment Act 1979 (the EP&A Act).

The Project will be assessed as State Significant Development (SSD) as defined under the *State Environmental Planning Policy (State and Regional Development) 2011*, and will require development consent under Part 4, Division 4.1 of the EP&A Act. The Department of Planning, Industry and Environment (DPI&E, formerly the Department of Planning and Environment; DP&E) will be the determining authority.

Consideration of Project with Regional and Local Planning Provisions

The proposed increase in production at the quarry is consistent with the objectives of the Port Macquarie-Hastings Local Environmental Plan RU1 zone. Extractive industries are permitted within the zone with development consent. It is therefore considered that the Project would not fragment or alienate any land or result in conflict with adjoining land uses. The Project would result in the employment of 10 additional staff members (resulting in 25 full-time employees across the entire project) and result in positive local economic benefits.

The continued and additional supply of a valuable resources in the form of aggregate, concrete and asphalt to the local construction industry as well as a facility for recycling of a waste concrete will meet the strategic goals of boosting the local economy and providing the materials to allow for infrastructure and housing developments. The quarry is ideally located away from substantial residential development, and located directly adjacent to the recently upgraded Sancrox Interchange and Pacific Highway, allowing for safe distribution of materials to the surrounding region to facilitate strategic urban growth.

E.4 CONSULTATION

Consultation was undertaken with relevant stakeholders through the environmental impact assessment process as requested throughout the Secretary's Environmental Assessment Requirements (SEAR's), in order to identify key environmental issues relevant to the proposed project. Relevant Government Agencies and Local Aboriginal Land Council Representatives were consulted during preparation of the EIS, and have been outlined in *Chapter 4* of this EIS.

Additionally community consultation was undertaken by the Proponent, which included the development of a Community Consultative Committee (CCC) in accordance with the SEAR's, and has been outlined in more detail in Chapter 4.

Evidence of consultation and associated responses have been compiled and included as *Annex B* of this EIS (Consultation Log).

E.5 APPROACH TO THE ASSESSMENT

In accordance with the NSW Department of Environment and Planning Guidelines for Preparing an Environmental Impact Assessment (DP&E, 2017) environmental factors associated with the project have been categorised into either Key Issues or Other Issues, which in turn dictates the level of assessment undertaken for the aforementioned issues. The separation into either group is primarily based on the potential impacts to each environmental factor, which was highlighted throughout the Preliminary Environmental Assessment (Hanson, 2015) and the SEAR's prepared for the proposed development (SSD 7293).

Key Issues Assessment

A Key Issue Assessment is the highest level of assessment and requires a supporting specialist report, along with a summary of the assessment included as a section within the EIS. Each of the following Key Issues below have been prepared in accordance with the former DPE guidelines (and relevant industry guidelines and standards) and associated specialist reports are provided as annexures throughout the EIS.

The Key Issues Assessments prepared for the EIS include:

- Biodiversity (*Chapter 5, Annex C*);
- Heritage (*Chapter 6, Annex D*);
- Surface Water (*Chapter 7, Annex E*);
- Groundwater (*Chapter 8, Annex F*);
- Soil and Land Resource (*Chapter 9*);
- Noise and Vibration (*Chapter 10, Annex G*); and
- Air Quality and Greenhouse Gas (*Chapter 11, Annex H*).

Other Issues Assessment

An Other Issue Assessment does not typically require a supporting specialist report as the impacts are generally less significant, and can be routinely managed using standard mitigation and management measures. As the Other Issues Assessments do not necessarily require a specialists report, all information regarding the assessment have been provided in the relevant section of the EIS.

The Other Issues Assessments prepared for the EIS include:

- Traffic and Access (*Chapter 12* and *Annex I*);
- Visual Amenity (*Chapter 13*);
- Socio-economic (*Chapter 14);*
- Hazards and Risks (*Chapter 15*);
- Waste Management (*Chapter 16*); and
- Quarry Closure and Rehabilitation (*Chapter 17*);

E.6 BIODIVERSITY

SLR Consulting Australia (SLR) were engaged to prepare a BioBanking Assessment Report (BAR) to support an application by Hanson Construction Materials Pty Ltd seeking project approval for expansion of the existing Sancrox Quarry. The SEAR's for the EIS, as issued by the Secretary of the former DP&E, require the preparation of a Biodiversity Assessment Report (BAR) in accordance with the *Framework for Biodiversity Assessment* (FBA). Refer to *Chapter 5* and *Annex C* for further information.

Direct Impacts

Direct impacts to biodiversity values are described within the FBA as 'an impact on biodiversity values that is a direct result of vegetation clearance from a development'. The final development footprint will involve the following direct impacts to biodiversity:

- clearing of 43.1 ha of native forest vegetation, which includes 0.55 ha of the Subtropical coastal floodplain forest Threatened Ecological Community;
- loss of hollow-bearing trees, some of which may provide potential roost sites and breeding habitat for a selection of bird, arboreal mammal, reptile and microchiropteran bat species; and
- removal of foraging habitat for locally occurring native fauna, in particular for threatened microchiropteran bats species, ground mammals, arboreal mammals and a range of bird species.

Impacts requiring Offsets

According to Section 9.3 of the FBA, impacts on native vegetation that require an offset include:

- impacts on EECs and CEECs, unless specifically nominated in the SEARs as an impact requiring further consideration; and
- impacts on PCT's associated with threatened species habitat and in a vegetation zone that has a site value score of >= 17

All vegetation zones mapped within the site have current site value scores of over 17 (refer to *Section 6.5.1* of the BAR) (SLR, 2018) and represent habitat for at least one threatened species; hence any clearing in these vegetation zones would require an offset.

In the attachments to the SEARs (see Appendix A of the BAR), the Office of Environment and Heritage (OEH) identify impacts that require further consideration. OEH states "Impacts on the following species, populations and ecological communities will require further consideration and provision of the information specified in S.9.2 of the Framework for Biodiversity Assessment:

- Biconvex Paperbark (*Melaleuca biconvexa*);
- Spider Orchid (*Dendrobium melaleucaphilum*); and
- Southern Swamp Orchid (*Phaius australis*)."

No evidence for the threatened plant species provided above was recorded during field surveys undertaken as part of the BAR. It is noted that targeted searches for threatened plants were conducted across the site on several occasions during 2015 and 2016, including during the known flowering period of the two orchid species and no individuals of these species were recorded.

Preferred Offset Strategy

The preferred offsetting option for the proposed development is a combination of the offset Options provided in Section 7.3 of the BAR (SLR, 2018), being:

Ecosystem credits:

- Generate available ecosystem credits from the proposed Offset Site – create a BioBanking Agreement over the Offset Site in consultation with OEH. This action will only provide some of the ecosystem credits required – most of the ecosystem credits required will need to be purchased.

- Purchase remaining like-for-like ecosystem credits from Credit Register (or approach potential credit sellers through the Expressions of Interest register).

- Purchase 'variation credits' by applying variation rules, in the scenario that like-for-like credit cannot be found after apply "reasonable steps". An Expression of Interest for the required credits will be published on the Office of Environment and Heritage (OEH) BioBanking 'Credits Wanted' register.

Species credits:

- No species credits required.

Supplementary measures:

- Identify and revegetate lands within the Sancrox Quarry that could form part of a north-south biodiversity corridor link through the site, in accordance with the 'notional linkage' identified for the Greater Sancrox Structure Plan (Phillips and Hopkins 2011).

The results of the BAR (SLR, 2018) suggest that there will be minor impacts to biodiversity (mainly vegetation) as a result of the proposed development. However the Biodiversity Offset Strategy (BOS) prepared for the proposed development proposes to offset approximately 49 ha of native vegetation by investing in a nearby parcel of land (creating an estimated 502 ecosystem credits), with the remainder of the ecosystem credits being purchased in due course.

E.7 HERITAGE

ERM was engaged by Hanson to undertake a Heritage Assessment to inform the EIS for the Project, which considered both Aboriginal and non-Aboriginal historic heritage values.

The objective of the Heritage Assessment was to meet the requirements of the SEARs, The Heritage Council of NSW and the NSW Office of Environment and Heritage. It provides a combined assessment of the tangible and intangible heritage values relating to the Project site, as identified during desk based assessment and field surveys undertaken in November 2017.

The assessment was undertaken using desktop analysis, archival research, field survey and Aboriginal stakeholder consultation. The assessment was undertaken in accordance with relevant legislative requirements and guidelines as listed in the assessment.

Searches of the local and state heritage registers were conducted in order to identify any historic heritage sites located within the Project site. A search of the Aboriginal Heritage Information Management System (AHIMS) site register was also conducted, to determine the location of any Aboriginal heritage sites within or surrounding the Project site.

Significance Assessment

Based on the desktop assessment, any surviving sites and features of non-Indigenous cultural heritage value within the Project site would be limited to portable domestic and rural artefacts, or features associated with grazing and timber extraction activities.

The archaeological survey did not result in the identification or recording of Aboriginal archaeological or cultural sites within the proposed extraction area, except for one potential scar tree located to the north of a small farm dam at the western extent.

The significance assessment prepared as part of the Heritage Assessment has been reproduced as *Table 2* below:

Table 2 Significance Assessment

Element	Significance Criterion	Assessment	Level of Significance
Potential Scarred Tree	Scientific	Has not been confirmed as a scarred tree.	Low
	Cultural	No further comments provided by the RAPS	Low
Potential Ceremonial Site	Scientific	Location cannot be confirmed. No physical evidence.	Low
	Cultural	Ceremonial sites are highly significant to local communities.	High

Mitigation Measures

Mitigation measures have been outlined throughout *Chapter 6* and *Annex D* of this EIS, and have been summarised below:

- In the unlikely event that historic or Aboriginal heritage items are found during works, the Unexpected Finds Protocol outlined in *Chapter 6* will be followed.
- In order to comply with best practice principles, all employees and subcontractors will undergo environmental awareness training as part of the site induction to ensure they understand their obligations and responsibilities.

E.8 SURFACE WATER / HYDROLOGY

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Hanson Construction Materials Pty Ltd (Hanson) to conduct a Hydrology Assessment to inform the Environmental Impact Statement (EIS) for the proposed Sancrox Quarry Expansion Project (the Project) (refer to Chapter 7 and *Annex E* of this EIS for additional information).

The Hydrology Assessment was prepared to address, and meet the requirements of relevant guidelines and legislation, as listed in the assessment.

In order to undertake the assessment, an investigation of the site was undertaken to understand the existing hydrological aspects of the surrounding area, and the current sediment controls.

To further inform the understanding gained from the site inspection, ERM undertook the following desktop activities:

- review of previous reports prepared for the quarry site;
- review and interpretation of:
  - aerial photography;
  - site survey; and
  - Proponent and PMHC supplied Geographical Information System (GIS) data.

Additionally, site hydrological data was obtained from an Intensity-Frequency-Duration (IFD) table developed for the site using the process outlined in Australian Rainfall and Runoff (Pilgrim, 1987).

Assessment

Potential impacts have been outlined throughout the Hydrology Assessment (ERM, 2018b) and summarised in *Table 3* below.

Conclusion

The hydrology assessment identified the potential soil and water impacts and constraints related to the Project. An erosion hazard assessment was undertaken using the RUSLE to determine the potential impacts of the Project, and this in turn was utilised to design the predominant mitigation measure for managing sediment-laden run-off generated by the site - the conceptual sediment basins.

The water balance for site operations demonstrates that surface water is available to meet the demands of the Project. The additional input provided by groundwater entering in to the quarry void will further supplement the water supply available for use. An aquifer interference approval will be required for the consumption of this groundwater (refer to *Groundwater Assessment* for further details).

A surface water monitoring program has been prepared and the site Environmental Protection Licence (EPL) will need to be varied to incorporate the proposed revision to current water monitoring. The program outlines the proposed surface water monitoring regime for the sediment basins that will be installed as the staged expansion progresses. With the implementation of sediment basins, the utilisation of the mitigation measures and the development of a Surface Water Monitoring Program (SWMP) and Progressive Erosion and Sediment Control Plans (PESCPs), the potential soil and water impacts of the Project can be effectively managed so that there is no significant, negative impact to the environment.

Table 3 Potential Hydrological Impacts

Construction Activities	Potential Impacts	Duration of Impact	Significance
Unsealed road network	• Creation of fugitive dust emissions due to vehicle movements. • Mud tracking at confluence of internal access roads with public road network.	Persistent during establishment of new stages and lifetime of quarrying operations. Internal road network will progressively increase as new stages are developed.	Low - access tracks created during stage establishment will be managed by sediment basins. Internal quarry roads during operation will runoff towards basins. Dust suppression measures proposed.
Establishment of future quarry stages	• Erosion of large disturbed areas during staged/progressive establishment and subsequent sedimentation of run-off. • Creation of fugitive dust emissions due to land and vegetation clearing activities. • Mulch stockpiles generating leachate run-off that may enter the surrounding surface water network.	Progressively increasing with life of quarry. Each basin for each stage will be functional until the quarrying excavates such that the run-off falls into the quarry void. This has been assumed to be no longer than three years per basin.	High – Significant area (greater than 38 ha is to be disturbed to allow for future quarry stages). It will be effectively managed by sediment basins until quarry void engulfs the catchment. Improvements to current site water management will be achieved by the establishment of the basin in the processing area and improved management in the proposed asphalt plant catchment via the conveyance of runoff to existing WHD 1.
Dewatering of site sediment basins and water accumulation points	• Introduction of contaminated water to natural surface waters, including release of water with high suspended solids.	Persistent during establishment of new stages and quarry operations.	Medium – Industry Standard procedure to dewater will manage risk. Surface water monitoring program and EPL variation will outline criteria for discharges/overflows from site water holding bodies.
Stockpile management	• Erosion of stockpiles and loss of soil resource. • Introduction of contaminated water to natural surface waters.	Persistent during quarry operational activities.	Low – dust suppression and management of moisture content, along with progressive stabilisation of topsoil to be used for rehabilitation limits risk.

Construction Activities	Potential Impacts	Duration of Impact	Significance
Concrete Batching Plant	• Contamination of waterways from water impacted by cement (washouts, cement storage areas, immediate vicinity of batch plant). • Release of water to soil and/or water bodies with increased pH, total suspended solids (TSS) and potentially other contaminants.	Lifetime of concrete batching plant	Medium – control measures as per *Section 7.5* to be implemented to manage risk and prevent negative impacts.
Asphalt Production Plant	• Introduction of hydrocarbon contamination to plant pad site, and subsequent potential contamination of run-off.	Lifetime of asphalt production	Low – industry standard practice limits potential for impacts
General site activities	• Hydrocarbon spills from machinery (burst hoses, mechanical failures, leaking machinery, etc.). • Contamination of waterways from hazardous substances due to incorrect storage (including drums and containers and spent oil filters). • Increased refuse in streams due to littering. • Contamination of soils and waterways from poor refuelling practices. • Discovery of previously contaminated sites.	Persistent throughout establishment of each stage and quarry operation	Low – risk is comparable to other construction activities. Within quarry void have very low potential for off-site contamination or surface water due to the topographical separation provided by the excavated void.
Water supply from within site	• Over-extraction of surface water or groundwater resulting in reduced environmental flows, reduced water availability for existing licensed users and impacts on water–dependent ecosystems.	Water required throughout entire lifetime of quarrying and concrete batching operations. Minimal volumes required during construction for dust suppression.	Low- Water balance undertaken to determine available water from existing and proposed water holding bodies. See *Section 7.*

E.9 GROUNDWATER

In order to meet the objectives of the groundwater related aspects of the SEARs, ERM conducted the following scope of works:

- a desktop assessment to describe the environmental site setting, including a search for groundwater users (both registered groundwater bores and groundwater dependant ecosystems) using publically available database sources;

- a groundwater field program to undertake aquifer parameter testing and groundwater and surface water sampling to characterise the aquifer system underlying the Project site; and

- groundwater modelling to evaluate groundwater inflow rates into the expanded quarry as well as potential groundwater drawdown proximal to the quarry and the potential magnitude of drawdown at identified groundwater users.

Groundwater Modelling

A numerical groundwater flow model (Model) was created to simulate the current hydrogeological conditions and at final quarry expansion. The Model was undertaken to address the impact assessment requirements of the NSW Aquifer Interference Policy. This included:

- estimating water take through groundwater inflows to the pit; and

- predicting groundwater level drawdown associated with pit development at groundwater user locations (both registered groundwater bores and the closest identified groundwater dependent ecosystem).

While the Project will include the expansion of the existing pit in multiple stages, the modelling was undertaken for a steady state scenario taking into consideration the full extent of the final planned pit void (at which stage steady state groundwater flow to the pit will be greatest and potential groundwater level drawdown proximal to the quarry will be greatest).

Results

The groundwater flow modelling indicates a steady state groundwater inflow rate of approximately 40 to 60 m^3/day to the final pit void, which equates to approximately 15 to 22 ML/year. The predicted steady state inflows are modest for a pit void of the proposed size, and the relatively low predicted inflow rates align with observations from the existing quarry where no active dewatering takes place and groundwater seepage into the pit is reportedly negligible.

Taking into consideration the impact assessment requirements of the NSW Aquifer Interference Policy, the predicted 2 m level drawdown contour for the stabilised cone of depression is of particular significance (as the minimal impact considerations specify a maximum of a 2 m decline at any water supply network). The modelling indicates that at its furthest extent (from the outer perimeter of the final pit) the 2 m drawdown contour may extend to approximately 800 to 1,100 m from the final pit (based on the base case and sensitivity run scenarios respectively).

Potential impacts may vary from negligible (if drawdown does not affect the operation and use of the bore) to significant if water level drawdown is such that it affects the useability of the bore.

Mitigation Measures

The NSW Aquifer Interference Policy specifies that monitoring requirements need to be developed that allow for the monitoring of actual impacts compared to predicted impacts, allowing for contingency plans to be enacted in a timely manner if actual impacts are higher than predicted and these impacts are found to be significant. It is recommended that a groundwater monitoring plan be developed that includes specifics of such a monitoring program, including threshold trigger values as well as a contingency strategy if triggers are exceeded.

While the development of such a plan falls outside the scope of this assessment, recommendations for monitoring requirements to be included in the Groundwater Monitoring Program would consider Water Take, Water Levels and Water Quality, which have been discussed in detail throughout *Chapter 8*.

Based on the findings presented throughout this chapter, and the results outlined throughout the Sancrox Quarry Expansion Groundwater Assessment (ERM, 2018c), it is concluded that impacts to groundwater as a result of the proposed development are expected to be minimal. This conclusion is based under the assumption that the mitigation measures outlined throughout *Chapter 8* (and throughout the Groundwater Assessment) are adhered to during and post-construction.

E.10 SOIL AND LAND RESOURCE

Existing Landform and Geology and Soil Characteristics

The Project site is situated in remnant open sclerophyll forest that is not currently used for agricultural production. An unsealed access track is located in the west of the Project site that provides access to the adjacent areas that have previously been cleared of vegetation and are used for cattle grazing.

The topography of the Study Area is characterised by floodplains and low lying hills up to approximately 60 m Australian Height Datum (m AHD), which is the highest point of the Study Area.

The 1:250,000 Hastings Geological Map Series SH 56-14 indicates that the Project site is situated over the Byabbara Beds Formation of the Carboniferous Period and Palaeozoic Era. The Byabbara Beds are characterised by lithic sandstone, siltstone, tuff, shale and limestone.

The soils at the Project site have predominately been removed prior to the excavation of the quarry in search of 'hard rock'. The highly disturbed extraction area is characterised by exposed rock and crushed particles of rock and clays. According to the soil landscapes described by Atkinson (1999), the majority of undisturbed portions of the Project site are part of the Cooperabung Soil Landscape. The western and southern extent of the Project site extends into the Euroka Soil Landscape. A small portion of the western extent of the Project site comprises the Kundabung Landscape. Additional information on each soil landscape group and dispersibility is outlined throughout *Chapter 9* of this EIS.

Assessment

Land and Soil Capability Assessment

None of the land within the Project site is in the highest land and soil capability (LSC) classes of land that is capable of a wide range of land uses. The largest percentage of the land within the Project site is LSC Class 6, low capability land that is capable of limited land uses. The next largest area is LSC Class 5 land that is moderate to low capability land. The small area of land in the western portion of the Project site is LSC Class 4 land of moderate capability. More information is provided in *Chapter 9* of this EIS.

Strategic Regional Land Use and Compatibility with Other Land Uses

Clause 12 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* requires assessment of compatibility of the Project with other land uses in the vicinity, particularly agricultural land use. The investigation of the agricultural mapping databases above identified that there is no conflict with the Project site and adjacent agricultural lands.

The Project site is zoned as primary production under the 2011 Port Macquarie Hastings Local Environmental Plan, though historic aerial imagery reveals has remained predominately unchanged (with the exception of an access track construction, a small dam and small plot of clearing between 1969 and 1989) as native open forest vegetation for approximately 58 years. Significant public benefit will be provided by the alteration of this currently unutilised land by the Project, with a longer term, reliable supply of rock for local development projects becoming available.

Contamination

No contamination risk is present or will be introduced by the Project that would warrant not undertaking the activity. Chemical and hydrocarbon management, spill prevention and control mitigation measures as outlined in *Chapter 7* to be implemented.

A site walkover will be undertaken prior to clearing activities taking place to ensure that any refuse is identified and can be removed from site and disposed of at an appropriate licenced location.

Should unexpected contamination be identified, works will cease and an appropriately experienced contamination specialist engaged to develop a strategy to manage the contamination.

Mitigation Measures

A number of mitigation measures have been outlined in Chapter 9 addressing impacts to soils, contamination, erosion and sediment and land slippage and will be implemented as required to ensure impacts are reduced where practicable.

E.11 NOISE AND VIBRATION

Environmental Resources Management Australia Pty Ltd (ERM) on behalf of Hanson Construction Materials Pty Ltd (Hanson) has completed a noise and vibration impact assessment (NVIA) for the expansion of the Sancrox Quarry, located on Sancrox Road, Sancrox New South Wales (NSW).

The NVIA has been prepared to document the findings of the assessment of environmental (noise, overpressure and vibration) factors, that was conducted in response to the assessment requirements specified for key issues as presented in the revised Secretary's Environmental Assessment Requirements (SEARs), dated 18 September 2017 for the Sancrox Quarry Extension Project (SSD 7293).

It should be noted that during the preparation of this report the quarry pit layout was modified in the north western corner, due to the risk of flooding identified in the Hydrology Assessment (ERM, 2018b). The updated staging layout is presented in *Chapter 2* of this EIS. Based on these minor changes to the pit layout, it is not anticipated that noise impacts will alter significantly. Therefore the original noise modelling results have been retained for this report.

The assessment was conducted to achieve a scope of works that allowed for the successful identification of potential receptors situated in the vicinity and potential area of influence of site emission sources and identification of significant noise and vibration generating plant, equipment and/or activities associated with the quarry and their likely/known emissions. The overall assessment methodology is presented in Chapter 2 of the NVIA (ERM, 2018d).

Potential impacts associated with construction road traffic and ground-borne noise, and impacts associated with construction and operational vibration were qualitatively assessed.

The assessment has identified that both construction and operational noise levels have the potential to exceed the applicable criteria, limits and thresholds of the *NSW Environment Protection Authority (EPA) – NSW Environmental Noise Management – Industrial Noise Policy (INP), January 2000* and the *NSW Interim Construction Noise Guideline 2009* (ICNG) if they are not suitably mitigated. The assessment also identified the blasting overpressure and vibration levels have only a limited potential to exceed the applicable AS2187 criteria and thresholds, as long as normal blast design planning and consideration for potential environmental impacts occurs.

Based on the NVIA findings noise mitigation, management measures and/or monitoring options were established as considered suitable to the magnitude and extent of the predicted construction and operational impacts.

Construction noise levels will be reduced and impacts (if any) minimised with the successful implementation of the recommendations provided in *Section 10.5*. Construction noise impacts may not be reduced to imperceptible or negligible levels for all receptors during all construction activities; however the recommendations presented in *Section 10.5* will ensure that any residual impacts are minimised as far as is commonly achievable.

Operational noise levels were predicted to exceed the applicable INP operational noise criteria and limits for all modelled conditions. As such, noise reducing mitigation and management measures were established to assist achieve compliance with the INP. The recommended mitigation and management measures have been provided in detail in *Section 10.5*.

E.12 AIR QUALITY AND GREENHOUSE GAS

This Air Quality and Greenhouse Gas (GHG) Assessment has been prepared in accordance with the latest version of Secretary's Environmental Assessment Requirements (SEARs) for the preparation of an EIS for the Sancrox Quarry Extension Project (Department of Planning and Environment, 2017) and forms the air quality assessment for the EIS to be submitted to the NSW Department of Planning and Environment (DP&E). The following scope of works has been undertaken:

- Assessment of potential for ambient air quality impacts and greenhouse gas emissions from construction and operation of the Proposed Project;
- Provision of mitigation measures to minimise impacts to the surrounding land use; and
- Recommendations for ambient monitoring to ensure compliance with legislation.

The Project has the potential for ambient air quality impacts and greenhouse gas emissions from the construction and operation of the following activities as listed in *Table 4*.

Table 4 ***Project Activities likely to cause Air Quality Impacts***

Quarry, including:	**Concrete Batching Plant, including:**	**Concrete Recycling Plant, including:**	**Asphalt Plant, including:**
• Drilling;	• Dry product delivery;	• Product delivery;	• Bitumen delivery and storage;
• Blasting;	• Product storage;	• Product storage;	• High quality aggregate delivery and storage;
• Product handling;	• Product transfer;	• Product handling;	• Dryer emissions;
• Rock processing;	• Pneumatic unloading of moist product;	• Crushing, using primary crusher; and	• Truck load out; and
• Wheel generated dust; and	• Weight hopper and mixer unloading; and	• Wheel generated dust.	• Wheel generated dust.
• Wind generated dust.	• Wheel generated dust.		

The criteria for all the emitted species were established through consideration of relevant legislation and guidelines, as listed in the assessment.

Assessment

The assessment of ambient air quality impacts identified that:

- The cumulative annual mean concentrations of PM10 are below the Approved Methods criterion at all sensitive receptors;
- Contemporaneous analysis identified that the cumulative (background plus project contribution) PM10 24-hour average predicted concentrations indicate exceedances of the Approved Methods Criterion at 13 sensitive receptors.
- Where exceedance of the Approved Methods Criterion occurs, a State Significant extractive development may be assessed against the criteria contained in the Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (the Policy) (NSW Government, 2018). Impacts predicted for the Project demonstrate an acceptable level of PM10 24 hour concentrations under the Policy;
- The cumulative annual mean concentrations of PM2.5 are below the Approved Methods criterion at all sensitive receptors;

- Contemporaneous analysis of the PM2.5 24-hour average predicted concentrations are below the Approved Methods Criterion at all sensitive receptors;

- The predicted concentrations for all other species are below the adopted criteria at all sensitive receptor locations.

The Project over its entire life cycle is estimated to release approximately 48.4 million tonnes of CO2-e into the atmosphere with scope 1 and scope 2 emissions accounting for 74% and 26% respectively of the total emissions. The main GHG emission sources over the life of the project representing 99% of all emissions are:

- Operations – Diesel for transport related purposes (38%)

- Operations – Electricity (26%)

- Operations – LNG (16%)

- Construction – Vegetation clearing (12%)

- Operations – Diesel for stationary energy purposes (6%)

Mitigation Measures

This air quality impact assessment considered all reasonable and feasible mitigation measures to minimise the emissions from the proposed activities at the site, including:

- Roads, which are likely to remain unchanged throughout the Project stages and to be frequently used by machinery, will be sealed using asphalt and swept daily to minimise wheel-generated dust emissions;

- Full dust extraction system for drilling;

- Utilisation of water sprays during truck rear dumping;

- The use of mobile sprinkler systems during the operation of front-end loaders (FELs);

- Dust suppression measures such as water sprays in place at the crushers and screeners;

- Water sprays used on all conveyor transfer points;

- The conveyor loading to be enclosed by a shroud;

- Level 2 watering (more than 2 litres/m2/hour) applied to unsealed roads to minimise impact from hauling;

- Water sprays to be utilised to minimise wind erosion from stockpiles during wind speeds of over 5.4 metres per second;

- The dry product delivered to the concrete batching and recycling plant and asphalt plant to be stored in aggregate storage bins enclosed on three sides. The walls to extend one metre above the height of the maximum quantity of raw material, and two metre beyond the front of the stockpile. The aggregate storage bins to be fitted with water sprays to keep the stored material damp at all times;

- Cement and cement supplement to be delivered to the concrete batching plant in the agitator trucks and pneumatically fed to the bottom-loaded silos;

- Concrete batching loading point to be totally enclosed with all particulate matter emissions generated by the facility captured by one bag filter located above the pan mixer;

- Concrete recycling facility outloading to be directly to processed material storage bins enclosed on three sides. The walls to extend one metre above the height of the maximum quantity of raw material, and two metre beyond the front of the stockpile. The recycled concrete storage bins to be fitted with water sprays to keep the stored material damp at all times;

- Vapour balancing system to be installed for the delivery of bitumen at the asphalt plant;

- Asphalt plant loading point will be totally enclosed. All particulate matter emissions generated at the loading point will be captured by one fabric filter associated with the natural-gas fired dryer; and

- Vapour recovery system to be employed for transfer of asphalt to trucks.

It is recommended that the Site additionally employs real-time ambient air quality monitoring system. This will allow staff to identify when additional mitigation measures are to be implemented to minimise impact from the onsite activities on days when the background concentrations of PM10 and PM2.5 exceed the criteria set by the Approved Methods.

E.13 TRAFFIC AND ACCESS

This Traffic and Access Assessment was prepared using the following guidelines and information:

- Austroads (2005) Guide to Traffic Engineering Practice- Part 5: Intersections at Grade;

- TTM (2013) Hanson Quarry Expansion Traffic Impact Assessment

- Accident data supplied by Transport for New South Wales;
- Traffic volumes provided by Hanson;
- Road safety information (heavy vehicle traffic etc.) taken from the recent Sancrox Interchange and Pacific Highway upgrades

Assessment

Construction

It is likely that the clearing for the first stage and the establishment of one or potentially both of the plants will occur simultaneously. Truck trips associated with the delivery of quarry product will also continue during these activities. The establishment of the plants and the clearing activities represents construction traffic at its maximum.

The design capacity, intersection types and standard of the recently completed Sancrox Interchange and Pacific Highway (as described in Section 12.3.4 of the Traffic and Access Assessment) is sufficient to accommodate existing traffic on Sancrox Road (including quarry product delivery trucks that will continue during construction) and the short-term increase in:

- light vehicles delivering construction staff to site; and
- heavy vehicles delivering infrastructure and floating clearing plant.

Operation

The typical daily traffic movements would include:

- light vehicle trips transporting staff to and from site concentrated at the start and end times of shifts;
- truck trips delivering quarried product and asphalt;
- concrete agitator trips to deliver concrete to construction sites;
- import of concrete constituents (sand and cement); and
- truck trips delivering waste concrete to site for recycling.

The Project activities will result in additional employees causing a minor increase in light vehicle movements for staff entering and exiting the site during their shifts.

The Project has proposed truck movements and equipment loading 24 hours/day for 365 days a year. Should approval be granted, it will allow for operational traffic to utilise the road network outside of the daytime period. Thus reducing the cumulative impact on traffic during higher volume periods. Based on night time road traffic noise criteria, the total number of truck trips

permissible on a local road during the night time period is 18 truck trips (36 movements). The total number of trips permissible within any hour during the night time period is 12 trips/ hour (24 movements/hour), noting that the truck trip limit for the total night time period cannot be exceeded.

Traffic volumes, particularly heavy vehicles such as truck and dog, and concrete agitator vehicles, will increase due to the Project. The operational traffic volume increase, including truck type, has been estimated for each Project activity and is provided in *Chapter 12* and *Annex I* of this EIS.

E.14 VISUAL AMENITY

A qualitative Visual Impact Assessment has been undertaken to assess the potential for the Project to impact the visual amenity of private landowners in the vicinity of the development and key viewpoints in the public domain, such as roads.

The proposed stages of the Project will progress into the peak of the hill to the west of the existing quarry and along the ridgeline further to the west. For the rural residential properties located to the north, south and west of the Project site, the landform and vegetation will still obscure and screen views of the Project site during expansion activities, resulting in no change in visual amenity.

Nearby commercial and industrial areas with potential to be affected by the Project are located to the east of the quarry. The removal of the narrow vegetative buffer to the east of the Project site to accommodate the proposed industrial development will result in greater exposure of the Project site to passing traffic along the Pacific Highway and the Cassegrain Winery. Given the speed of the traffic and the already interrupted view across the highway, no substantial change in visual amenity is anticipated.

The Project is unlikely to have visual amenity impacts due to the topography and vegetation obscuring and screening views from most directions. Retaining the vegetative buffer and the implementation of standard light spill management measures is recommended to ensure negligible impacts.

E.15 SOCIO-ECONOMIC

The Project is not expected to result in any significant negative economic or social impacts for the local and wider communities upon the implementation of the mitigation measures proposed. The Project will facilitate numerous construction projects within the region, which in addition to the jobs created by the project, will result in economic benefits for the community. Given the expected population increase in the future, construction materials proposed for production at the Sancrox Quarry will be vital for the sustainable expansion and growth of the area. The proposed concrete waste recycling will generate a beneficial reuse of this waste stream and lessen the burden on limited landfill volume in the region.

E.16 HAZARDS AND RISKS

A hazard analysis and risk screening assessment has been undertaken for the Project, which evaluates the likely risks to public safety, focusing on the transport, handling and use of hazardous materials and bushfire risk. The assessment also determines whether the Project should be considered a hazardous or potentially hazardous industry under *State Environmental Planning Policy 33 – Hazardous and Offensive Development (SEPP 33).*

Assessment

The risk screening process for the storage of hazardous materials at the Project site and the transportation of hazardous materials to/from the site demonstrates that in all cases, types and quantities would be below the Applying SEPP 33 thresholds. For storage, this demonstrates that operational inventories would not pose a significant risk of harm beyond the site boundary. For transportation, this also demonstrates that risks are unlikely to be significant.

It can be concluded that the risks associated with storage and transportation of hazardous materials are unlikely to be significant or pose a risk to public safety. Given that Applying SEPP 33 thresholds are not exceeded, the Project is not considered to be a hazardous or potentially hazardous industry under SEPP 33. Therefore a Preliminary Hazard Analysis is not required to be undertaken for the Project.

Bushfire

The nature of the proposed Project activities will not increase the potential for or severity of bushfires in the locality, however the risk that a fire may start in the surrounding area and threaten the quarry will be addressed within the overall Emergency Response Plan. The existing site layout already provides an area of defendable space around all administration and workshop buildings, and the proposed clearing of land mapped as Vegetation Category 1, will result in further reduction of bushfire fuel loads.

Nevertheless, due to the existence of the Project site within a bushfire prone area, associated bushfire prevention and mitigation measures are provided in *Chapter 15* to minimise bushfire risks should they occur within and/or adjacent to the Project site.

E.17 WASTE MANAGEMENT

The waste assessment was prepared to provide guidance on the classification and removal of wastes generated as a result of the construction and operation of the Project.

Hanson provided an estimation of waste types and volumes based on the understanding of waste generated by current operations on the site. Where such information was unavailable for the site, Hanson provided waste volumes based on waste generation estimates for the proposed Brandy Hill Quarry, which has a similar extraction rate to this Project. An understanding of the process of operating a concrete batching and recycling facility and an asphalt production plant were utilised to generate likely waste streams from these activities.

Relevant regulatory guidelines and legislation were referred to in the preparation of the waste assessment.

The Waste Management Hierarchy will be incorporated into the waste reduction and resource recovery strategies for the construction and operation of the Project. Hanson prioritizes waste avoidance and strives for best practice with extraction and processing of materials. This ensures the most efficient use of the available resource with minimal waste generation.

E.18 QUARRY CLOSURE AND REHABILITATION

Final Land Use Options

The 30 year life of the proposed quarry operations expose the project and its final land use to potential changes in stakeholder expectations, requirements and preference for the final land use options at the quarry. There is also the possibility for updated guidelines from government that outline rehabilitation requirements and methodologies. Hanson commit to regular consultation with community and relative government agencies to ensure the final land use/rehabilitation of the quarry is acceptable. The current conceptual rehabilitation and final land use options are discussed in detail throughout *Chapter 17.* The rehabilitation of the site with native endemic plant species, and inundation of the void over time by surface and groundwater being considered a suitable Conceptual Closure Plan for use during feasibility, development and detailed design.

Rehabilitation Objectives

General rehabilitation objectives as outlined in the *Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry* (CDIIS 2016a) are dependent on which rehabilitation option is chosen:

- rehabilitation to a new landform, land capability or final land use. This general rehabilitation objective will be applied should the option to use the quarry void for the storage of treated effluent be chosen; and

- restoration or reclamation of the area so that the pre-mining conditions are replicated (75% of mines in Australia use native plant species because the establishment of native ecosystems gives the greatest chance of self-sustainability). This general objective will be applied should the option to revegetate the site with native, endemic species be chosen.

Beneath the overarching general rehabilitation objective are more specific temporal social and financial objectives requiring consideration. These specific objectives are outlined in the *Strategic Framework for Mine Closure* (ANZMEC/MCA, 2000) and include to:

- enable all stakeholders to have their interests considered during the closure process;
- ensure the closure process occurs in an orderly, cost-effective and timely manner;
- ensure the cost of closure is adequately represented in company accounts and that the community is not left with a liability;
- ensure there is clear accountability, and adequate resources, for the implementation of the closure plan;
- establish a set of indicators which will demonstrate the successful completion of the closure process; and
- reach a point where the company has met agreed completion criteria to the satisfaction of the responsible authority.

These objectives will form the basis of the Quarry Closure and Rehabilitation Plan to be prepared post-approval. The Plan will be prepared to the preferred option of rehabilitation with native endemic plant species and inundation over time by surface and groundwater.

Measuring success against rehabilitation outcomes will be assessed through the inclusion of specific performance indicators and monitoring strategies. The Quarry Closure and Rehabilitation Plan will be regularly reviewed to ensure that outcomes and performance indicators are being met, and whether the need exists to modify the plan to better suit the current environment. The proposed rehabilitation outcomes are provided in *Chapter 17*.

Progressive Rehabilitation

Sancrox Quarry currently practices progressive rehabilitation on site. Hanson's opportunistic and progressive rehabilitation would continue throughout the Project life, as part of a planned program of activities to achieve an acceptable final landform. Rehabilitation will be carried out progressively following each stage of extractive operations to ensure a stable landform and to control soil erosion.

The progressive approach helps minimise the liability falling on the operator by rehabilitating the quarry during the operation rather than undertaking the larger task of rehabilitating the quarry following the closure of the quarry, when there is no direct income from quarrying activities (CDITR 2006).

The progressive approach will be beneficial to the overall structure of the ecosystem following the conclusion of quarrying activities. The diversity of the ecosystem will be enhanced by the stands of vegetation of differing ages, heights and depths from the staggered timing of the revegetation activities.

Maintenance of Rehabilitated Areas

Rehabilitated areas are to be maintained as follows:

- following planting, plants will be watered daily for the first week and once a week for the following three months;
- preceding this establishment stage, watering will be undertaken on an as needed basis, with increased watering in dry periods;
- weed control measures will be implemented on a three monthly basis for the first two years following planting; and
- erosion control devices will be regularly inspected (monthly) and particularly after heavy rainfall to ensure proper operation.

Regular monitoring of the revegetated areas will be required during the initial vegetation establishment period and beyond to demonstrate that the objectives of the rehabilitation strategy are being achieved and that a sustainable, stable landform has been provided. The adjacent remaining vegetation may provide a suitable reference site for comparison.

E.19 MITIGATION MEASURES

All mitigation measures outlined throughout each assessment chapter (both key issues and other issues) have been collated and are provided within *Chapter 18* of this EIS.

E.20 CONCLUSION

This EIS has assessed the potential environmental impacts associated with the proposed expansion and increase in annual extraction rates at Sancrox Quarry alongside the proposed establishment of the concrete batching plant, asphalt production plant, and concrete recycling facility The EIS was prepared having regard to biophysical, economic and social considerations and the principles of ESD. There were no significant environmental impacts identified during the preparation of the EIS that cannot be mitigated by appropriate mitigation measures and management strategies.

The environmental assessment process has been used to drive the development of the site and ensure operations will be sustainable and create minimal disruption to the local community. Proposed operations have been designed to ensure sustainable water use and management, minimise traffic impact on local roads, ensure acceptable noise and dust emissions, effective management of waste and to minimise visibility of the operations. All of the potential environmental impacts of the Project have been considered and mitigation measures developed to minimise any impacts as detailed throughout the EIS.

The Project will provide a viable supply of construction materials to the surrounding region. The Project can be implemented with minimal adverse environmental impacts as demonstrated throughout this assessment and is justified in terms of the overall economic benefits to the local, state and national economies. The construction materials, such as those produced at Sancrox Quarry, will be used to meet a fundamental community need for the construction of roads, other infrastructure and major development projects in the region.

The Project will allow for the sourcing of construction materials to be produced at a site that is already highly disturbed. The construction materials produced will be used throughout the region and will have positive flow on effects throughout the local economy through the creation of jobs in associated industries.

ABBREVIATIONS

Abbreviation	Description
AAAA	Aerial Agriculture Association of Australia
ABS	Australian Bureau of Statistics
ACMA	Australian Communications and Media Authority
AGL	Above Ground Level
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
AM	Amplitude Modulation
ANZECC	Australian and New Zealand Environment Conservation Council
APZ	Asset Protection Zone
ASS	Acid Sulfate Soil
BAR	Biodiversity Assessment Report
BCA	Building Code of Australia
BC Act	*Biodiversity Conservation Act 2016*
BGS	Below Ground Surface
BoM	Bureau of Meteorology
CB	Citizens' Band Radio
CCC	Community Consultative Committee
CEF	Community Enhancement Fund
CEMP	Construction Environmental Management Plan
CHA	Cultural Heritage Assessment
CLM Act	*Contaminated Land Management Act 1997*
CNMP	Construction Noise Management Plan
CO_2 –e	Carbon dioxide equivalent
CoRTN	United Kingdom (UK) – Calculation of Road Traffic Noise
Council	Port Macquarie – Hastings Council
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTMP	Construction Traffic Management Plan
dB	decibel
DCP	Development Control Plan
DECC	Department of Environment and Climate Change
DNVGL	Derived Native Grassland
DoD	Commonwealth Department of Defence
DoEE	Commonwealth Department of Environment & Energy (formally Commonwealth Department of Environment (DOE))
DPI&E	NSW Department of Planning, Industry and Environment (formerly NSW Department of Planning and Environment)
DP&E	Former NSW Department of Planning and Environment
DP&I	NSW Department of Planning & Infrastructure
DTI	NSW Department of Trade and Investment
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EMR	Electromagnetic Radiation
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	NSW Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPI	Environmental Planning Instrument
EPL	Environmental Protection Licence
ERA	Environmental Risk Assessment
ERM	Environmental Resources Management Australia Pty Ltd
ESD	Ecologically Sustainable Development

EVC	Ecological Vegetation Class
FDI	Fire Danger Index
FEL	Front-end loader
FM Act	*Fisheries Management Act 1994*
FTE	Full time equivalent
GHG	Greenhouse Gas
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GWh	Gigawatt hours
ha	hectares
Hanson	Hanson Construction Materials Pty Ltd
Hz	Hertz
IEC	International Electro technical Commission
INP	NSW Environmental Noise Management – Industrial Noise Policy
ISEPP	*State Environmental Planning Policy (Infrastructure) 2007*
ISO	International Standards Organisation
km	kilometre
kV	Kilovolt
LEP	Local Environment Plan
LGA	local government area
m	metres
MNES	Matters of National Environmental Significance
MOS	Manual of Standards
Mt	Million tonnes
MW	Megawatt
nm	Nautical Miles
NP&W Act	*National Parks and Wildlife Act 1974*
NPI	NSW Environmental Noise Management – Noise Policy for Industry (new noise policy)
NSW	New South Wales
NW Act	*Noxious Weeds Act 1993*
OEH	NSW Office of Environment and Heritage
OH&S	Occupational Health and Safety
ONMP	Operational Noise Management Plan
PA	Project Area
PAC	NSW Planning and Assessment Commission
PAD	Potential Archaeological Deposit
PBP	Planning for Bushfire Protection
PCT	Plant Community types
PEA	Preliminary Environmental Assessment
PHA	Preliminary Hazard Analysis
PMHC	Port Macquarie – Hastings Council
POEO Act	*Protection of the Environment Operation Act 1997*
RAP	Registered Aboriginal Party
RAV	Restricted Access Vehicles
RBL	Rating Background Level
REAP	Renewable Energy Action Plan
RECs	Renewable Energy Certificates
REF	Review of Environmental Factors
RET	Renewable Energy Target
RFS	NSW Rural Fire Service
RMS	Roads and Maritime Services (formerly the Roads and Transport Authority)
RNP	Road Noise Policy
Roads Act	*Roads Act 1993*
SEARs	Secretary's Environmental Assessment and Requirements

Secretary	NSW Secretary for Planning and Environment
SEE	Statement of Environmental Effects
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
SRD SEPP	*State Environmental Planning Policy (State and Regional Development) 2011*
SSD	State Significant Development
SWL	Standing Water Level
The Proponent	Hanson Construction Materials Pty Ltd
TSC Act	*Threatened Species Conservation Act 1995*
vpd	Vehicles per day
WHD	Water Holding Dam
WM Act	*Water Management Act 2000*

1 INTRODUCTION

This Chapter describes the background to the proposed development, a description of existing operations, Project objectives and alternatives and the Environmental Impact Statement (EIS) structure.

1.1 BACKGROUND AND PROJECT OVERVIEW

Hanson Construction Materials Pty Ltd (Hanson) currently operates a hard rock quarry, known as Sancrox Quarry, on Sancrox Road, Sancrox, located approximately 8 km west of Port Macquarie. The Sancrox Quarry is within the Port Macquarie Hastings Council (PMHC) local government area on the Mid North Coast of NSW. The current Sancrox Quarry comprises Lot 353 DP 754434, Lot 1 DP 720807 and Lot 1 DP 704890.

The quarry is considered a major economic resource for regional and state development. Hanson propose to extend the life of the quarry by expanding the approved extraction boundary and increase the annual extraction limit to facilitate the extraction and distribution of high quality construction materials for the use in civil infrastructure and road construction projects. The proposed extraction limit will increase the current annual maximum extraction limit from approximately 455,000 tonnes per annum (tpa) to 750,000tpa.

Additionally the proposed Project includes the establishment of a concrete batching plant and recycling facility and an asphalt production plant, as further described in *Chapter 2*.

The Project will comprise the lots listed above as well as extending the lateral extent of the quarry westwards, into Lot 2 in DP 574308, which is also owned by Hanson. Lot 2 in DP 574308 to the north of the proposed expansion area will also be utilized as a biodiversity offset area, as outlined in the Biodiversity Assessment Report (Annex C of this EIS). The existing quarry extent and the Project site consisting of Hanson owned lots and occupied Crown land are shown in *Figure 1.1*.

1.2 PROJECT HISTORY

Sancrox Quarry has been owned and operated by Hanson since 1998. Hanson currently has ownership of approximately 145 ha, of which approximately 12 ha is currently used in the extraction, processing and storage of high quality aggregate materials (Hanson, 2015a). The current approval is for extraction of 175,000 cubic metres (m^3) per annum, equating to approximately 450,000 tpa.

Sancrox Quarry currently operates to the approvals as outlined in *Section 1.2.1*, an Environmental Management Plan and Environmental Protection Licence (EPL) (EPL 5289) issued by the Environment Protection Authority (EPA) under the *Protection of the Environment Operations Act 1997* (POEO Act).

The current approved hours of operation and activities are provided in *Table 1.1.*

Table 1.1 Current Approved Activities and Hours of Operation

Hours	Day	Approved Activity
7am to 5pm	Monday to Friday	Normal operations
7am to 1pm	Saturday	Normal operations
7am to 11pm	Every day of the year	Additional activities including truck movements into, around and out of the Sancrox Quarry, as well as equipment loading
11pm to 7am	Up to 20 occasions	Additional operations

Source: Hanson (2015a)

1.2.1 Approval History

Sancrox Quarry operations are currently approved in accordance with three concurrent development consents, which have been modified by Section 96 of the *Environment Planning and Assessment Act 1979* (EP&A Act) at various stages as detailed in *Table 1.2*. Conditions exist within the development consents that should be read in conjunction with one another. The current extraction rate of 455,000 tpa was approved as a modification to development consent (DA 1995/0193) under section 96(2) of the EP&A Act.

All existing conditions of consent will be surrendered within six months of project approval, should this project be approved.

Table 1.2 Project Approval History

Development Consent	Original approval date	Modification date(s)	Approval and Modification Details
DA No. 1995/193	19 November 1995[1]	5 June 2007[1] 7 January 2008[1] 18 November 2009[1] 12 March 2014[2]	1995 - an application was made to PMHC to continue gravel extraction at the site (DA 1995/193) which was approved on 19 November 1996 subject to conditions of development consent. 2007 - a modification was sought to alter operating hours to accommodate demands for quarry materials for infrastructure works during evening and night periods. This modification was granted approval subject to amended conditions on 5 June 2007. 2008 – a modification was sought to allow the movement of trucks into the site, operation of loading equipment, loading of trucks and movement of trucks out of the site during evening a night time periods and on weekends. This modification was granted approval subject to amended conditions on 7 January 2008. 2009 - a modification was sought to update conditions of consent relating to blasting to bring them in line with current industry practice. This modification was granted approval subject to on conditions on 18 November 2009. 2014 – a modification was sought to temporarily increase the quarry extraction limits. This modification was granted approval subject to amended conditions on 12 March 2014.
DA No. 2004/609	12 January 2005[1]	4 July 2007[1]	2004 - development consent was sought to extend the eastern boundary of the approved extraction area and was subsequently approved with a new DA 2004/609, subject to conditions of development consent by PMHC on 12 January 2005. 2007 - a modification was sought to expand the western extraction limit of the quarry, as well as amending the conditions which related to the upgrade of Sancrox Road and operating hours at the quarry. The modification was granted approval subject to amended conditions on 4 July 2007.
DA No. 2006/497	11 December 2006[2]	Not yet modified	2006 – development consent was sought to install and operate a temporary asphalt plant. The application was approved on 11 December 2006, subject to conditions of development consent.

1. Hanson (2015a); and
2. PMHC (2018)

1.2.2 Adjacent Projects

Sancrox Interchange and Pacific Highway

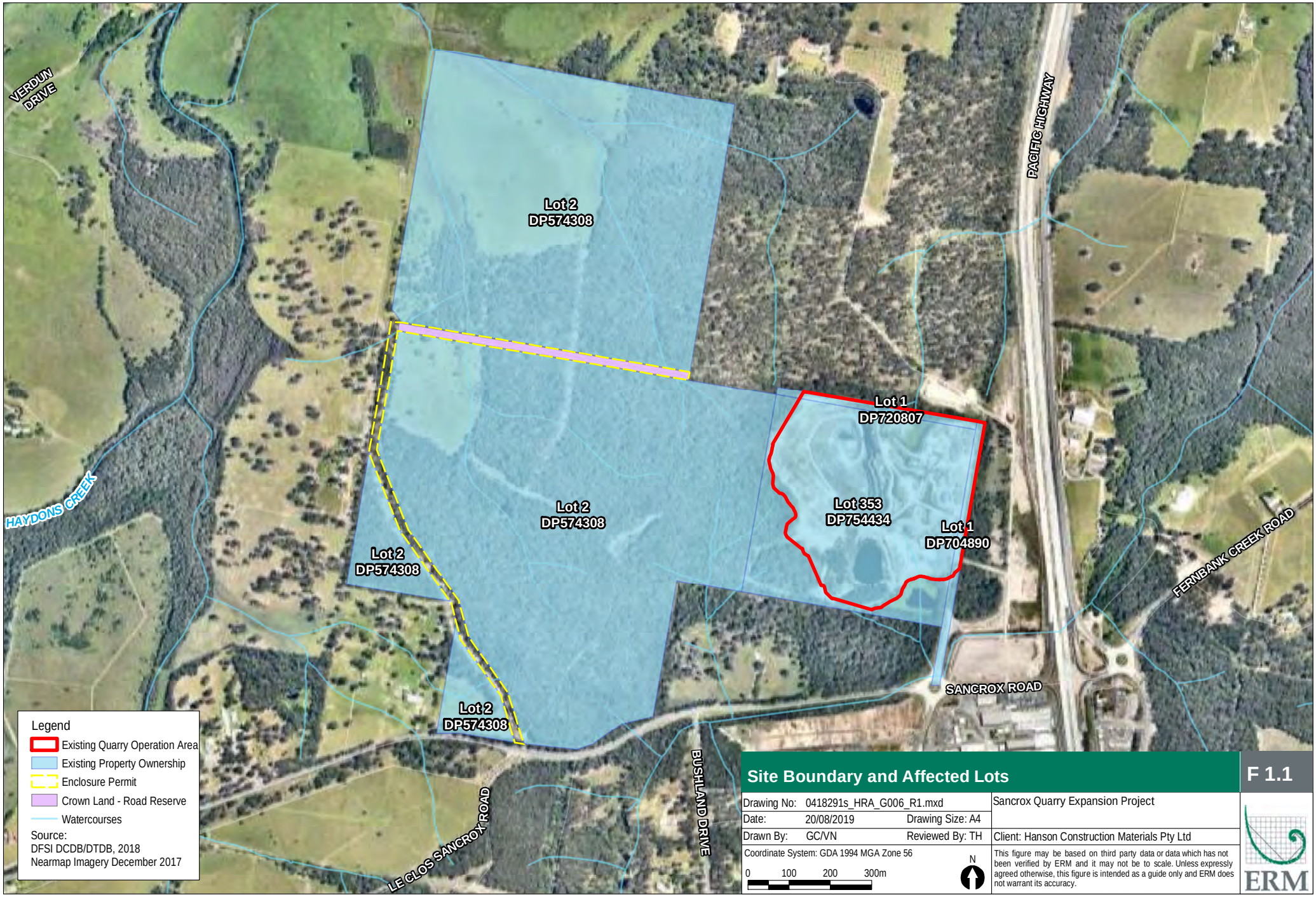
The road infrastructure directly adjacent to the Sancrox Quarry has recently undergone redevelopment and improvement.

The Sancrox Interchange connects to the Pacific Highway which services northern, southern and eastern movements from the quarry and was opened to the public on 30 November 2015. The Interchange was designed to cater for the existing industry and businesses in the area, as well as servicing the area which is planned for development as an industrial precinct.

The Pacific Highway in the vicinity of the quarry has recently been upgraded, as part of the Oxley Highway to Kempsey Pacific Highway Upgrade Project. The Highway is now dual carriageway, 110km/hr Motorway class road.

Sancrox Employment Precinct

To the east of the quarry, construction has commenced the development of an estate zoned for light industry. The *Greater Sancrox Structure Plan 2014-2034* (PMHC, 2015) outlines future development options including rural residential to the west of the quarry and south of Sancrox Road.


VERDUN DRIVE
PACIFIC HIGHWAY
Lot 2 DP574308
Lot 1 DP720807
Lot 353 DP754434
Lot 1 DP704890
Lot 2 DP574308
Lot 2 DP574308
Lot 2 DP574308
HAYDONS CREEK
FERNBANK CREEK ROAD
SANCROX ROAD
BUSHLAND DRIVE
LE CLOS SANCROX ROAD
Legend
Existing Quarry Operation Area
Existing Property Ownership
Enclosure Permit
Crown Land - Road Reserve
Watercourses
Source:
DFSI DCDB/DTDB, 2018
Nearmap Imagery December 2017
Site Boundary and Affected Lots
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Drawing No: 0418291s_HRA_G006_R1.mxd
Date: 20/08/2019
Drawing Size: A4
Drawn By: GC/VN
Reviewed By: TH
Coordinate System: GDA 1994 MGA Zone 56
0 100 200 300m
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Sancrox Quarry Expansion Project
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

1.3 PROJECT OBJECTIVES

Cement, Concrete and Aggregates Australia (CCAA) estimates that a typical house requires 110 tonnes of crushed rock and 53 m^3 of concrete, which in the case of the Sancrox Quarry, would amount to 90 tonnes of concrete aggregates, totalling 200 tonnes of hard rock quarry products per dwelling built (CCAA, 2015). With an estimated 59,600 new homes predicted by the *Mid North Coast Regional Strategy 2009*, an estimated 12 million tonnes of hard rock quarry products will be required.

Regional roads are predominately sealed with high quality aggregate which is produced at Sancrox Quarry. As a building product, concrete is still the cheapest and most widely used building material available. Due to the low embodied energy of concrete, it is a more sustainable product than many other building materials.

This demand sets the context for the primary objectives of the Project, which are to:

- deepen and extend the lateral extents the extraction area, and extend the life of the quarry to maximise winning of a hard rock aggregate and fill materials for supply to construction projects in the region. This will enable Hanson to continue to produce a range of high quality aggregate and road construction materials to supply development within the region;

- construct a concrete batching plant and asphalt production plant at the quarry site. The development of these plants within the site will limit the requirement to haul aggregate as feedstock to these processes, thus reducing emissions associated with road haulage; and

- construct a concrete recycling facility at the quarry site, which will allow for the beneficial reuse of concrete washout material in the local area. Recycling of the concrete washout material will meet the objectives of ecological sustainable development (ESD).

It is also noted that in order to eliminate property fragmentation over Hanson owned land, Hanson is proposing the closure and purchase of a parcel of Crown owned land (*Figure 1.1*), under the Roads Act 1993. Hanson currently holds an Enclosure Permit (number: 49229) under this Act.

The extension of an existing quarry is considered ESD, as it consolidates disturbance to an existing quarrying location, avoiding disturbance of a new area currently undisturbed by quarrying. The establishment of the new infrastructure will predominately be within the disturbed area of the existing quarry footprint, and is also considered ESD as it avoids establishment of infrastructure on previously undeveloped land.

1.4 PROJECT ALTERNATIVES

In accordance with Clause 7 of Schedule 2 of the EP&A Regulation, a number of alternatives to the Project assessed in this EIS were considered by Hanson in the development of the project description and are considered below, including alternative sourcing of materials, alternative locations, siting of ancillary infrastructure, hours of operation and the do nothing options.

1.4.1 *Alternative sourcing of material*

Sancrox is the only Hanson owned quarry in the Port Macquarie region. By road, the nearest Hanson owned hard rock quarry to Sancrox is Brandy Hill Quarry, located 200km south of Port Macquarie. Delivering products to the region from this quarry would be unviable due to excessive transport costs. Increasing prices to mitigate this would make Hanson less competitive within the region and lead to increases in construction costs for all industries.

Purchasing materials from other companies would mean paying higher costs for aggregates resulting in less profit. Hanson would become reliant upon external companies resulting in a loss of control in the production of aggregates and consequently increasing the risk of being unable to attain the required quantities of aggregates.

1.4.2 *Alternate Location*

The Sancrox Quarry has been investigated geologically with percussion drill holes and additional diamond drill holes in the extended areas as detailed in Hanson (2015). The investigation determined that Ordovician metasediments outcrop in the immediate area south and south west of the site (Hanson, 2015). The presence of this outcrop predicates that the site is underlain by these sediments (Hanson, 2018). The surrounding outcrops were determined to be either sand or schist (Hanson, 2018).

The schist which Port Macquarie is built on is a moderate grade metamorphic rock (Hanson, 2018). This rock type is a melange that is considered unsuitable for use as hard rock aggregate (Hanson, 2018). The sand surrounding the town has been identified as Quarternary alluvial dune deposits, and is also considered unsuitable for hard rock applications (Hanson, 2018).

There are other isolated pockets of Metamorphic and volcanic rocks, whether these would be suitable as aggregate is unknown, however the extent and changeability of the pockets would make it an unreliable option (Hanson, 2018).

Sancrox is located just over the Cowarra fault into the Hastings Block, which is made up of an expanse of Lithic sandstone with predominant metamorphic fragments (Hanson, 2018). This is considered the most appropriate, consistent rock in close proximity to Port Macquarie for the generation of hard rock aggregates, and as such the Quarry is located in the most viable location (Hanson, 2018).

Finding other suitable hard rock resources close to Port Macquarie is considered a difficult prospect (Hanson, 2018). Land holdings with adequate area to open a new quarry would be expensive to acquire and develop, and are unlikely to be readily available (Hanson, 2018). The processes involved in establishing a new quarry have potential to cause greater environmental impact than expanding the existing quarry site at Sancrox.

The existing quarry has operated and co-existed with the surrounding environment for 20 years (Hanson, 2018). The resource at Sancrox is readily accessible with functioning extraction and processing infrastructure in place, hence expanding the existing site was identified as the option with the lowest environmental impact.

Siting of Ancillary Infrastructure

The proposed quarry expansion seeks to undertake new ancillary activities, including concrete batching and recycling, and asphalt production. The siting of this ancillary infrastructure was undertaken with the objective of consolidating infrastructure, minimising environmental impacts to the extent feasible and maximising the recently established Sancrox interchange for safer access to the Pacific Highway.

The consolidation of the concrete batching within the quarry site has associated environmental benefits from the reduced haulage. The quarried rock, a constituent in the concrete batching process, does not have to be transported from the site as would have been the case had a separate concrete batching plant been proposed.

The consolidation of the activities to one site rather than the possible alternative of up to four separate sites simplifies the process of environmental compliance management for Hanson's environmental management team.

The consolidation of the infrastructure to the quarry site allows for direct access to the Sancrox interchange that was constructed to provide safe access to the Pacific Highway and service the broader industrial estate in the location. The facilities consolidation at the quarry limits the interaction of local traffic to road users within the Sancrox area in comparison to the much larger population of road users within Port Macquarie should the facilities have been established within Port Macquarie's Lake Road industrial estate.

The concrete batching and recycling infrastructure is proposed to be located within the north – east portion of the site in an area heavily disturbed by previous quarrying activities, thereby reducing the footprint of new disturbance and specifically reducing potential ecological and heritage impacts.

1.4.3 Alternative Footprint

The proposed quarry has been designed, where practicable, to incorporate land already devoid of vegetation (SLR 2018). This limits the clearing of native vegetation where possible. Consequently, approximately 29% of the proposed quarry footprint includes cleared areas and areas of non-native vegetation (SLR 2018).

Extending the proposed footprint in other directions would not have been viable as exploration identified either unsuitable or unreliable deposits. The Preliminary Environmental assessment proposed a larger quarry footprint, extending into the north west beyond current proposed design. The quarry extent in this location was reduced in order to avoid the risk of flooding, which was identified to encroach on the originally proposed footprint. The updated footprint is presented in Chapter 2 of this EIS. The original proposed footprint and the reduced footprint are demonstrated in Figure 8.1. Where potential impacts were considered to be reduced by the decrease in quarry footprint, the assessment retained the original footprint, providing the worst case scenario for the assessment.

1.4.4 Hours of Operation

The quarry seeks approval for quarry activities and ancillary facility operations to occur 24 hours a day, 7 days a week.

Key factors to justify the 24 hour, seven days/week operations are outlined below.

(1) Construction projects, particularly road construction projects, can require delivery of materials outside standard construction hours. This is required to expedite the road construction process, or to limit disturbance to road users. To enable Hanson to supply such projects, 24 hours/seven days a week operation is required to enable products to be prepared and trucks to leave site during the night time period. Should 24 hours/seven days a week operation not be sought, Hanson would not be able to bid on such projects, thus limiting competition in the market. Reduced competition could potentially have negative flow on consequences, such as reduced time and cost efficiency of night time construction works, thus potentially generating negative economic impacts to the broader community.

(2) 24 hour/seven day a week operation allows for the transportation of material during the night time period. This reduces day time road congestion by limiting non-essential truck movements during the day time period. This has a positive impact on efficiency of the road network and reduced traffic waiting times.

(3) To allow for construction projects to remain within their own construction operating hours, the ability for concrete and asphalt to be transported outside of normal construction hours, thus maximising external project construction hours reduces the likelihood of construction projects exceeding standard construction hours and thus impacting the broader community.

The *Mid North Coast Regional Strategy* (DoP 2009) recognises the importance of the Mid North Coast Region's natural resources base to the continued sustainable growth and development of the region. In particular, the Sancrox Quarry was identified in the Strategy as important for extractive resources. By 2031, the Mid North Coast population is expected to grow by 28% (DoP, 2009), with an annual average growth rate of approximately 1.1% over the next 25 years, among the highest regional growth rates in regional NSW (DoP, 2009). This population growth will stimulate housing development, which in turn will increase demand on hard rock aggregates and batched products such as cement and asphalt.

Hanson considered not increasing the hours of operation at the site, and maintaining the existing approved hours of operations. However, maintaining the status quo with respect to operating hours would limit Hanson's ability to service future demand, with forecast population growth as detailed in the *Mid North Coast Regional Strategy*, identifying an estimated 59,600 new homes, together with the construction and maintenance of the regional road network.

The continued and additional supply of the valuable aggregate, concrete and asphalt resources to the local construction industry as well as a facility for recycling of a waste concrete will meet the strategic goals of boosting the local economy and providing the materials to allow for infrastructure and housing developments. The increase in operating hours will enable the forecast future demand to be serviced form the site.

1.4.5 Not undertaking the Project

Not undertaking the quarry expansion component of the Project would prevent the utilisation of the hard rock resource identified adjacent to the existing quarry.

Not undertaking the construction of the concrete batching plant and asphalt production plant would similarly reduce competition in the area, thus limiting the potential economic benefits for local users of asphalt and concrete.

Not establishing the concrete recycling facility would limit the options for locals to recycle waste concrete, thus limiting the number of waste concrete recycling options and preventing competition, and its associated economic benefits.

The economic benefits to the local and regional community provided directly and indirectly by employment associated with the Project would be lost, should it not be undertaken.

The 24 hour operation of the site would allow for more efficient dispersal of products to individual project development sites, thus improving efficiencies and productivity within the local construction industry.

1.5 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS (SEARS)

Revised SEARs were issued by DP&E on 18 September 2017 which supersede the SEARs previously issued for the Project, and form the basis of the environmental impact assessment for the Project (refer to *Annex A*).

Table 1.3 provides a summary of the SEARs and includes a reference to where each requirement has been addressed in the EIS and corresponding technical assessments.

Table 1.3 Secretary's Environmental Assessment Requirements (SSD 7293)

Requirement	Location within EIS
General Requirements	
The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*.	Chapter 0

In particular, the EIS must include:
- a stand-alone executive summary;
- a full description of the development, including:
  - the resource to be extracted, including the amount, type and composition;
  - the site layout and extraction plan, including cross-sectional plans;
  - the production process and processing activities, including the in-flow and out-flow of materials and points of discharge to the environment;
  - surface infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate approvals process);
	Chapter 2

- a waste (overburden, rejects, tailings etc.) management strategy;	Chapter 16
- a water management strategy;	Chapter 7 (and subsequent SWMP post approval)
- a rehabilitation strategy to apply during, and after completion of, extraction operations, and proposed final use of site;	Chapter 17

Requirement	Location within EIS
- the likely interactions between the development and any existing, approved or proposed development in the vicinity of the site;	Chapter 1
- a strategic justification of the development focusing on site selection and the suitability of the proposed site;	Chapter 3
- a list of any approvals that must be obtained before the development may commence;	Chapter 3
- an assessment of the likely impacts of the development on the environment, focussing on the key issues identified below, including: - a description of the existing environment likely to be affected by the development, using sufficient baseline data; - an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice; - a description of the measures that would be implemented to avoid, minimise, mitigate and/or offset the likely impacts of the development, and an assessment of: - whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; - the likely effectiveness of these measures; and - whether contingency measures would be necessary to manage any residual risks; and - a description of the measures that would be implemented to monitor and report on the environmental performance of the development;	Chapter 4 and associated impact assessment chapters
- a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS;	Chapter 18
- consideration of the development against all relevant environmental planning instruments (including Part 3 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007);*	Chapter 3
- the reasons why the development should be approved, having regard to: - relevant matters for consideration under the *Environmental Planning and Assessment Act 1979,* including the objects of the Act; - the biophysical, economic and social impacts of the project, including the principles of ecologically sustainable development; - the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses; - feasible alternatives to the development (and its key components), including the consequences of not carrying out the development;	Chapter 3 Chapter 1
- a signed declaration from the author of the EIS, certifying that the information contained within the document is neither false nor misleading.	Chapter 0

Requirement	Location within EIS
In addition to the matters set out in Schedule 1 of the Environmental Planning and Assessment Regulation 2000, the development application must be accompanied by a signed report from a suitably qualified expert that includes an accurate estimate of the capital investment value (as defined in Clause 3 of the Environmental Planning and Assessment Regulation 2000) of the development, including details of all the assumptions and components from which the capital investment value calculation is derived.	Annex J
Key Issues	
Noise & Blasting - including: - a detailed assessment of the likely construction, operational and off-site transport noise impacts of the development in accordance with the Interim Construction Noise Guideline, NSW Industrial Noise Policy and the NSW Road Noise Policy respectively, and having regard to the Voluntary Land Acquisition and Mitigation Policy; - - if a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the Interim Construction Noise Guideline; - proposed blasting hours, frequency and methods; - a detailed assessment of the likely blasting impacts of the development (including noise, vibrations, overpressure, visual and odour) on people, animals, buildings, infrastructure and significant natural features, having regard to the relevant ANZEC guidelines; - reasonable and feasible mitigation measures to minimise noise emissions; and - monitoring and management measures, in particular real-time and attended noise monitoring;	Chapter 10 Annex G
Air Quality - including: - a detailed assessment of potential construction and operational impacts, in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW,* and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}, and having regard to the *Voluntary Land Acquisition and Mitigation Policy;* - an assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products; - reasonable and feasible mitigation measures to minimise dust and emissions; and - monitoring and management measures, in particular, real-time air quality monitoring;	Chapter 11 Annex H
Water - including: - a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures; - identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*; - demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP); - a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo;	Chapters 7 and 8 Annex's E and F (Surface Water/Hydrology and Groundwater, respectively)

Requirement	Location within EIS
- an assessment of any likely flooding impacts of the development; an assessment of the likely impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives; - an assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users; and - a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts;	
Biodiversity - including: - accurate predictions of any vegetation clearing on site; - a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, and having regard to the *NSW Biodiversity Offsets Policy for Major Projects and the Framework for Biodiversity Assessment*; and - a strategy to offset any residual impacts of the development in accordance with the NSW Biodiversity Offsets Policy for Major Projects, including evidence that the appropriate type and quantum of offsets will be available;	Chapter 5 Annex C
Heritage - including: - an assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including evidence of appropriate consultation with relevant Aboriginal communities/parties and documentation of the views of these stakeholders regarding the likely impact of the development on their cultural heritage; and - identification of historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items, having regard to the relevant policies and guidelines listed in Attachment 1;	Chapter 6 Annex D
Traffic & Transport – including: - accurate predictions of the road traffic generated by the construction and operation of the development, including a description of the types of vehicles likely to be used for transportation of quarry products; - a detailed assessment of potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road network (as identified above}, including a road safety audit; and - a description of the measures that would be implemented to mitigate any impacts, including concept plans of any proposed upgrades, developed in consultation with the relevant road and rail authorities (if required);	Chapter 12 Annex I
Land Resources - including a detailed assessment of: - potential impacts on soils and land capability (including potential erosion and land contamination) and the proposed mitigation, management and remedial measures (as appropriate); - potential impacts on landforms (topography), paying particular attention to the long term geotechnical stability of any new landforms (such as overburden dumps, bunds etc); and - the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements in Clause 12 of *State Environmental Planning Policy (Mining, Petroleum*	Chapter 9

Requirement	Location within EIS
Production and Extractive Industries) 2007, paying particular attention to the agricultural land use in the region	
Waste - including estimates of the quantity and nature of the waste streams that would be generated or received by the development and any measures that would be implemented to minimise, manage or dispose of these waste streams;	Chapter 16
Hazards - including an assessment of the likely risks to public safety, paying particular attention to the transport, handling and use of any hazardous or dangerous goods;	Chapter 15
Visual - including a detailed assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, paying particular attention to any new landforms, and to minimising the lighting impacts of the development;	Chapter 13

Social & Economic- including:
- a detailed assessment of the likely social impacts of the development on the local and regional community in accordance with the *Social impact assessment guideline for State significant mining, petroleum production and extractive industry development;* and
- a detailed assessment of the likely economic impacts of the development, paying particular attention to:
  - the significance of the resource;
  - the costs and benefits of the project; identifying whether the development as a whole would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates; and
  - the demand for the provision of local infrastructure and services
	Chapter 14

Rehabilitation - including the proposed rehabilitation strategy for the site having regard to the key principles in the *Strategic Framework for Mine Closure,* including: - rehabilitation objectives, progressive rehabilitation commitments, methodology, monitoring programs, performance standards and proposed completion criteria; - nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and - the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.	Chapter 17
Consultation During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities, service providers, Aboriginal stakeholders, community groups and affected landowners. Consultation to be undertaken with: - affected landowners; - community groups; - Port Macquarie-Hastings Council; - Office of Environment and Heritage (including the Heritage Branch); - Environment Protection Authority; - Division of Resources and Geoscience within the Department; - Department of Primary Industries (including the DPI Water, NSW - Forestry, Agriculture and Fisheries sections and Crown Lands division); - North Coast Local Land Services; - Roads and Maritime Services; - NSW Rural Fire Service; and	Chapter 4 and Annex B

Requirement	Location within EIS
establish a Community Consultative Committee for the project in accordance with the *Community Consultative Committee Guidelines for State Significant Projects,* and consult with the committee during the preparation of the EIS.	

1.6 STRUCTURE OF THE EIS

This EIS has been prepared to ensure that the Project is described adequately; addresses the SEARs, assesses the potential environmental impacts; and identifies proposed mitigation measures. The overall structure of the EIS is outlined in *Table 1.4*.

Table 1.4 Structure of the EIS

EIS Chapter	Description
Introduction	Provides an overview of the Proposed project and introduces the Proponent, project history and alternatives.
Project Description	Provides a detailed description of the proposed development including the key components for both the construction and operational phases of the Project.
Strategic and Statutory Context	Provides a strategic justification of the proposed development focusing on site selection and the suitability of the proposed site; Describes the SSD Planning Approval Process and relevant Commonwealth, State and local legislative frame work in relation to the Project.
Community and Stakeholder Engagement	Summarises the consultation activities undertaken with key external stakeholders (including government agencies, authorities and the local community).
Environmental Impact Assessment, including: - Biodiversity - Heritage - Hydrology/Surface Water - Groundwater - Soil and Land Resources - Noise and Vibration - Air Quality and Greenhouse Gas - Traffic and Access - Visual Amenity - Socio-economic - Hazards and Risk - Waste Management - Quarry Closure and Rehabilitation	Describe the physical, biological, cultural, social and economic environments within and in the vicinity of the PA, the potential risks and impacts (including cumulative impacts) of the proposed Project upon the existing environment, and the mitigation and management measures that would be undertaken to minimise these risks and impacts.

EIS Chapter	Description
Mitigation Measures	Provides an overview of the environmental management framework to be developed for the Project, including a summary of the mitigation measures and commitments made throughout the EIS to be implemented during the construction, operation and decommissioning of the Project.
Evaluation and Conclusion	Presents the conclusions of the EIS.
References	Consolidates all references contained within the EIS.

1.7 THE PROPONENT

Sancrox Quarry is owned and operated by Hanson Construction Materials Pty Ltd (Hanson), which forms part of the HeidelbergCement Group. Hanson is a major supplier of aggregates, sands and premixed concrete to the civil, industrial, residential, and commercial construction industries. Hanson and its subsidiaries operate over 70 quarries and more than 300 concrete plants throughout Australia, employing over 3,000 people nationwide. Hanson operate twelve quarries in NSW, ranging from sand to hard rock quarries.

Hanson operates to ISO/AS 14001 to reduce the impact its operations have on the environment. Sancrox Quarry has an Environmental Management System in place and strives for continual improvement in all aspects of its environmental performance.

REFERENCES

CCAA (2015) **Providing the essential materials to build our nation – Policy priorities for Australia's extractive industry**. Cement Concrete and Aggregates Australia.

Hanson (2015) **Geology, drill results and Resources 2015 – Sancrox Quarry, Stubbs Extension.** Hanson Construction Materials Pty Ltd.

Hanson (2015a) **Preliminary Environmental Impact Statement – Sancrox Quarry Expansion Project**. Hanson Construction Materials Pty Ltd.

Hanson (2018) **Sancrox Project need, justification and alternatives considered**. Hanson Construction Materials Pty Ltd.

PMHC (2018) **Application Tracker**. Port Macquarie Hastings Council. Sourced on 30 April 2018 from https://datracker.pmhc.nsw.gov.au/Application/ApplicationDetails

2 PROJECT DESCRIPTION

This Chapter describes all construction and operation aspects of the proposed quarry expansion, including the establishment of new ancillary infrastructure comprising a concrete batching, concrete recycling facility and asphalt production plant, for which the development approval is being sought.

2.1 PROPOSED ACTIVITY

The proposed activity, herein referred to as the Project, incorporates the following key components:

- increased annual extraction to 750,000 tonnes per annum (tpa);
- construction and operation of a concrete batching plant with an output of 20,000 tpa;
- construction and operation of a concrete recycling facility to process 20,000 tpa; and
- construction and operation of an asphalt production plant with an output of 50,000 tpa.

Concurrent to the proposed activities is the closing and purchasing a section of Crown owned land to facilitate the development of the biodiversity offset area to the north of the proposed quarry expansion area.

A Project description summary is provided in *Table 2.1.* The proposed extraction footprint and location of the new concrete batching plant, concrete recycling facility and asphalt production plant and the relocated product processing plant (herein referred to as ancillary infrastructure) are shown in *Figure 2.1* and *Figure 2.2.* Existing quarry operations will continue as much as possible during construction of the proposed infrastructure.

Table 2.1 Project Description Summary Table

Project Components/Aspects	Currently Approved Sancrox Quarry	Proposed Project
Quarry Life	20 years	30 years
Limits on production	455,000 tpa	750,000 tpa
Quarry Footprint	17.18 ha	48.61 ha
Final Quarry Depth	RL – 14m AHD	RL – 40m AHD
Product Processing Plant and Stockpile Area	Located in north-east corner of site	To be relocated to the south of quarry pit
Site Office, Weighbridge and Workshop	Located near site entrance	To remain in same location

Project Components/Aspects	Currently Approved Sancrox Quarry	Proposed Project
Water Holding Dams (WHD)	Two located in the south-east corner of site	To remain in same location. Additional WHDs will be constructed throughout the various stages of the Project to manage sediment.
Concrete Batching Plant	Not currently operating	20,000 tpa To be located in north-east corner of site
Concrete Recycling Facility	Not currently operating	20,000 tpa To be located in north-east corner of site
Asphalt Production Plant	Not currently operating	50,000 tpa To be located south of quarry pit
Hours of Operation	Quarry operates: - 7am – 5pm Monday to Friday - 7am – 1pm Saturday Truck movements and equipment loading: - 7am-11pm Monday – Friday -7am – 1pm Saturdays, Sundays and Public Holidays. Operations are permitted between 11:00pm and 7:00am on a maximum of 20 occasions within a year.	Quarry operations (incl. production and maintenance): 24 hours a day, 7 days a week Truck movements and equipment loading: 24 hours 7 days Blasting: 8am – 5pm Monday to Friday
Employee numbers	15 full-time employees (with casual and contractors on an as needed basis)	10 additional full-time employees, resulting in 25 full-time employees.

2.2 *SITE CONTEXT*

2.2.1 *Land Tenure*

Hanson owns the four lots that encompass the Project footprint:

- Lot 2 DP 574308;
- Lot 353 DP 754434;
- Lot 1 DP 704890; and
- Lot 1 DP 720807.

In order to eliminate property fragmentation over the site, Hanson is proposing the closure and purchase of a parcel of Crown owned land under the Roads Act 1993. Hanson currently holds an Enclosure Permit (number: 49229) under this Act.

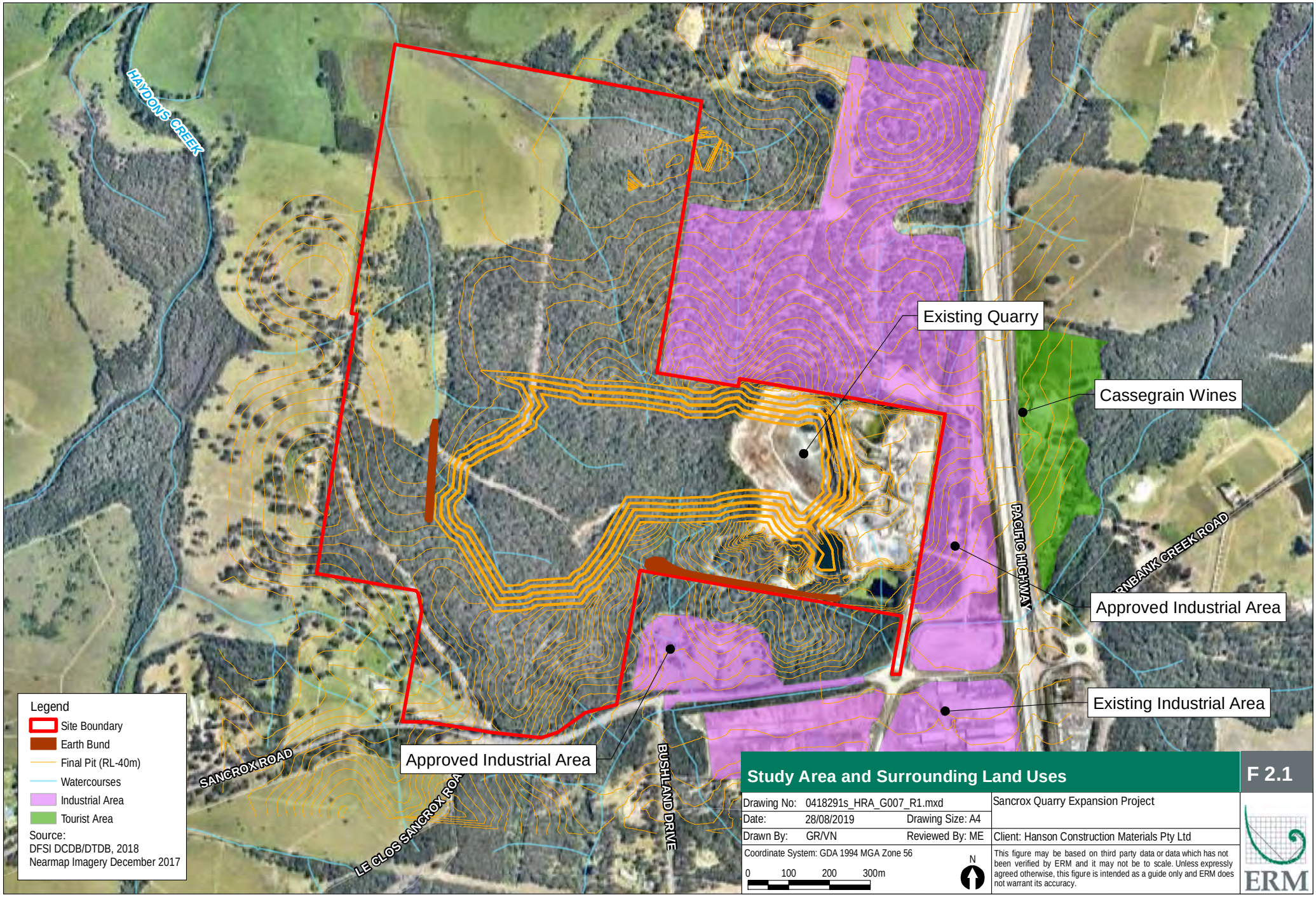
Hanson have operated a quarry at the site since 1998.

2.2.2 *Surrounding Land Use*

The environment surrounding the quarry site includes remnant woodland vegetation immediately adjacent to the north, west and south. A narrow strip of vegetation is present along the eastern boundary, with partially cleared land located 100m to the east. The Pacific Highway and Cassegrain Winery are located approximately 175m and 210m to the east, respectively. Sancrox Road is located approximately 230m to the south of the site, with a suite of industrial facilities beyond.

The closest residence to the site is located approximately 150 m to the south-west, along Sancrox Road. A number of rural residential residences are also located along Bushland Drive to the south-west of the site, the closest being approximately 650m to the south-west. A further rural residential residence is located approximately 1km to the west.

The future development of commercial infrastructure is proposed along the Pacific Highway, adjacent to the existing Sancrox Quarry, as identified in *Figure* 2.1, and detailed in *Section 1.2.2*.


HAYDONS CREEK
Existing Quarry
Cassegrain Wines
PACIFIC HIGHWAY
RNBANK CREEK ROAD
Approved Industrial Area
Existing Industrial Area
Approved Industrial Area
SANCROX ROAD
LE CLOS SANCROX ROA
BUSHLAND DRIVE
Legend
Site Boundary
Earth Bund
Final Pit (RL-40m)
Watercourses
Industrial Area
Tourist Area
Source:
DFSI DCDB/DTDB, 2018
Nearmap Imagery December 2017
Study Area and Surrounding Land Uses
F 2.1
Drawing No: 0418291s_HRA_G007_R1.mxd
Date: 28/08/2019
Drawing Size: A4
Drawn By: GR/VN
Reviewed By: ME
Coordinate System: GDA 1994 MGA Zone 56
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Sancrox Quarry Expansion Project
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

Quarry sump

Silt Retention Dam

Concrete Batching Plant & Recycling Facility

Three tier sediment treatment train

Pit Floor

Old Processing Plant (to be relocated)

New Processing Plant

New Asphalt Production Plant

New Stockpile Area

Existing Site Office, Weightbridge & Workshop

Water Holding Dam 1 (WHD1)

Water Holding Dam (WHD2)

Noise Bund

Legend

- Existing Property Ownership
- Lot Boundary
- Infrastructure
- Haul Road
- Road Network

Source:
Spatial Data: DFSI DCDB/DTDB 2017
Imagery Data: nearmap August 2017

Ancillary Infrastructure

F 2.2

Drawing No:	0418291s_HRA_G002_R3.mxd		Sancrox Quarry Expansion Project Hydrology Assessment Report
Date:	30/09/2019	Drawing Size: A4	
Drawn By:	GC	Reviewed By: ME	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

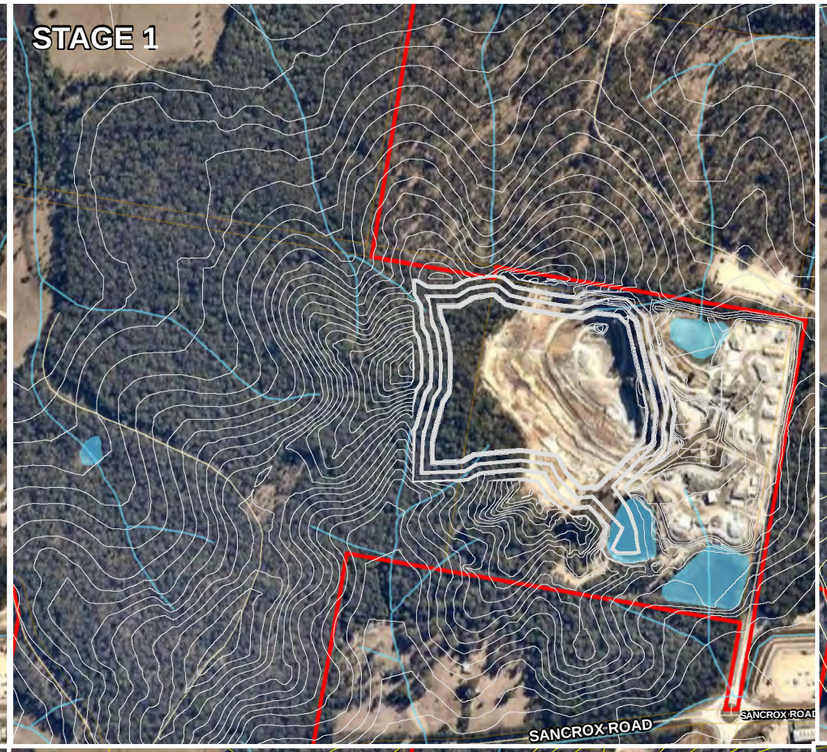
2.3 *EXPANDED QUARRY OPERATIONS*

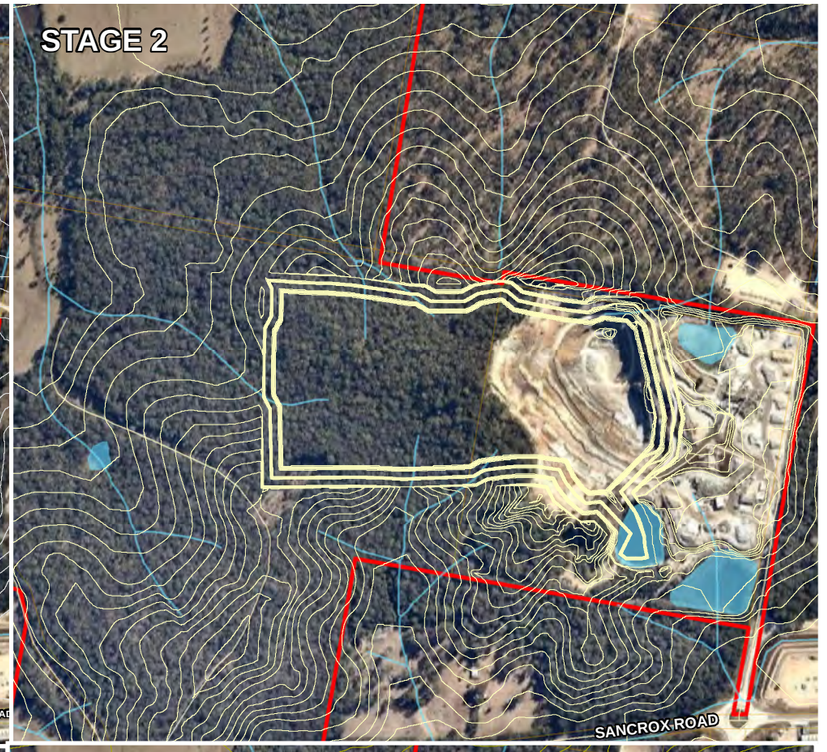
The resource being quarried comprises a range of rock types, including conglomerates with some associated mudstones, shales and coal as identified by geological investigations undertaken by Hanson (2015). The resource is considered high quality, hard rock aggregate, which has historically been utilized throughout major construction projects within the locality, including the most recent Pacific Highway Upgrade. Refer to *Chapter 3* for further details on the Project's strategic context.

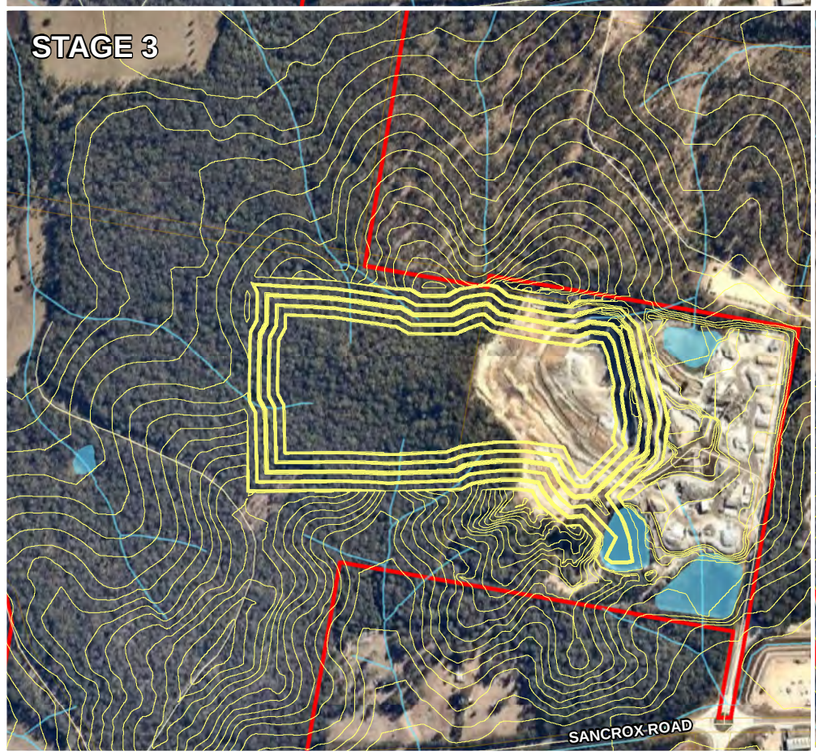
2.3.1 *Project Staging*

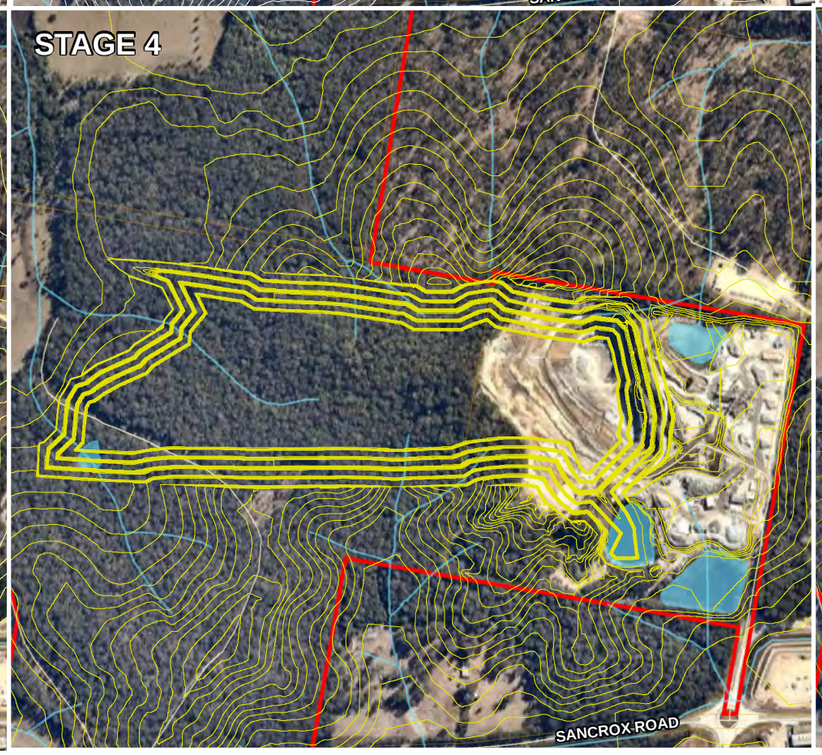
The proposed quarry expansion will be completed in five separate stages, over the 30 year lifetime of the Project. Each stage is described below and shown in *Figure 2.3*. Cross-sections for each stage are provided in *Figure 2.4* to *Figure 2.8*.

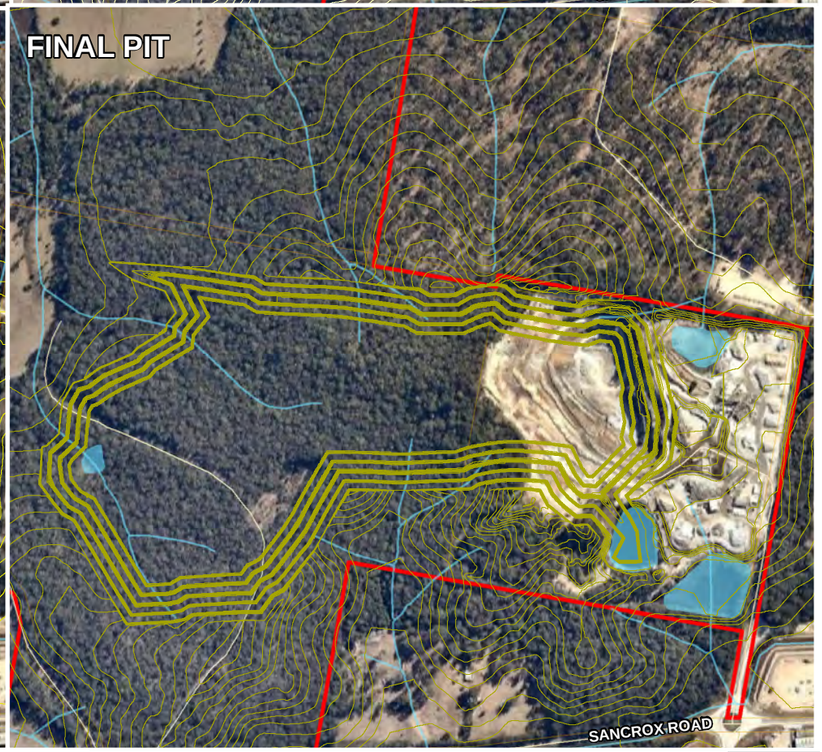
With the exception of Stage 3, all stages will require clearing of vegetation to allow for the development to progress. The cleared vegetation will be mulched and removed from site where it cannot be beneficially reused on-site for erosion and sediment controls. Clearing will be undertaken by plant such as a bulldozer, one to two excavators, a mulcher and haul trucks to convey the mulch off-site. It is expected that each stage requiring clearing will take three to four weeks to clear and mulch.











Legend

- Existing Property Ownership
- Lot Boundary
- Road Network
- Watercourses

Quarry Staging:

- Stage 1 (RL-14m)
- Stage 2 (RL-14m)
- Stage 3 (RL-40m)
- Stage 4 (RL-40m)
- Final Pit (RL-40m)

Source:
Spatial Data: DFSI DCDB, DTDB 2017
Imagery Data: nearmap August 2017

Quarry Staging

F 2.3

Drawing No:	0418291s_EIS_G002_R2.mxd		Sancrox Quarry Expansion Project
Date:	27/07/2018	Drawing Size: A4	
Drawn By:	LT	Reviewed By: ME	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 100 200m

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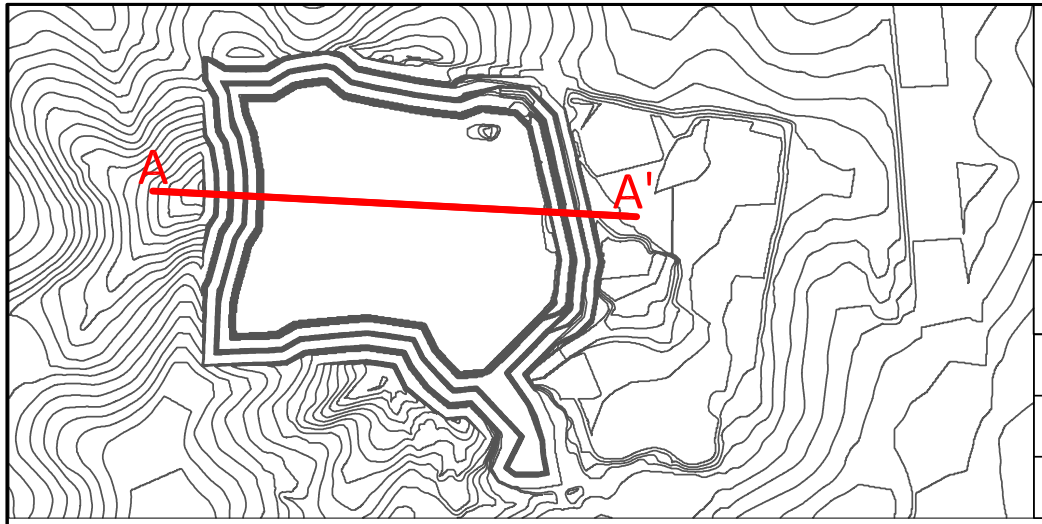
ERM



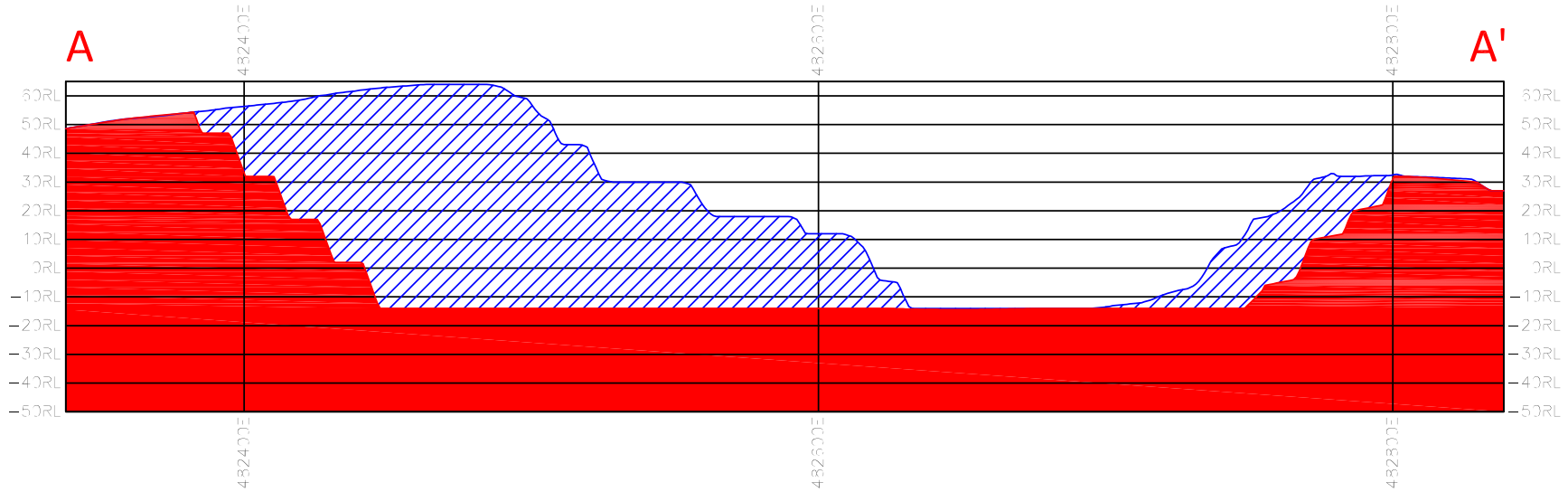
Sancrox Quarry - Extension Project

Staged Development Plan - Cross-Sections

Date: May '17 | Stage 1

2017 flyover surface

Stage 1 pit design



Cross-Section A-A'

F2.4

Drawing No:	0418291s_HRA_C001_R0.cdr		**Sancrox Quarry Expansion Project**
Date:	19/07/2018	Drawing size: A4	
Drawn by:	GC	Reviewed by: TB	Client: Hanson Construction Materials Pty Ltd

0 25 50m

N

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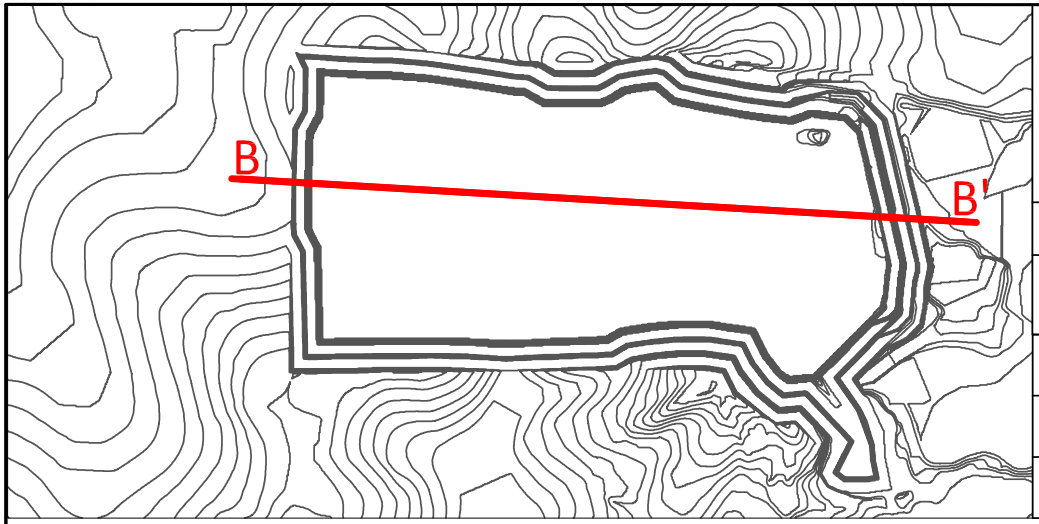
ERM

Source:

Cross-section supplied by Client June 2018.
max-40st x-section loc.dwg



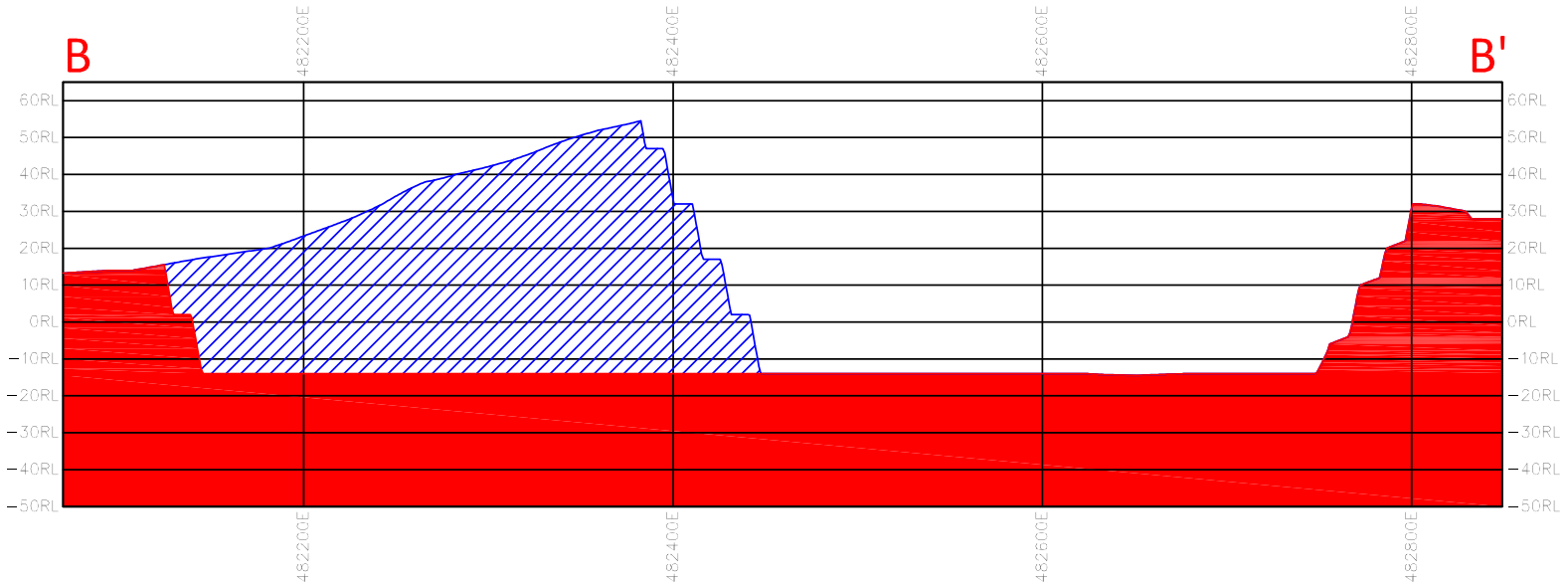
Sancrox Quarry - Extension Project

Staged Development Plan - Cross-Sections

Date: May '17 | Stage 2

Stage 1 pit design

Stage 2 pit design



Source:
Cross-section supplied by Client June 2018.
max-40st2 x-section loc.dwg

Cross-Section B-B'

F2.5

Drawing No:	0418291s_HRA_C002_R0.cdr		**Sancrox Quarry Expansion Project**
Date:	19/07/2018	Drawing size: A4	
Drawn by:	GC	Reviewed by: TB	Client: Hanson Construction Materials Pty Ltd

0 50 100m

N

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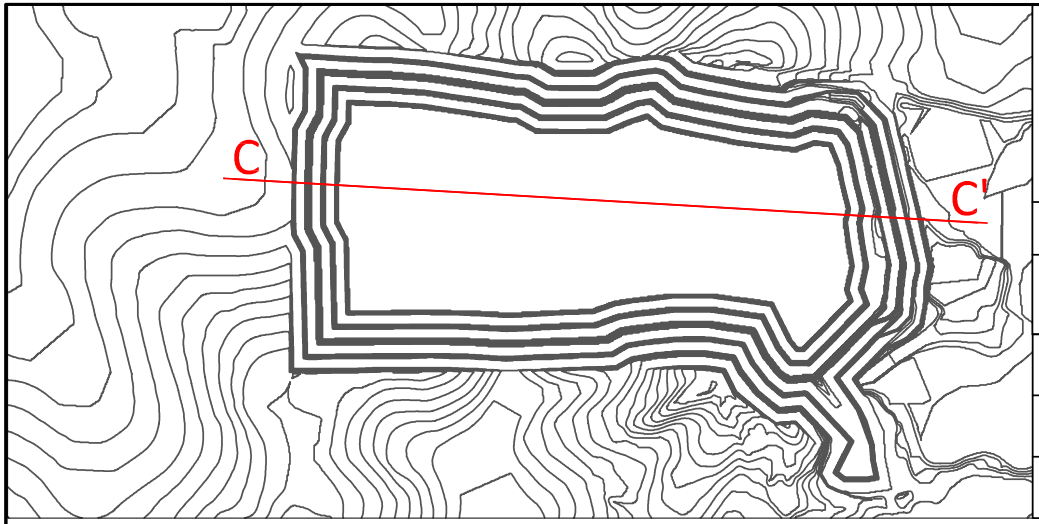
ERM



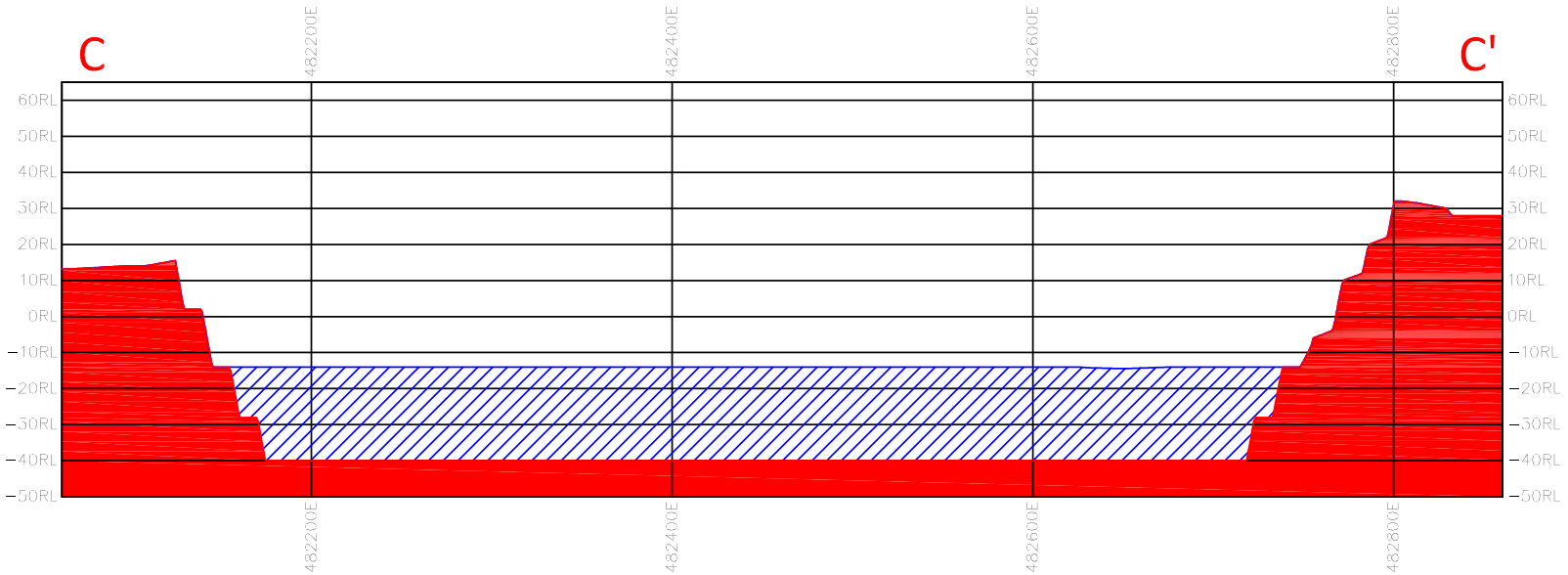
Sancrox Quarry - Extension Project

Staged Development Plan - Cross-Sections

Date: May '17 | Stage 3

Stage 2 pit design

Stage 3 pit design



Source:
Cross-section supplied by Client June 2018.
max-40st3 x-section loc.dwg

Cross-Section C-C'

F2.6

Drawing No:	0418291s_HRA_C003_R0.cdr		**Sancrox Quarry Expansion Project**
Date:	19/07/2018	Drawing size: A4	
Drawn by:	GC	Reviewed by: TB	Client: Hanson Construction Materials Pty Ltd

0 50 100m

N

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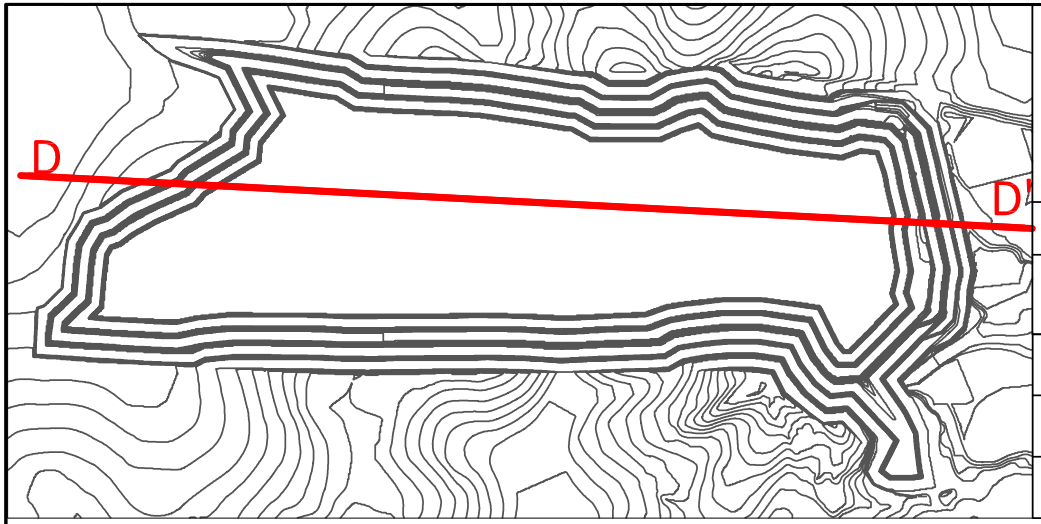
ERM



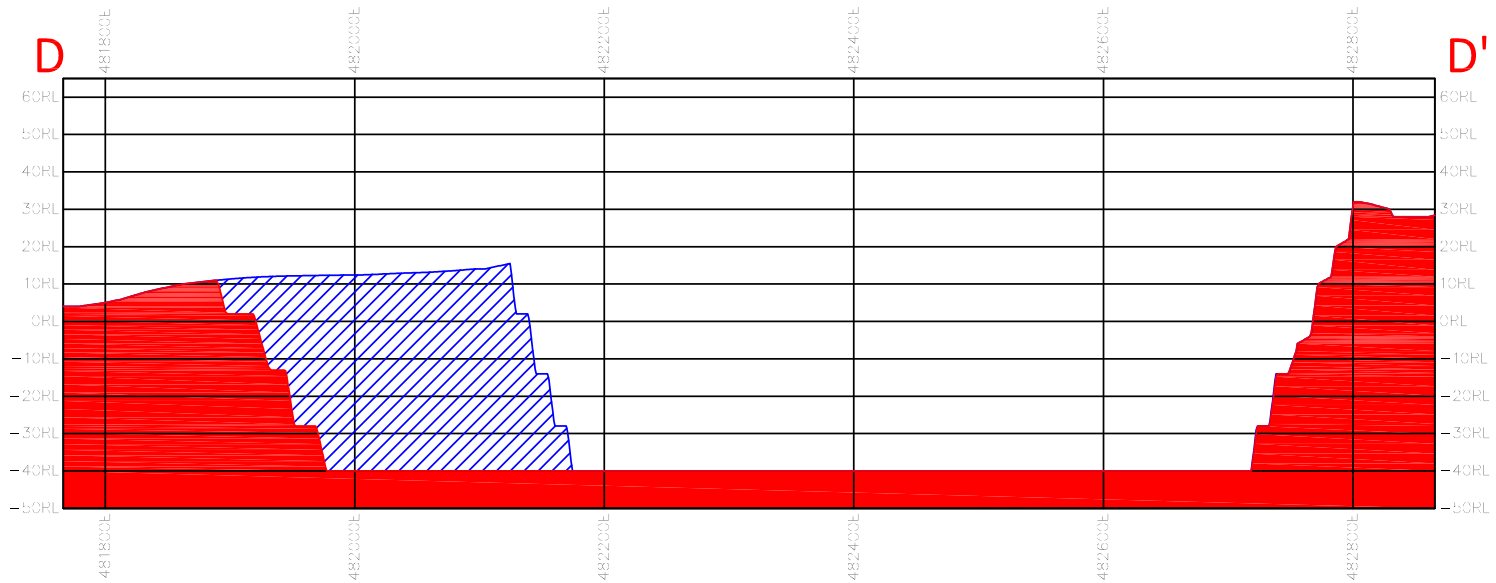
Sancrox Quarry - Extension Project

Staged Development Plan - Cross-Sections

Date: May '17 | Stage 4

Stage 3 pit design

Stage 4 pit design



Source:
Cross-section supplied by Client June 2018.
max-40st4 x-section loc.dwg

Cross-Section D-D'

F2.7

Drawing No:	0418291s_HRA_C004_R0.cdr		**Sancrox Quarry Expansion Project**
Date:	19/07/2018	Drawing size: A4	
Drawn by:	GC	Reviewed by: TB	Client: Hanson Construction Materials Pty Ltd

0 50 100m

N

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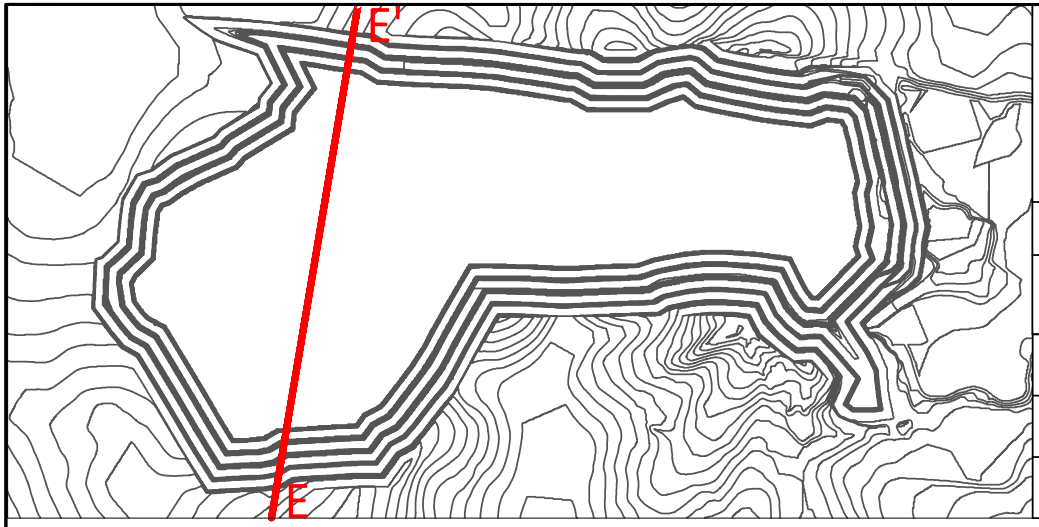
ERM



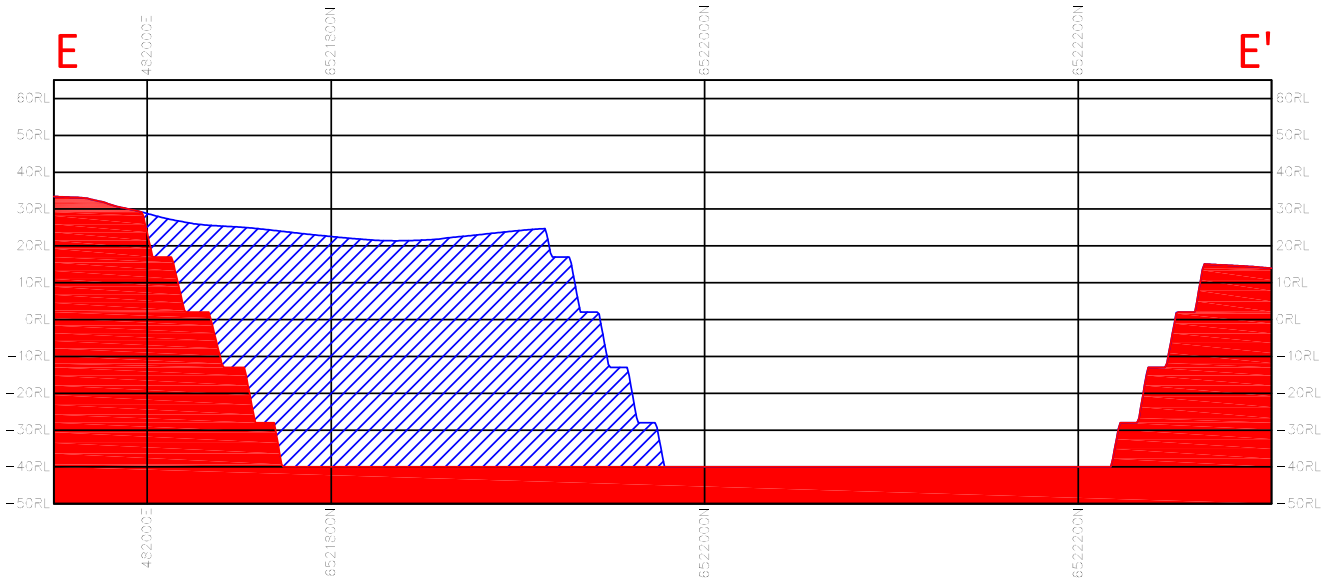
Sancrox Quarry - Extension Project

Staged Development Plan - Cross-Sections

Date: May '17	Stage 5

Stage 4 pit design

Stage 5 pit design



Cross-Section E-E'

F2.8

Drawing No:	0418291s_HRA_C005_R0.cdr		**Sancrox Quarry Expansion Project**
Date:	19/07/2018	Drawing size: A4	
Drawn by:	GC	Reviewed by: TB	Client: Hanson Construction Materials Pty Ltd

0 50 100m

N

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ERM

Source:

Cross-section supplied by Client June 2018.
max-40st5 x-section loc.dwg

Stage 1

Stage 1 involves the expansion of the western side of the quarry into the uncleared area to a depth of RL-14 (AHD). To allow for the construction of the ancillary facilities, vegetation clearing and development of pads will be undertaken during this stage.

Stage 2

Stage 2 will further expand the existing western side of the quarry at the same depth of RL-14 (AHD).

Stage 3

Stage 3 will widen and deepen the benches towards the western extraction boundary. At this stage there will be up to four benches (dependant on the topography at the pit void), some of which will be active and others at progressive or final stages of rehabilitation. The quarry pit floor will be lowered from RL – 14 (AHD) to RL - 40m (AHD).

Stage 4

Stage 4 involves the expansion of operations to the west to the extraction boundary at the same depth of RL – 40 (AHD).

Stage 5

The final stage will expand the quarry along the southern extraction boundary at the same depth of RL – 40 (AHD).

2.3.2 Extraction Process

Quarrying

The basic methodology for quarrying at Sancrox Quarry will involve the following processes:

- ripping and stockpiling of material in-pit;
- drilling and blasting at greater depths where rock is significantly harder and ripping is no longer feasible;
- internal hauling of material to the processing plant;
- loading, transport and distribution of product to customers; and
- progressive rehabilitation (refer to *Chapter 17* for further details on quarry rehabilitation).

Following ripping and/or blasting, an excavator will be located on the rock heap, and will load material into internal haul trucks to deliver to the processing plant. An excavator or front end loader will be used to load product into haul trucks following processing. Some material will be stockpiled on-site as required in order to meet demand requirements during peak extraction periods.

Overburden Management

Overburden will be removed and stored, predominantly at the perimeter of the quarry at each stage. This material will be utilised to provide cover for the batters and the quarry floor upon completion of quarrying.

Stockpile Management

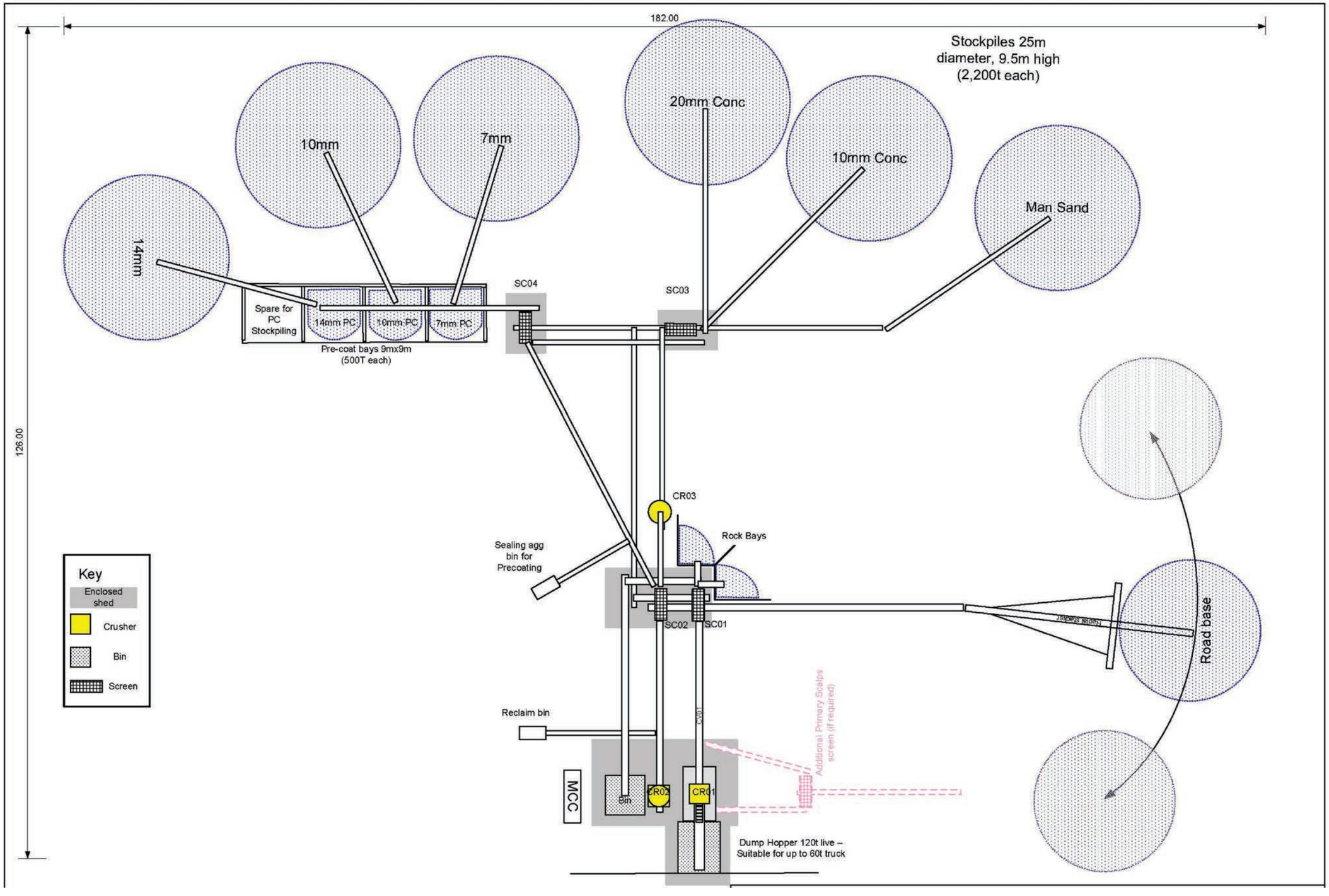
The site currently has an area of approximately 2.2 ha for aggregate stockpiling. The stockpiles are located towards the eastern portion of the site adjacent to the main crusher and screen and in the southern portion of the site between the two WHDs and the site office and workshop. The extracted materials are processed and stockpiled on-site, before being loaded with a front end loader into road trucks to be delivered to customers.

The Project proposes to include the development of new stockpile areas, south of the existing pit as shown in *Figure* 2.2.

The internal access road to the proposed stockpiles from the front gate will be asphalt sealed to limit dust generation.

2.3.3 Processing Plant

The proposed processing plant will comprise a crusher and screener for the crushing, grinding and separating of rock into various sizes of aggregate. The processing plant will be located within the proposed 'Infrastructure Area', at the southern end of the existing lot (Lot 353 DP 754434), as shown in *Figure 2.2*. A typical layout for the processing plant is shown in *Figure 2.9.*



Typical Layout for Processing Plant

F2.9

Drawing No:	0418291s_QE_C001_R0.cdr		Sancrox Quarry Expansion Project
Date:	19/10/2018	Drawing size: A3	
Drawn by:	GC	Reviewed by: TH	Client: Hanson Construction Materials Pty Ltd

Drawing Not to Scale

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ERM

2.3.4 *Water Management*

A summary of conceptual water flow and quality management is provided in *Chapter 7*, with further detail provided in the Hydrology Assessment (*Annex E*). The primary water flow management method will be drains/bunds to prevent non-project related, upslope run-off entering the quarry void. The primary water quality management method will be progressive rehabilitation and clearing to manage erosion and WHDs to capture and treat sediment laden site run-off. Water for input into production and dust management will be sourced from these new and existing WHDs, with a water balance identifying a sufficient supply as described in *Chapter 7*.

The EPL will require modification to allow for the proposed WHDs to discharge from site upon meeting water quality criteria, verified by water quality sampling. The EPL will also need to be updated to incorporate the increased extraction rate.

Dust Suppression

Dust suppression at Sancrox Quarry utilises both fixed sprinklers and a water cart. Site staff are informed of dust being an important environmental management issue through induction and training. Sancrox Quarry maintains a complaints register to ensure all community complaints are recorded and dealt with in a timely manner. All drivers are aware that by law, any potential dust generating load leaving Sancrox Quarry must be covered.

The water cart is utilised on an as needed basis dependent upon weather conditions. The water cart is utilized during warm and windy conditions to ensure minimal dust leaves the site.

Sprinklers are located along bund walls areas that see lots of traffic movement. This allows regular dust suppression to occur in the busiest areas of the quarry. The sprinklers operate on a timer which is set to meet the needs of that season.

Chapter 11 provides further information on proposed dust suppression measures during construction and operation of the Project.

2.3.5 *Traffic Movements and Haulage Routes*

The quarry is serviced by the Sancrox Interchange, which is a loop road comprising of Sancrox Road off the quarry access road, Frogs Road and Fernbank Creek Road. There is an overpass bridge providing passage for Frogs Road over the Pacific Highway. The Sancrox Interchange provides for north, south and eastern traffic movements from the quarry by linking to the Pacific Highway and Winery Drive linking with Hastings River Drive towards Port Macquarie. Both the Pacific Highway and the Sancrox Interchange have recently opened to traffic, hence have been constructed to modern design requirements. Western movements from the quarry are recommended on the Oxley Highway which is serviced by an interchange from the southbound Pacific Highway carriageway.

The expanded quarry operation will increase average truck volumes to approximately 200 truck trips per day (a 'trip' is a two movements – in and out of site).

Further information in relation to traffic and access associated with construction and operation aspects of the Project is provided in *Chapter 12*.

2.4 *PROPOSED ANCILLARY INFRASTRUCTURE*

Hanson proposes to construct an asphalt production plant, and relocate the existing processing plant and stockpiles to the Infrastructure Area, south of the existing pit, as shown in *Figure* 2.2. The concrete batching plant and concrete recycling facility will be constructed in the north eastern portion of Lot 353 DP 754434 as shown in *Figure* 2.2.

It is expected that the demolition and removal of existing structures will take approximately 1-2 months to complete, while the construction of the proposed ancillary infrastructure will take approximately 12 months. Further detail is outlined for each section of proposed ancillary infrastructure below.

2.4.1 *Concrete Batching Plant and Recycling Facility*

Hanson is seeking consent to construct and operate a concrete batching plant and recycling facility, capable of producing 20,000 tpa of cement and receiving up to 20,000 tpa of concrete material for recycling. It will be located in the north-east corner of the site (refer to *Figure 2.2*). The plant will batch wet cement in agitators for use in regional construction projects. The recycled concrete aggregate will be beneficially reused as a substitute for virgin aggregates in products such as road base and drainage materials. Crushing may be required to size recycled concrete aggregates such that it is suitable for the intended use.

Three main types of commercial vehicles will operate at the plant:

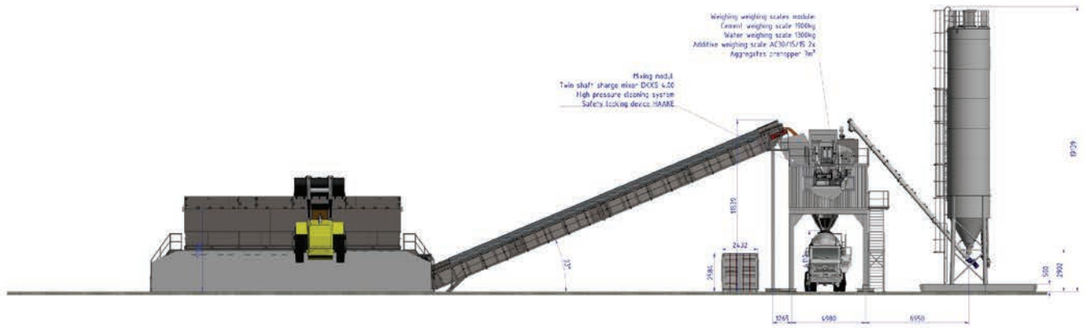
- agitator trucks – delivering concrete mixed to regional construction projects.
- cement tankers – delivering cement to the Site.
- aggregate trucks – delivering sand aggregates to the Site for use in the batching process.

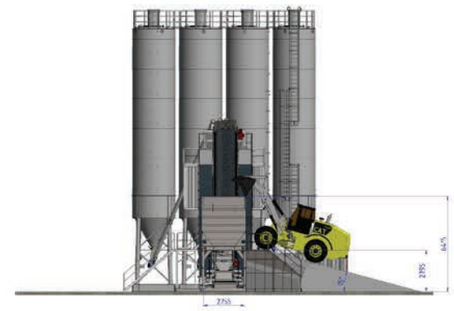
Other on-site vehicles will include a front end loader, which will be used to transfer basalt aggregates from the quarry stockpiling area for use in the batching process.

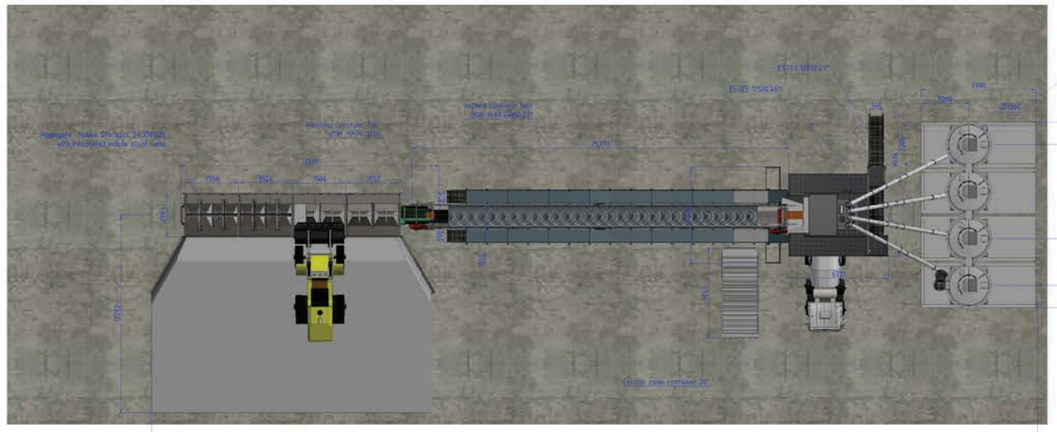
All batching activities will be totally enclosed with fabric filters and material storage bins will be enclosed on three sides.

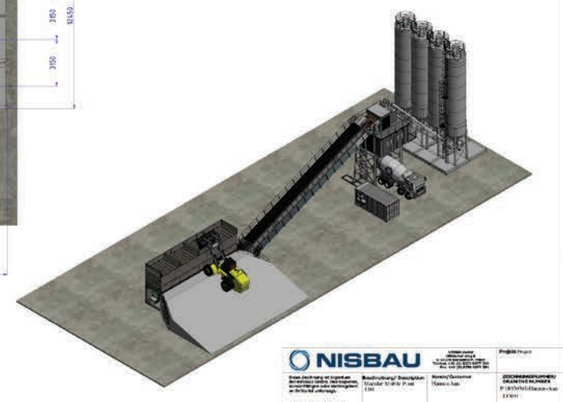
A typical layout for the concrete batching plant and recycling facility is shown in *Figure 2.10.*

CONCRETE BATCHING PLANT

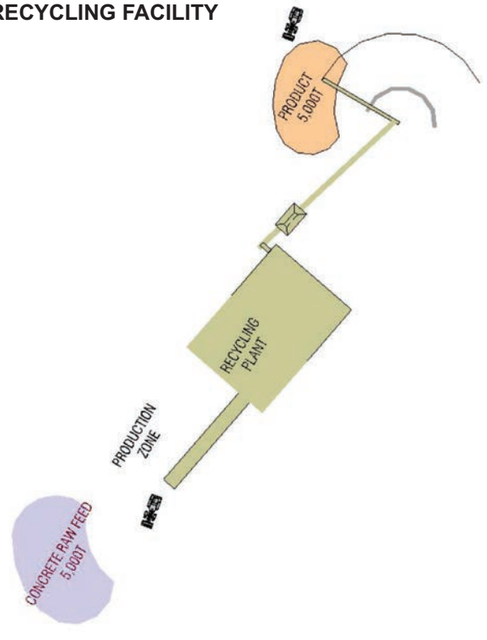








RECYCLING FACILITY



Typical Layout for Concrete Batching Plant and Recycling Facility			F2.10
Drawing No: 0418291s_QE_C002_R0.cdr		Sancrox Quarry Expansion Project	
Date: 19/10/2018	Drawing size: A3		
Drawn by: GC	Reviewed by: TH	Client: Hanson Construction Materials Pty Ltd	
Drawing Not to Scale		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.	

Construction

Construction of the concrete batching plant and concrete recycling facility will take approximately three months and involve the following activities:

- earthworks to establish a level pad for the construction of the plant and environmental controls;
- construction of a concrete hardstand area;
- delivery of components by heavy vehicles;
- configuration and construction of plant components; and
- pre-commissioning tests.

Equipment laydown areas will be provided within the existing quarry footprint, preventing additional clearing or use of land beyond the Project boundary.

Operation

The operation of the concrete batching plant and concrete recycling facility will be comprised of:

- cementitious materials silos;
- aggregate storage bins with dust suppression systems;
- weigh hoppers for aggregates and cementitious materials;
- conveyor belt (with cover) from aggregate bins to pan mixer;
- pan mixer;
- dust extractor for capturing of cementitious materials located above the pan mixer;
- water holding tank;
- admixture/additives storage facility;
- first flush system; and
- a truck/concrete agitator washout bay.

The raw, hard rock aggregate materials will be delivered to the concrete batching plant from the processing plant and cementitious materials will be imported from off-site. The raw materials will be stored in silos or holding bins and used in the batching process by an automated, computerised control system. The cementitious materials will be pneumatically fed from the delivery trucks to the storage silos to prevent potential dust emissions.

Aggregates will be transported along the conveyor to the mixer. Once released, the raw materials will enter a pan mixer which will homogenise the feed materials to produce the readymade concrete. All discharge to the pan mixer will be via enclosed system to ensure adequate containment of materials. After a set duration and completion of quality control checks of the product, the concrete batch will be pneumatically loaded to the concrete agitator trucks, for off-site delivery.

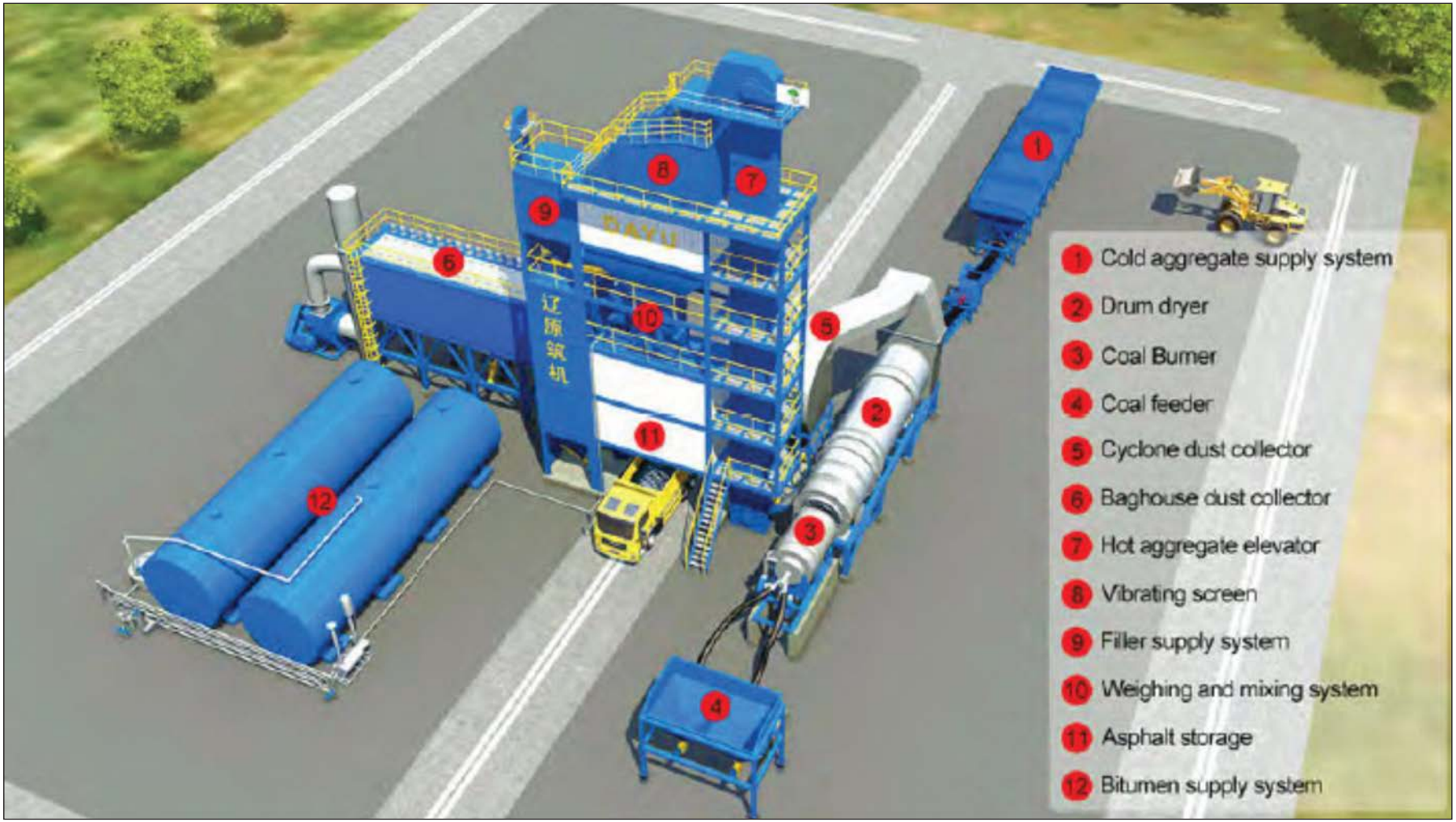
A first flush system will be constructed within the concrete batching plant and recycling facility area to manage cement laden washout water generated from the area. Sediment collected in the first flush system will be regularly removed to ensure the on-going efficiency of the system. Removed sediment will be dried and recycled at the concrete recycling facility.

Concrete agitator trucks will be washed out into a dedicated concrete washout bay. Similar to the first flush system, any accumulated sediment will be regularly removed, following drying and recycled at the recycling plant.

The concrete batching plant will generate approximately 11 agitator trips per day during operation. The concrete recycling facility will generate approximately eight truck trips per day.

2.4.2 Asphalt Production Plant

The asphalt production plant will produce asphalt to be used for road construction. The asphalt production plant will be located within the Infrastructure Area as shown in *Figure 2.2*. A typical layout for the concrete batching plant and recycling facility is shown in *Figure 2.1.*



Typical Layout for Asphalt Production Plant

F2.11

Drawing No:	0418291s_QE_C003_R0.cdr		Sancrox Quarry Expansion Project
Date:	19/10/2018	Drawing size: A4	
Drawn by:	GC	Reviewed by: TH	Client: Hanson Construction Materials Pty Ltd

0 10 20m

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ERM

The asphalt production plant will be comprised of:

- aggregate hoppers;
- bitumen tanks;
- conveyor;
- mixer/batcher;
- pre-coat plant (tanks of hydrocarbon pre-coat product and stockpiles);
- baghouse filters; and
- boiler to heat bitumen.

The plant will be gas powered. A triple interceptor or similar pollution control device will be utilised as a "first flush" for the potential hydrocarbon contaminated areas in the plant site. The downslope WHD servicing the plant catchment will also be fitted with a floating hydrocarbon boom as a precautionary measure to contain any potential loss of hydrocarbons from the plant catchment.

A vapour balancing system will be installed for the delivery of bitumen on-site and a vapour recovery system will be utilised for transfer of asphalt to trucks to minimise odour and dust emissions. The access road from the front gate to the asphalt production plant will be asphalt sealed to limit dust generation.

Construction

Construction of the asphalt production plant will take approximately three months and involve the following activities:

- clearing of proposed Infrastructure Area that is currently vegetated;
- mulching cleared vegetation and removal of mulch from site;
- earthworks to establish a level pad for the construction of the plant and environmental controls;
- construction of a concrete hardstand area;
- delivery of components by heavy vehicles;
- configuration and construction of plant components; and
- pre-commissioning tests.

It is likely that the asphalting of internal roads will commence upon the operation of the asphalt production plant. Equipment laydown areas will be provided within the existing quarry footprint, preventing additional clearing or use of land beyond the Project boundary.

Operation

Operation of the asphalt production plant requires high quality aggregate and bitumen. The aggregate for asphalt production will be obtained from the rock processed at the processing plant and will be delivered directly to the aggregate storage bins at the asphalt production plant.

The produced asphalt will be loaded into trucks and taken off-site via the weighbridge. The production of asphalt will generate approximately 21 truck trips per day.

2.4.3 Pug Mill

A pug mill will be used to mix materials for application of road base, and will also be located within the proposed Infrastructure Area. A typical pug mill consists of a horizontal boxlike chamber with a top inlet and a bottom discharge at the other end, two shafts with opposing paddles and a drive assembly.

2.5 SITE FACILITIES AND SERVICES

Existing facilities and services established at the quarry include an administrative office with amenities including toilet, shower and lunch room, a workshop with refuelling area and hazardous material storage area, and parking spaces to accommodate both employees and visitors.

A weighbridge is located near the site entrance, which weighs material being transported to and from the quarry.

These existing facilities and services will remain in their current position during the site redevelopment, as shown in *Figure 2.2*.

The administrative office is serviced by tank water and a Council approved on-site effluent management system.

Electricity is supplied by the power lines traversing north-south on the eastern side of the site. The site redevelopment and construction of new ancillary infrastructure may require realignment of these poles or installation of new feeder lines to the infrastructure. All permits to develop these works will be obtained from the electricity provider, as required.

2.6 PLANT AND EQUIPMENT

A range of plant and equipment will be utilised during the operation of the Project, including:

- light vehicles to convey staff to and from, as well as around site;

- heavy vehicles (predominately truck and dogs) to convey materials within the site and deliver quarried materials, concrete and asphalt off-site. The delivery of concrete washout material to site will also be undertaken by heavy vehicles;
- crusher and screener (quarried material processing plant);
- front end loaders to load trucks and distribute product around site;
- excavators to separate rock stockpiles and load trucks;
- concrete batching plant and recycling facility components;
- asphalt production plant components;
- pug mill components;
- pumps for dewatering and distributing water around site. One such pump will also likely operate a standpipe to fill the water carts;
- water carts for product moisture and dust suppression;
- road sweeper;
- sprinklers for dust suppression;
- weighbridge; and
- concrete agitators.

Additional equipment will also be required for construction, as outlined throughout this section.

2.7 *WORKFORCE*

By extending the life of Sancrox Quarry to 30 years, the current workforce of 15 operators, supervisors and management will be retained. Should consent be granted to increase production to 750,000 tpa, a larger workforce of approximately 25 employees will be required for quarry operations, increasing existing workforce by 10.

In addition to the quarrying staff, the concrete batching plant will employ up to five concrete agitator truck drivers, one batcher and one concrete plant manager.

The asphalt production plant is expected to employ between four and five employees, potentially including:

- One plant manager;
- Two batchers / dispatchers;

- One loader;
- Two truck drivers; and
- One Lab Technician

Concrete waste recycling will employ two drivers to transport the unused concrete from Hanson concrete plants to Sancrox Quarry for stockpiling while waiting to be crushed. This recycled product will be used at Sancrox Quarry and may also be transported to other Hanson quarries to produce more environmentally sustainable road base materials throughout the region.

The Project is anticipated to provide important economic benefits into the local economy. Employment opportunities will be created in the labour and trade employment sectors. Additional benefits include employment opportunities during the construction and operation phases of the Project, and flow on effects to the local economy. Increasing Sancrox Quarry's workforce, due to rising production levels, along with the addition of the concrete batching and asphalt production plant and associated employment opportunities, is further discussed in the Socio-Economic Assessment, contained within *Chapter 14*.

2.8 DEMOBILISATION AND LAND REHABILITATION

Sancrox Quarry currently practices progressive rehabilitation on site. Hanson's opportunistic and progressive rehabilitation will continue throughout the Project life, as part of a planned program of activities to achieve an acceptable final landform. Rehabilitation will be carried out progressively following each stage of extractive operations to ensure a stable landform and to control soil erosion.

The progressive approach helps minimise the liability falling on the operator by rehabilitating the quarry during the operation rather than undertaking the larger task of rehabilitating the quarry following the closure of the quarry, when there is no direct income from quarrying activities (CDITR, 2006).

The progressive approach will allow for rehabilitation methods to be tested and consequently improved to ensure rehabilitation methods are effective (CDITR, 2006).

Quarry rehabilitation work will be undertaken in accordance with relevant guidelines and requirements of the SEARs.

Further information in relation to quarry closure and rehabilitation is provided in *Chapter 17*.

2.9 WASTE STREAMS

Waste streams to be generated during construction and operation are discussed in *Chapter 16*. The waste management hierarchy will be applied to limit the generation of waste that is to be directed to landfill and where practicable, resource recovery exemptions will be utilised.

The development of the waste concrete recycling facility is the creation of a commercial enterprise based on the principle of the beneficial reuse of a resource, hence is considered Environmentally Sustainable Development (ESD).

REFERENCES

Commonwealth Department of Industry Tourism and Resources (CDITR) (2006) **Mine Rehabilitation Handbook.**

Ecomak (2018) **Screw Conveyors and Pug Mill**. Accessed on 1 February 2017 from http://www.ecomak.co.in/en/products/dust-disposal-system/screw-conveyors-and-pug-mill.html

3 STRATEGIC AND STATUTORY CONTEXT

This Chapter identifies the relevant policies and plans which demonstrate the strategic planning context and need for the Project. It provides a description of how the Project complies with the relevant legislation, policies and plans, including an overview of the importance of the Project within the strategic planning context.

The Chapter has been prepared with due regard to guidance provided in the Guidelines for Preparing an EIS (DP&E, 2017), with the level of detail provided for each section of relevant legislation relating to the overall relevance to the Project.

3.1 STRATEGIC CONTEXT

The *Mid North Coast Regional Strategy* (Department of Planning [DoP], 2009) recognises the importance of the regions natural resources base to the continued sustainable growth and development of the region. By 2031, the Mid North Coast population is expected to grow by 28% to around 424,600 (DoP, 2009). This represents an annual average growth rate of approximately 1.1% over the next 25 years, among the highest regional growth rates in regional NSW (DoP, 2009). The population of the Port Macquarie-Hastings Region is projected to increase from 76,788 in 2012 to 104,589 by 2031, an increase of 27,801 people, or 36.2% (PMHC, 2013).

Population increases of this size stimulate housing development that has a requirement for hard rock aggregates and batched products such as cement and asphalt. Renovations and council infrastructure improvement projects will generate waste concrete and the provision of the proposed recycling allows for an additional local facility for processing of this material for beneficial reuse.

According to the *Mid North Coast Regional Strategy*:

"The Region's economy is now largely based on service, manufacturing, construction and primary industries. Many of the industries depend on environmental and natural resources such as extractive materials, forests, soils and water, which must be protected in the face of the growing population."

Additionally:

"Local environmental plans will protect land identified as having extractive resources of regional significance and their haulage routes"

The Sancrox Quarry was identified in the *Mid North Coast Regional Strategy* (DoP 2009) as important for extractive resources. DoP (2009) stressed the importance of protecting extractive resources for their optimal economic use and not sterilising land suitable for extractive purposes by enabling inappropriate land use.

3.2 COMMONWEALTH LEGISLATION

3.2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) relates to the protection of the environment and the conservation of biodiversity. The EPBC Act incorporates an assessment and approvals system for:

- actions that have a significant impact on matters of national environmental significance (NES);
- actions that have a significant impact on the environment of Commonwealth land; and
- actions carried out by the Commonwealth Government.

Matters of National Environmental Significance

A search using the Department of the Environment (DoE) Protected Matters Search Tool (PMST) was undertaken by SLR Consulting Australia Pty Ltd (SLR) on 22 December 2016. The search was conducted as part of a Biodiversity Assessment Report (BAR) (SLR, 2017) prepared for the Project and is provided in *Annex C* of this EIS. The results of the search are summarised in *Table 3.1* below.

Table 3.1 Relationship of the Project to Matters of National Environmental Significance

Matter of National Environmental Significance	Application to the Project	Relevant Section
World Heritage Areas	Not relevant	N/A
National Heritage Places	Not relevant	N/A
Great Barrier Reef Marine Park	Not relevant	N/A
Wetlands protected by international treaty (the Ramsar Convention)	Not relevant	N/A
Nationally listed threatened species and ecological communities	Yes – Two threatened ecological community and 57 threatened species have the potential to occur at the site.	*Chapter 5 & Section 8.1 of BAR*
Nationally listed migratory species	Yes – 55 nationally listed migratory species have the potential to occur at the site.	*Chapter 5 & Section 8.1 of BAR*
All nuclear actions	Not relevant	N/A
Commonwealth Marine Areas	Not relevant	N/A
Water resource, in relation to coal seam gas development and large coal mining development.	Not relevant	N/A

Other protected matters include the:

- environment, where actions proposed are on, or will affect Commonwealth land and the environment; and
- environment where Commonwealth agencies are proposing to take an action.

The action is not being undertaken by a Commonwealth agency. Commonwealth land in the locality includes Australian Postal Commission, Australian Telecommunications Commission and Defence Services Homes Corporation. The Project is not located on Commonwealth land and there is no Commonwealth land likely to be affected.

Implications for the Project

The potential impact of the Project on threatened species, migratory species and Endangered Ecological Communities has been assessed, with discussion of the determination of highly unlikely adverse impacts provided in *Chapter 5* and the BAR in *Annex C* of this EIS. Therefore, Commonwealth approval under the provisions of the EPBC Act is not required.

3.3 STATE LEGISLATION

3.3.1 Environmental Planning and Assessment Act 1979

The relevant State planning legislation is the *Environmental Planning and Assessment Act 1979* (EP&A Act). The EP&A Act institutes a system of environmental planning and assessment within New South Wales and is administered by the Department of Planning and Environment (DP&E).

State Significant Development

The proposed increase in production at the Sancrox Quarry to 750,000tpa is classified as 'state significant development' under Schedule 1, Clause 7 of *State Environmental Planning Policy (State and Regional Development) 2011* , as the Project will result in the extraction of more than 500,000 tonnes of extractive materials per annum. The total resource available is based on quarrying operations within the existing quarry footprint to RL - 40m, and benched quarry walls is approximately 3,220,000 tonnes.

The Project will be assessed as State Significant Development (SSD) and will require development consent under Part 4, Division 4.1 of the EP&A Act. DP&E will be the determining authority.

Integrated Development

The development is also classified as 'integrated development' as it requires an environment protection licence (EPL) under *Section 48* of the *Protection of the Environment Operations Act 1997* (POEO Act).

Other Provisions

The EP&A Act is supplemented by the EP&A Regulation, as well as a suite of Environmental Planning Instruments (EPIs), namely Local Environmental Plans (LEPs) and State Environmental Planning Policies (SEPPs). The EPIs implemented under the EP&A Act that are considered relevant to the Project are:

- *State Environmental Planning Policy (Mining, Petroleum and Extractive Industries) 2007;*
- *State Environmental Planning Policy 33 – Hazardous and Offensive Development;*
- *State Environmental Planning Policy 44 – Koala Habitat Protection;*
- *State Environmental Planning Policy (State and Regional Development) 2011; and*
- *Port Macquarie – Hastings Local Environmental Plan 2011.*

These provisions are considered further in *Table 3.3*.

3.3.2 Biodiversity Conservation (Savings and Transitional) Regulation 2017

The NSW legislation regarding biodiversity transitioned on 25 August 2017 with the commencement of the *Biodiversity Conservation Act 2016* (BC Act). The BC Act is now required to be considered regarding biodiversity impact assessment for future development applications.

The *Biodiversity Conservation (Savings and Transitional) Regulation 2017* contains guidance and legislative clarity regarding how the transition to the new BC Act applies to projects which were in the process of assessment or at the point of development application submission during this transition period.

Relevant to this project, the *Biodiversity Conservation (Savings and Transitional) Regulation 2017* (Clause 27(1)(b)) defines a "pending or interim planning application" as:

"*an application for planning approval (or for the modification of a planning approval) made within 18 months after the commencement of the new Act if an environmental impact statement is to be submitted in connection with the application and the Secretary of the Department of Planning and Environment issued, before the commencement of the new Act, environmental assessment requirements for the preparation of the statement*"

Further, relating to the above provision, clause 28 (2) states:

"*For the purposes of paragraph (b) of the definition of pending or interim planning application in subclause (1), if the environmental assessment requirements referred to in that paragraph are re-issued, then the application is a pending planning application if the application is made within 18 months after the re-issue of the requirements (but only if the application is made within 3 years after the commencement of the new Act).*

Clause 28(1) states that:

"The former planning provisions continue to apply (and Part 7 of the new Act does not apply) to the determination of a pending or interim planning application."

Implications for the Project

The SEARs for the project were originally issued on 19 October 2015 and subsequently re-issued on 18 September 2017. The project meets the definition of a pending or interim planning application under the provisions of Cl 27 (1)(b) of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017.* As the SEARs have been re-issued, the provisions of Cl 28 (1) and Cl 28(2) provide a period of 18 months after the re-issue of the SEARs (ie 18 months after 18 September 2017) for the pending or interim planning application to be made utilising the provisions of the former planning provisions (ie *Threatened Species Conservation Act 1995)* and Framework for Biodiversity Assessment.

3.3.3 Protection of the Environment Operations Act 1997

The POEO Act establishes the NSW environmental regulatory framework and includes a licensing requirement for certain activities identified in *Schedule 1* of the Act. Section 48 of the POEO Act states that a licensing requirement applies for scheduled activities where Schedule 1 indicates that a licence is required at which the avidity is carried on.

Clause 16 of Schedule 1 of the POEO Act states:

> *(1) This clause applies to crushing, grinding or separating, meaning the processing of materials (including sand, gravel, rock or minerals, but not including waste of any description) by crushing, grinding or separating them into different sizes.*
>
> *(2) The activity to which this clause applies is declared to be a scheduled activity if it has a capacity to process more than 150 tonnes of materials per day or 30,000 tonnes of materials per year.*

Clause 19 of Schedule 1 of the POEO Act states:

> *"(1) This clause applies to the following activities:*
>
> *land-based extractive activity, meaning the extraction, processing or storage of extractive materials, either for sale or re-use, by means of excavation, blasting, tunnelling, quarrying or other such land-based methods.*
>
> *(3) Each activity referred to in Column 1 of the Table to this clause is declared to be a scheduled activity if it meets the criteria set out in Column 2 of that Table."*

Table 3.2 Schedule 1 Clause 19 - Extractive Activities Table (POEO ACT 1997)

Column 1	*Column 2*
Activity	***Criteria***
land-based extractive activity	*involves the extraction, processing or storage of more than 30,000 tonnes per year of extractive materials*

Implications for the Project

The Project is classified as a 'land-based extractive activity' and a crushing, grinding and separating operation. As the proposed increase in production at the Sancrox Quarry will involve the extraction and crushing/separating of more than 30,000 tpa, it is a scheduled activity and requires an EPL under Section 48 of the POEO Act.

The quarry currently operates under a premises-based EPL (EPL No. 5289) for "crushing, grinding or separation works" and "extractive industries". A variation to the EPL will be required as the Project will increase the production limit to 750,000 tpa.

3.3.4 Water Management Act 2000

The *Water Management Act 2000* (WMA) was introduced to provide a comprehensive singular piece of legislation to effectively manage and regulate access, and use of, the State's water resources. The objectives of the WMA include:

- to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and the water quality; and
- to recognise and foster the significant social and economic benefits to the state that result from the sustainable and efficient use of water.

The WMA also details activity approvals (permitting requirements) when an aquifer is penetrated or construction occurs within 40m of a watercourse.

Implications for the Project

Part 4 Division 4.7 Section 4.41 (1)(g) of the EP&A Act states that authorisations are not required should the Project be granted SSD approval, including:

a water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the Water Management Act 2000.

Therefore the Project is exempt under Part 4 Division 4.7 Section 4.41 (1) (g) of the EP&A Act for the need to obtain:

- a controlled activity permit;
- a water supply work approval;
- a drainage work approval;
- a flood work; or
- a water use approval.

An aquifer interference approval will however be required, given that the proposed extraction will intercept an aquifer.

3.3.5 Additional State Legislation Applicable to the Project

State legislation with a lower relative relevance to the Project are summarised in *Table 3.3*.

Table 3.3 Statutory Context

Legislation	Description and objectives of Act	Consideration and Assessment	Location in EIS
Water Act 1912	Regulates new water licences and the trade of water licences and allocations. *Section 10* of the *Water Act 1912* requires that: *(1) Any occupier of land whereon any work to which this Part extends (not being a joint water supply scheme) is constructed or used, or is proposed to be constructed or used, for the purpose of:* *(a) water conservation, irrigation, water supply or drainage, or* *(b) (Repealed)* *(c) changing the course of a river* *May apply to the Ministerial Corporation in the form prescribed for a licence to construct and use the said work, and to take and sue for the purposes specified in the application the water, if any, conserved or obtained thereby, and to dispose of such water for the use of occupiers of land for any purpose.*	In addition to Section 10 of the Water Act 1912, the NSW Aquifer Interference Policy (*Section 3.3.4*) specifies that a water licence is required irrespective of whether water is taken for consumptive use (i.e. for water supply purposes) or whether water is taken incidentally in the course of undertaking the activity. Aquifer interference activities taking water outside of Water Sharing Plan (WSP) areas require a license under the *Water Act 1912* and the water take estimation provided by the groundwater modelling (refer to *Chapter 8*) should be taken into consideration during the water licence application process. Hanson currently holds a Water Access Licence (WAL42524) for water supply works undertaken on site. The predicted water take of the quarry extension should be compared to the current licence allowance prior to submitting a request for a revised or new licence.	*Chapter 8 & Groundwater Assessment (Annex F)*
National Parks and Wildlife Act 1974	Guides the management of conservation areas as well as the protection of native vegetation, native fauna and Aboriginal objects across NSW. Under the Act, it is illegal to move, damage, deface or destroy a relic without written permission from the NSW Office of Environment and Heritage (OEH).	A Heritage Assessment has been prepared as part of this EIS which identified a potential Aboriginal scar tree identified in western side of the proposed expansion area which is likely to be impacted by the Project. Mitigation measures and alternatives have been recommended to avoid impacts where practicable.	*Chapter 6 & Heritage Assessment (Annex D)*

Legislation	Description and objectives of Act	Consideration and Assessment	Location in EIS
Rural Fires Act 1997	The main objectives of the *Rural Fires Act 1997* are to: • prevent, mitigate and suppress bush and other fires in NSW; • co-ordinate bushfire fighting and bushfire prevention throughout the State; • protect people from injury or death and property from damage and as a result of bushfires; and • protect the environment.	The Project would not impede the protection of any nearby buildings or infrastructure from bushfire. No subdivision is proposed as part of the Project and therefore there is no requirement for a bush fire safety authorisation from the Commissioner of the NSW Rural Fire Service.	*Chapter 15*
Native Vegetation Act 2003	The *Native Vegetation Act 2003* was repealed on 25 August 2017. Current legislation governing the clearing of native vegetation is the *Local Land Services Act 2013* and the *Biodiversity Conservation Act 2016*.	N/A, see the *Local Land Services Act 2013* summary below.	N/A, see the *Local Land Services Act 2013* summary below.
Biosecurity Act 2015	To reduce the negative impact of weeds on communities, the economy and the environment by establishing control mechanisms	The BAR discusses weed management methods.	*Chapter 5 & BAR (Annex C)*
Local Land Services Act 2013 (LLSA)	The NSW legislation regarding regulation of native vegetation clearing, within land that has been classified Rural, transitioned on 25 August 2017 with the commencement of the amended *Local Land Services Act 2013*. This Act's purpose includes the establishment of a Native Vegetation Panel responsible for approving native vegetation clearing that does not require development consent, or assessment under Part 5 of the EP&A Act.	As the Project requires development consent under Part 4 of the EP&A Act, any native vegetation clearing required for the proposed works will fall under the regulations set out in the BC Act.	*Chapter 5 & BAR (Annex C)*
Fisheries Management Act 1994	This Act aims to conserve threatened species, populations and ecological communities of fish and marine vegetation, and to promote biological diversity through ecologically sustainable development.	No threatened aquatic fauna was identified in Haydon's Creek which is located to the west of the proposed expansion area, and therefore further consideration under this Act is not required.	*Chapter 5 & BAR (Annex C)*

Legislation	Description and objectives of Act	Consideration and Assessment	Location in EIS
Heritage Act 1977	This Act aims to develop an understanding of and encourage conservation of State heritage by enabling the identification and registration of items of State heritage significance.	A Heritage Assessment has been prepared as part of this EIS which identified a potential Aboriginal scar tree identified in western side of the proposed expansion area which is likely to be impacted by the Project. Mitigation measures and alternatives have been recommended to avoid impacts where practicable.	*Chapter 6 & Heritage Assessment (Annex D)*
Threatened Species Conservation Act 1995	The *Threatened Species Conservation Act 1995* was repealed on 25 August 2017. Current legislation governing the threatened species conservation is the Biodiversity Conservation Act 2016.	See Biodiversity Conservation Act 2016 below.	See Biodiversity Conservation Act 2016 below.
State Environmental Planning Policies (SEPP)			
SEPP 33 – Hazardous and Offensive Development	Assesses the potential hazards associated with the proposed development by providing definitions and guidelines for: • Hazardous Industry; • Offensive Industry; • Hazardous storage establishment; and • Offensive storage establishment.	A preliminary risk screening assessment has been undertaken in accordance with the SEPP 33 for the Project. The findings of the assessment determined that the Project is considered unlikely to be potentially hazardous or offensive, and as such a Preliminary Hazard Analysis (PHA) has not been prepared nor warranted.	*Chapter 15*
SEPP 44 – Koala Habitat Protection	Aims to conserve and manage areas of natural vegetation that provide habitat for koalas to promote abundance of koalas throughout their current present range and to reverse the current trend of koala population decline.	Detailed flora and fauna investigations were undertaken as part of the BAR to determine the potential for 'potential' and 'core' koala habitat to exist throughout the Project area. SEPP 44 does not apply to projects that are being assessed as State Significant Developments, however SEPP 44 definitions for koala habitats have still been incorporated and assessed.	*Chapter 5 & BAR (Annex C)*

Legislation	Description and objectives of Act	Consideration and Assessment	Location in EIS
SEPP State and Regional Development 2011 (SEPP SRD)	Identifies development to which the SSD assessment and determination process under Division 4.1 in Part 4 of the EP&A Act applies.	Schedule 1 of the SEPP SRD identifies development for the purpose of extractive industry as State Significant when more than 500,000 tpa of resource is proposed to be extracted. This is the case for this Project, and as a result it is classified as SSD pursuant to Section 89C of the EP&A Act and declared as such by the SEPP SRD.	*This Chapter*
SEPP (Mining, Petroleum Production and Extractive Industries) 2007	The policy aims to provide for the proper management and development of mineral, petroleum and extractive material resources for the purpose of promoting the social and economic welfare of the State (among other aims)	Under Clause 7(3)(a) of this SEPP, the Project is permissible with consent as an extractive industry being carried out on land for the purposes of agriculture or industry (i.e. Primary Production in the PMHC LEP 2011). To meet the requirements of Clause 12 of the SEPP, this EIS identifies land zoning and adjacent land uses, provides a land resource assessment, assesses the environmental impacts of the Project and provides mitigation measures to manage them. Options for final rehabilitation are also provided.	*This Chapter, Chapter 9 & Chapter 17*

3.4 LOCAL AND REGIONAL PLANS

The local and regional plans, strategies and key sections of legislation relevant to the Project are discussed below.

3.4.1 North Coast Regional Plan 2036

The *North Coast Regional Plan 2036* (DP&E, 2017) has been prepared to guide the NSW Government's land use planning priorities and decisions to 2036, and provides an overarching framework to guide subsequent and more detailed land use plans, development proposals and infrastructure funding decisions.

3.4.2 Mid North Coast Regional Strategy 2031

By 2031 the population of the NSW Mid North Coast is predicted to grow by more than 28% to around 424,000. The purpose of the *Mid North Coast Regional Strategy 2031* is to ensure that the Mid North Coast can continue to prosper over the next 25 years while protecting areas of high environmental, cultural and resource value (DP&E, 2009).

The strategy aims to encourage and facilitate industry and employment opportunities within the region. The regional strategy also encourages the completion of the upgrade of the Pacific Highway which will lead to greater efficiency and safety for residents and visitors when travelling both intra and inter-regionally.

3.4.3 Port Macquarie – Hastings Local Environmental Plan 2011

The provisions of the *Port Macquarie – Hastings Local Environmental Plan 2011* (PMH LEP) apply to the Project.

The Sancrox Quarry site is zoned *RU1 Primary Production* under the PMH LEP. The objectives of the RU1 zone are:

- *To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.*
- *To encourage diversity in primary industry enterprises and systems appropriate for the area.*
- *To minimise the fragmentation and alienation of resource lands.*
- *To minimise conflict between land uses within this zone and land uses within adjoining zones.*

3.4.4 Urban Growth Management Strategy 2011-2031

The *Mid North Coast Regional Strategy* requires PMHC to prepare an Urban Growth Management Strategy (UGMS) which identifies growth areas and achieves regional outcomes and targets. The UGMS was adopted in December 2010, and approved by the NSW Department of Planning in May 2011. The purpose of the UGMS is to provide a sound strategic planning framework for residential, rural residential, retail, industrial and tourism development in the Port Macquarie-Hastings LGA to 2031.

3.4.5 Greater Sancrox Structure Plan 2014-2034

PMHC has prepared the *Greater Sancrox Structure Plan 2014-2034* to guide future development of land in the Greater Sancrox area. The plan is identified in the UGMS as a key objective to ensuring adequate land is made available to facilitate growth for urban/residential, rural-residential, employment/industrial and tourist development in the Port Macquarie-Hastings LGA to 2031 in a planned and sustainable manner.

3.4.6 Port Macquarie-Hastings Development Control Plan 2013

The Port Macquarie-Hastings Development Control Plan (DCP) provides guidelines for local development which enhances natural and cultural heritage values consistent with the local amenity. It applies to all land zoned under the PMH LEP and should be applied in conjunction with the EP&A Act and other SEPPs which may apply to the land to which the DCP applies.

This document outlines the structure planning process and identifies a preferred land use strategy for the study area.

3.4.7 Consideration of Project with Regional and Local Planning Provisions

The proposed increase in production at the quarry is consistent with the objectives of the PMH LEP RU1 zone. Extractive industries are permitted within the zone with development consent. It is therefore considered that the Project would not fragment or alienate any land or result in conflict with adjoining land uses. The Project would result in the employment of 25 additional staff members and result in positive local economic benefits.

The continued and additional supply of a valuable resources in the form of aggregate, concrete and asphalt to the local construction industry as well as a facility for recycling of a waste concrete will meet the strategic goals of boosting the local economy and providing the materials to allow for infrastructure and housing developments. The quarry is ideally located away from substantial residential development, and located directly adjacent to the recently upgraded Sancrox Interchange and Pacific Highway, allowing for safe distribution of materials to the surrounding region to facilitate strategic urban growth.

Department of Planning (2009). **Mid North Coast Regional Strategy**.

Geoscience Australia (2017) **Oil and Gas Pipelines of Australia**.

4 COMMUNITY AND STAKEHOLDER ENGAGEMENT

This chapter describes the development approval process used to involve the community and relevant government authorities in the proposed production increase.

4.1 GOVERNMENT AGENCY CONSULTATION

Consultation has been undertaken with numerous public authorities during the preparation of the EIS. The government agencies consulted as well as a summary of the consultation are provided in *Table 4.1*. All correspondence provided by ERM and responses received are provided in *Annex B* of this EIS.

Table 4.1 Government Agency Engagement Summary

Stakeholder	Correspondence Method	Issues raised by stakeholder	Response
Former Department of Planning and Environment (DPE); now the Department of Planning, Industry and Environment (DPI&E)	Correspondence provided on the 16 February 2018. ERM has engaged with the agency during the Soil and Land Resources Assessment and Groundwater Assessment.	Response received on 7 March 2018. Indicated that relevant items were provided in previous submission during preparation of SEARs and no additional items were required.	Previous submission received upon request for SEARS are addressed within this EIS
Office of Environment and Heritage (OEH)	Correspondence provided on the 14 February 2018.	Response received on 16 March 2018 with regards to Heritage. No additional issues raised. NSW OEH general correspondence did not receive a response.	No additional items raised, the EIS will address originally provided items with the submission provided with SEARs.
Environmental Protection Authority (EPA)	Correspondence provided on the 14 February 2018.	Response received on 5 March 2018. General statement about processing plant.	Assessment of and mitigation measures for processing plant have been included in the technical assessments (primarily the noise, and air quality, summarised in Section 10 and 11 respectively).
Department of Primary Industries	Correspondence provided on the 14 February 2018. ERM has engaged with the agency during Surface Water Assessment and Soil and Land Resources Assessment.	Response received on 3 April 2018. No issues raised.	No additional items raised, the EIS will address originally provided items with the submission provided with SEARs.
Roads and Maritime Services (RMS)	Correspondence provided on the 14 February 2018.	Response received on 8 March 2018. No issues raised.	No additional items raised, the EIS will address originally provided items with the submission provided with SEARs.
Port Macquarie Hastings Council	Correspondence provided on the 14 February 2018.	Response received on 16 February 2018. No issues raised.	No additional items raised, the EIS will address originally provided items with the submission provided with SEARs.

Stakeholder	Correspondence Method	Issues raised by stakeholder	Response
NSW Rural Fire Service	Correspondence provided on the 16 February 2018. ERM has engaged with them during preparation of the Hazard Assessment.	Response received on 22 February 2018. No issues raised.	No additional items raised, the EIS will address originally provided items with the submission provided with SEARs.
North Coast Local Land Services	Correspondence provided on the 16 February 2018. ERM has engaged with them during the Soil and Land Resources Assessment.	Followed up on the 3 April 2018. No issues raised.	No additional items raised, the EIS will address originally provided items with the submission provided with SEARs.

4.2 *LOCAL ABORIGINAL LAND COUNCIL CONSULTATION*

The development of the heritage assessment involved extensive consultation to develop with the Registered Aboriginal Parties (RAP), and ultimately included:

- Birpai Local Aboriginal Land Council;
- Birpai Traditional Owners;
- Yangaay; and
- Norm Archibald.

The extensive list of the consultation undertaken as part of the Heritage assessment aimed to keep indigenous communities and representatives informed and involved in the project. Consultation was undertaken from 4 September 2017 to 14 March 2018, with the full summary of consultation undertaken provided as Annex A of the Heritage Assessment (refer to *Annex C* of this EIS).

4.3 *COMMUNITY CONSULTATION*

Hanson have been proactive in consulting the community, including affected landowners, local businesses, industry and environmental groups and community associations throughout the proposed project. A summary of ongoing consultation with the community is provided in *Annex B* of this EIS.

Hanson contacted DPE (now DPI&E) to request the appointment of an Independent Chairperson and the formation of the Sancrox Quarry Extension Project Community Consultative Committee (SQEPCCC). On March 2 2018, Ms Lisa Andrews was appointed as the independent chairperson for the SQEPCCC. In accordance with the guidelines, Ms Lisa Andrews prepared advertisement for membership of the SQEPCCC, which was advertised within the local newspaper noting that applications are open for 28 days. Additionally Mr Simon Jones (Sancrox Quarry Manager) provided a copy of the advertisement via a letterbox drop along Sancrox Road and Fernbank Creek Road. Ms Lisa Andrews also wrote to Port Macquarie-Hastings Council, Birpai Local Aboriginal Land Council, Port Macquarie Chamber of Commerce and Residents Action Network Inc.

Following the closing date for advertisement on the 26 May 2018, Ms Lisa Andrews undertook membership interviews to complete the report to the Department of Planning and Environment including the assessment of all nominees against the selection criteria. On the 26 June 2018 the Department of Planning and Environment endorsed the committee members for the SQEPCCC.

The first SQEPCCC meeting was held on the 6 July 2018 at 11:00am with five of the seven members present for the meeting. Hanson representatives included:

- Andrew Driver;
- Jeremy Keefe;
- Simon Jones; and
- Belinda Pignone.

Two apologies were received from Tony Thorne and Jeff Gillespie.

4.3.1 Community Consultative Committee (CCC)

The SEARs require the establishment of a Community Consultative Committee for the project in accordance with the Community Consultative Committee Guidelines for State Significant Projects, and to consult with the committee during the preparation of the EIS.

Hanson was responsible for the community consultation for the project and developed the CCC. Details of the CCC members is outlined in *Table 4.2* below:

Table 4.2 Community Consultation Committee Meeting Member Details

Name	Membership Details
Lisa Andrews	Independent Chairperson
Maurice Driscoll	Community Representative
Maureen Churnside	Community Representative
Hilton King	Residents Action Network (RAN) stakeholder group Representative
Jeff Gillespie	Community Representative
John Cassegrain	Community Representative
Anthony Thorne	Port Macquarie Chamber of Commerce stakeholder group Representative
Geoff Freeman	Community Representative
	Council Representative
Simon Jones	Hanson, Sancrox Quarry Manager (person with direct responsibility for operational and environmental management)
Belinda Pignone	Hanson, Graduate Environment and Compliance Coordinator
Jeremy Keefe	Hanson, Area Manager
Andrew Driver	Hanson, Development Manager

Documents prepared for the CCC by the proponent are provided in *Annex B* of this EIS.

The dates of the CCC meetings and an outline of issues discussed are provided in *Table 4.3*.

Table 4.3 Community Consultation Committee Meetings

CCC meeting number	Dates	Outline of discussion topics
01	Friday 6 July, 2018	• Andrew Driver provided a description of the current project overview and proposed project overview – including concrete batching plant, asphalt plant and concrete recycling plant. • Complaints handling and the amount of complaints received in the past. • Environmental monitoring requirements for current and proposed project. • The type of materials that are produced at the current and proposed project. • Blasting procedure was described to CCC members. • The application process was described to CCC members.
02	During exhibition period	TBC

5 BIODIVERSITY

SLR Consulting Australia (SLR) was engaged by Hanson to prepare a Biodiversity Assessment Report (BAR) to inform the EIS for the Project.

The objective of the BAR was to meet the requirements of the SEARs and the NSW Office of Environment and Heritage (OEH) and undertake the assessment in accordance with the *Framework for Biodiversity Assessment* (FBA). It provides a detailed description of the ecological values of the Study Area, an assessment of potential impacts of the Project and recommended mitigation measures to minimise these impacts. This chapter provides a summary of the findings and recommendations of the BAR (SLR, 2019; refer to *Annex C* of this EIS).

It should be noted that this BAR assesses the original proposed quarry footprint area (as shown in *Figure 5.2*). The quarry footprint was decreased during the assessment phase by approximately three hectares (ha) in the north-western corner of the pit to avoid the mapped flood risk area. The assessment footprint was later increased to include noise attenuation structures (bunds) which conversely required an additional 1.26 ha of vegetation removal along the western margin of the site. As such, the offset credits derived from the assessment and proposed vegetation clearance are representative of the larger originally proposed quarry footprint. The reduction in the quarry footprint (by 1.94 ha in total) will ultimately reduce vegetation clearing, and as a result would reduce the offset credits, however Hanson have agreed to keep the original offset credit amount during the preparation of the Biodiversity Offset Strategy (BOS) and expansion of the Sancrox Quarry. Accordingly, the depiction of the quarry footprint and the vegetation zones described in this version of the BAR remain unchanged from the original version submitted with the EIS for adequacy review.

5.1 METHODOLOGY

5.1.1 Information Sources

The key information sources utilised in the assessment include:

- The OEH *Atlas of NSW Wildlife* for previous records of threatened species from the locality;
- The Protected Matters Search Tool for matters of national environment significance (as listed under the EPBC Act) predicted to occur within the locality;
- The Species Profile and Threats (SPRAT) Database , for detailed information on threatened species of relevance to the site and the locality;
- GIS data on Interim Biogeographic Regionalisation for Australia (IBRA) regions and Mitchell Landscapes;

- The BioBanking Credit Calculator, for lists of predicted ecosystem credit species and species credit species and for the Project credit requirements;
- Regional vegetation mapping, including GIS data that was utilised to prepare base vegetation maps and design field surveys;
- Data collected during field surveys; and
- Officers of OEH NSW Offsets Policy Team who provided assistance on particular matters relating to the FBA and the Credit Calculator.

Key documents that were reviewed and applied to inform this BAR include:

- Greater Sancrox Structure Plan 2014-2034 (PMHC 2015);
- Vegetation of the Port Macquarie Hastings LGA (Biolink 2013); and
- Greater Sancrox Ecological Assessment (Biolink 2011).

5.1.2 Methods Summary

The BAR was prepared according to the steps and processes detailed in the FBA, including the following key steps:

- Desktop review – database searches to identify listed threatened biota (species, populations and communities) of potential relevance to the Study Area; initial GIS mapping; survey design;
- Field survey of the Study Area (refer to Appendix B of the BAR (SLR, 2019) for details). The Study Area comprised Lot 2 DP574308 (the Project expansion), Lot 353 DP754434 (the existing quarry and proposed plant locations) and Lot 2 DP574308 (biodiversity Offset Site) to the north of the proposed expansion area (as shown in *Figure 1.1*);
- GIS mapping and data compilation;
- Using GIS and field survey results to complete the 'landscape assessment';
- Identification of vegetation zones and use of BioBanking plot/transect data and GIS mapping to assess 'site value';
- Applying the proposed development footprint in GIS to calculate vegetation removal;
- Application of the Credit Calculator, including identification of candidate threatened species and impact credit calculations; and
- Preparation of the BAR and BOS.

Annex C provides details of the field surveys, including methods, survey effort and weather conditions. The field surveys conducted as part of the BAR (SLR, 2019) are as follows:

- Targeted orchid survey on 16 October 2015, timed to coincide with the known flowering period of the threatened orchid *Dendrobium melaleucaphilum*. The track logs for the targeted survey are provided in the BAR in *Annex C*;
- Five-day, four-night survey for threatened fauna species conducted by two ecologists from 30 November to 4 December, 2015;
- Two-day survey by two ecologists to conduct plot/transect surveys according to the BioBanking methodology set out in the FBA; and
- One-night, one-day survey conducted by one ecologist between 14 and 15 December 2015, to address minimum recommended survey effort (when combined with the five-day four-night survey) for a selection of threatened species previously recorded in the locality.

The BAR (SLR, 2019) and associated fieldwork was undertaken by experienced ecological consultants. The Biobanking credit calculations were prepared by an experienced scientist, accredited under the Section 142B (1) (c) of the *Threatened Species Conservation Act 1995* (Biobanking accredited assessor #0107). Further details on the roles and qualifications of the ecologists responsible for undertaking the assessment and preparing the report has been provided in Section 1.7 of the BAR (SLR, 2019).

5.2 EXISTING ENVIRONMENT

The Study Area is a mosaic of forested areas, low-lying swampy terrain, cleared grazing land and areas of disturbance and infrastructure. The Study Area incorporates the existing quarry, with surrounding areas of cleared and disturbed terrain, open water in detention dams, roads and the buildings and infrastructure of the quarry administration centre. West of the existing pit, where the quarry expansion is proposed, lies a tract of bushland that extends over an elevated hill rising to 62 m above sea level. Further west, open grassland is interspersed with scattered trees across low-lying terrain that drains to the northwest. The Study Area and proposed clearing footprint are outlined in *Figure 5.1* below.

Several hundred metres (m) further northwest lies the Hastings River, which eventually drains to the coast at Port Macquarie several kilometres (km) east of the Study Area. The cleared grassy areas in the western parts of the Study Area are used for cattle grazing.

Similarly, in the north western parts of the Study Area (including the northern parts of Lot 2, which is proposed to set aside as a biodiversity offset) the land has been cleared and supports cattle grazing over grasslands. Adjoining these cleared grassy areas to the east are stands of swamp forest and paperbark swamp forest. Section 7.8 of the BAR (SLR, 2019) contains further details on the nature and condition of the proposed Offset Site.

5.2.1 Vegetation

Plant community types (PCTs) were mapped across the Study Area during the field survey, using vegetation mapping of the Port Macquarie-Hastings LGA as a base map. Three broad vegetation types mapped within the Study Area recorded in the site include:

- Flax-leaved Paperbark - Mixed Eucalypt Coastal Floodplain Wetlands Forest Complex;
- Spotted Gum Grassy Dry Forest; and
- White Stringybark - Tallowwood - Grey Gum Dry Forest.

Using the online NSW Vegetation Information System (VIS) database, these communities were converted into PCTs, as outlined in *Table 5.1*.

Table 5.1 Conversion of Council mapping units to PCTs

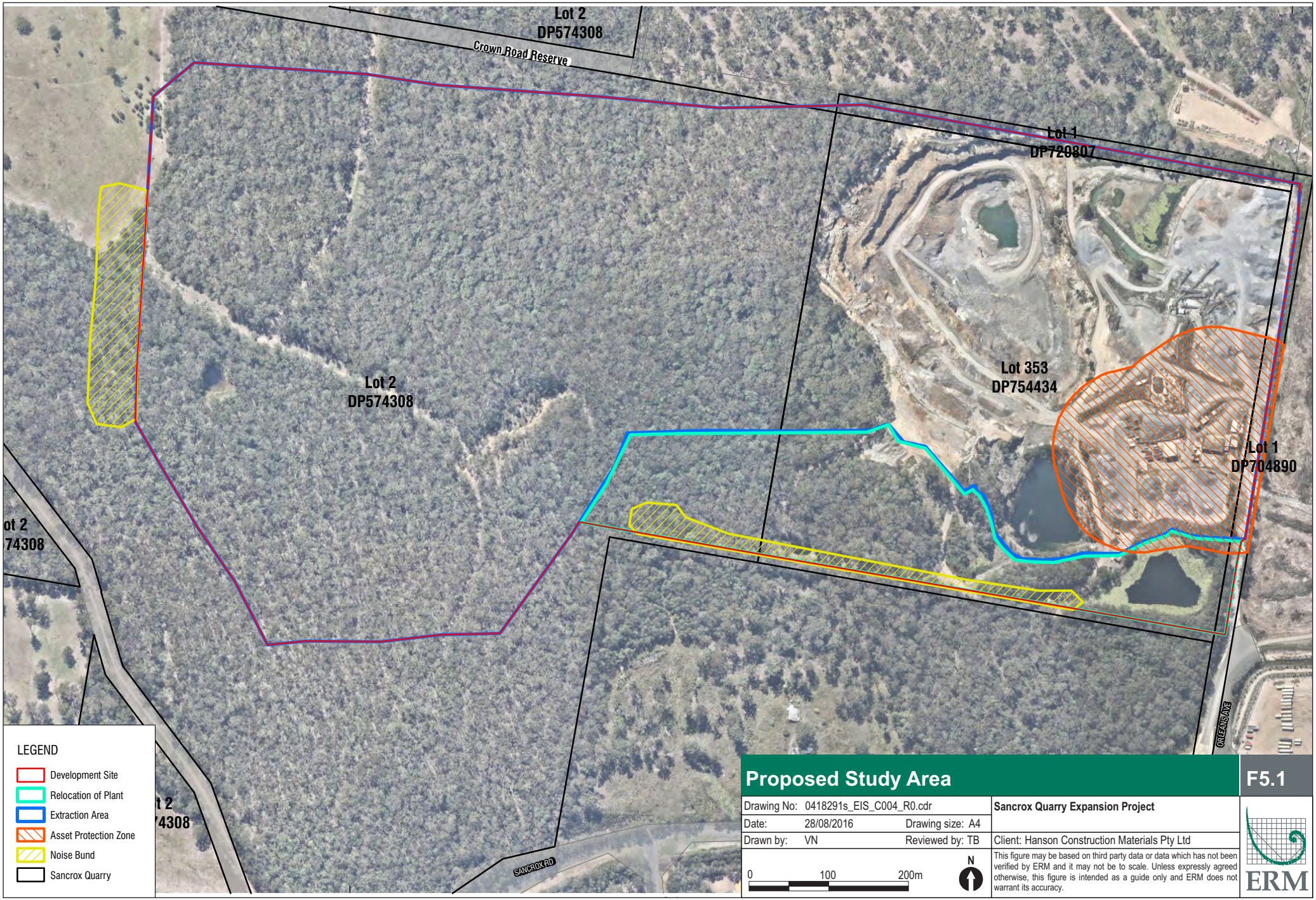
Council Vegetation Type	PCT ID No.	PCT Name
Flax-leaved Paperbark - Mixed Eucalypt Coastal Floodplain Wetlands Forest Complex	686	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion
Spotted Gum Grassy Dry Forest	1215	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
White Stringybark - Tallowwood - Grey Gum Dry Forest	1262	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast

Table 5.2 lists the vegetation formation and vegetation class associated with each PCT mapped within the Study Area.

Table 5.2 Formations, classes and PCTs mapped within the Study Area

Vegetation Formation	Vegetation Class	PCT Name	Area (ha)
Forested Wetlands	Coastal Floodplain Wetlands	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	0.6
Dry Sclerophyll Forests	Hunter - Macleay Dry Sclerophyll Forests	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	11.0
Dry Sclerophyll Forests	North Coast Dry Sclerophyll Forests	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	31.0
		Total Native Vegetation	**42.6**

The conversion, along with additional information about the mapped PCTs is provided in Section 3 of the BAR (SLR, 2019).


Lot 2
DP574308
Crown Road Reserve
Lot 1
DP720807
Lot 2
DP574308
Lot 353
DP754434
Lot 1
DP704890
ot 2
74308
t 2
4308
SANCROX RD
ORLEANS AVE
LEGEND
Development Site
Relocation of Plant
Extraction Area
Asset Protection Zone
Noise Bund
Sancrox Quarry
Proposed Study Area
F5.1
Drawing No: 0418291s_EIS_C004_R0.cdr
Sancrox Quarry Expansion Project
Date: 28/08/2016
Drawing size: A4
Drawn by: VN
Reviewed by: TB
Client: Hanson Construction Materials Pty Ltd
0
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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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5.3 ASSESSMENT

5.3.1 Summary of Impacts

Biodiversity impacts associated with the Project have been divided into direct and indirect impacts, in accordance with the FBA.

Direct Impacts

Direct impacts to biodiversity values are described within the FBA as… '*An impact on biodiversity values that is a direct result of vegetation clearance from a development*'. The final development footprint will involve the following direct impacts to biodiversity:

- Clearing of 43.1 ha of native forest vegetation, which includes 0.55 ha of the *Subtropical coastal floodplain forest* threatened ecological community (TEC);
- Loss of hollow-bearing trees, some of which may provide potential roost sites and breeding habitat for a selection of bird, arboreal mammal, reptile and microchiropteran bat species; and
- Removal of foraging habitat for locally occurring native fauna, in particular for threatened microchiropteran bats species, ground mammals, arboreal mammals and a range of bird species.

Impacts to Native Vegetation

All native vegetation within the development footprint will be removed. The total area of vegetation removal required for construction and operation of the proposal is 43.1 ha, which represents 71 percent (%) of the development footprint. These areas of native vegetation will be replaced with permanent infrastructure for the proposed quarry, and therefore impacts on native vegetation (and associated habitats) would be permanent. *Figure 5*.2 shows the proposed impacts on native vegetation zones within the site, which is described in *Table 5.3* below.

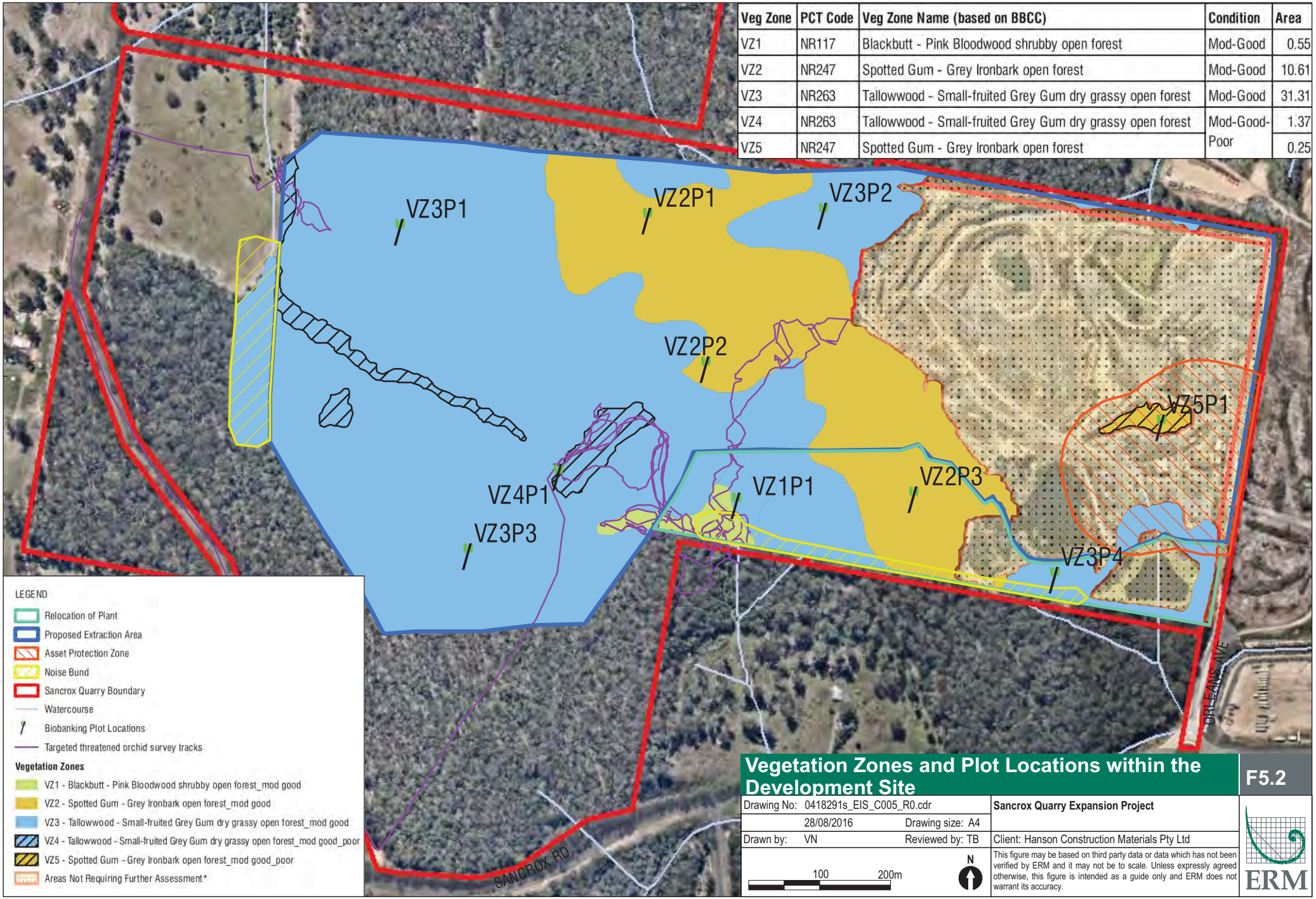
Table 5.3 Native vegetation impacts

Vegetation Type	Condition	Area of Clearing (ha)
Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion[1]	Good/Mod	0.55
Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	Good/Mod	10.61
Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	Good/Mod	30.32
Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	Good/Mod_Poor	1.37
Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	Good/Mod_Poor	0.25
	TOTAL	**43.1**

[1] This vegetation type is a form of the threatened ecological community (TEC) *Subtropical coastal floodplain forest*, which is listed as endangered under Schedule 1 (Part 3) of the TSC Act.

Impacts to Fauna and Habitat

The removal of vegetation as discussed above, will have direct impacts to local fauna, with the loss of hollow-bearing trees, which may provide roost sites and breeding habitat for a selection of bird, arboreal mammal, reptile and microchiropteran bat species. In addition, there are direct impacts caused through the removal of foraging habitat for locally occurring native fauna, in particular for threatened microchiropteran bats species, ground mammals, arboreal mammals and a range of bird species.



Veg Zone	PCT Code	Veg Zone Name (based on BBCC)	Condition	Area
VZ1	NR117	Blackbutt - Pink Bloodwood shrubby open forest	Mod-Good	0.55
VZ2	NR247	Spotted Gum - Grey Ironbark open forest	Mod-Good	10.61
VZ3	NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest	Mod-Good	31.31
VZ4	NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest	Mod-Good-Poor	1.37
VZ5	NR247	Spotted Gum - Grey Ironbark open forest		0.25

Vegetation Zones and Plot Locations within the Development Site

F5.2

Drawing No: 0418291s_EIS_C005_R0.cdr		Sancrox Quarry Expansion Project
28/08/2016	Drawing size: A4	
Drawn by: VN	Reviewed by: TB	Client: Hanson Construction Materials Pty Ltd

100 200m

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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

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Indirect Impacts

The FBA describes indirect impacts as: '… *development related activities [that] affect threatened species, threatened species habitat, populations or ecological communities in a manner other than direct impact'*. Indirect impacts in relation to the proposed development include:

- Potential for sedimentation and run-off to occur during construction and operation of the quarry and associated infrastructure. These are to be managed using appropriate sediment and erosion control measures and in accordance with an engineered stormwater management system (see *Chapter 7, 9* and *18*).

- There is some potential for animal strike (particularly macropods and birds) by increased traffic across the site. The speed limit will be reduced to 40 km/hr along the access road as animal strike is less likely at these speeds.

- Deposition of dust on vegetation adjoining the quarry, leading to reduced plant health and foraging quality for local native fauna.

- An increased presence of weeds is a possibility across the site. Weed management is to be integrated into the construction and operational management measures. Vehicle wash down is proposed and implementation of property maintenance will reduce the likelihood of weeds entering retained or adjacent areas of native vegetation.

- Rubbish and pollution may enter the site from staff or during the general day-to-day operation of the facility. To reduce the likelihood of waste entering the environment, all waste materials from the facility are proposed to be collected and transported off site for disposal or distribution. Skip bins will be provided and regularly maintained for other general waste.

Impacts Requiring Offsets

According to Section 9.3 of the FBA, impacts on native vegetation that require an offset include:

- Impacts on endangered ecological communities (EECs) and critically endangered ecological communities (CEECs), unless specifically nominated in the SEARs as an impact requiring further consideration; and

- Impacts on PCTs associated with threatened species habitat and in a vegetation zone that has a site value score of >= 17.

All vegetation zones mapped within the site have current site value scores of over 17 (refer to Section 6.5.1 of the BAR (SLR, 2019)) and represent habitat for at least one threatened species; hence, any clearing in these vegetation zones would require an offset. The PCTs requiring offset and the corresponding number of ecosystem credits required are listed in *Table 5.4* below.

Table 5.4 PCTs requiring offsets and credits required

PCT Code	PCT Name	TEC	Clearing Area (ha)	Credits Required
686	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion (NR117)	Yes	0.55	33
1215	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion (NR247)	No	10.86	490
1262	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast (NR263)	No	30.32	1926
		Total	**41.73**	**2449**

Additional information in regards to the application of Biobanking credits and the Credit Report for associated development impacts is provided in Sections 6.5 and 6.6, and Appendix I of the BAR (SLR, 2019).

In the attachments to the SEARs (see Appendix A of the BAR), OEH identify impacts that require further consideration. OEH states "Impacts on the following species, populations and ecological communities will require further consideration and provision of the information specified in s.9.2 of the FBA:

- Biconvex Paperbark (*Melaleuca biconvexa*);
- Spider Orchid (*Dendrobium melaleucaphilum*); and
- Southern Swamp Orchid (*Phaius australis*)."

No evidence for the threatened plant species provided above was recorded during field surveys undertaken as part of the BAR (SLR, 2019). It is noted that targeted searches for threatened plants were conducted across the site on several occasions during 2015 and 2016, including during the known flowering period of the two orchid species and no individuals of these species were recorded.

Section 6.4 of the BAR (SLR, 2019) provides additional information in regards to impacts requiring further consideration.

The results of the assessments determined that a biodiversity offset was required in accordance with the FBA and the *NSW Biodiversity Offsets Policy for Major Projects* (the 'Offsets Policy', NSW Government and OEH 2014). Additionally, a BOS is required to set out how the proponent intends to fulfil the project's offset requirement and is to be submitted to the Department of Planning & Environment with the project application, in accordance with the Offsets Policy.

Preferred Offset Strategy

The preferred offsetting option for the proposed development is a combination of the offset options provided in Section 7.3 of the BAR (SLR, 2019), being:

Ecosystem credits:

- Generate available ecosystem credits from the proposed Offset Site – create a Stewardship Agreement over the Offset Site in consultation with OEH. This action will only provide some of the ecosystem credits required – most of the ecosystem credits required will need to be purchased.

- Purchase like-for-like ecosystem credits from Credit Register (or approach potential credit sellers through the Expressions of Interest register).

- Purchase 'variation credits' by applying the variation rules under the FBA, in the scenario that like-for-like credit cannot be found after completing "reasonable steps". In this regard, an Expression of Interest for the required ecosystem credits will be published on the OEH BioBanking 'Credits Wanted' register.

- Pay the monetary value of the remaining credit obligation into the Biodiversity Conservation Fund (BCF).

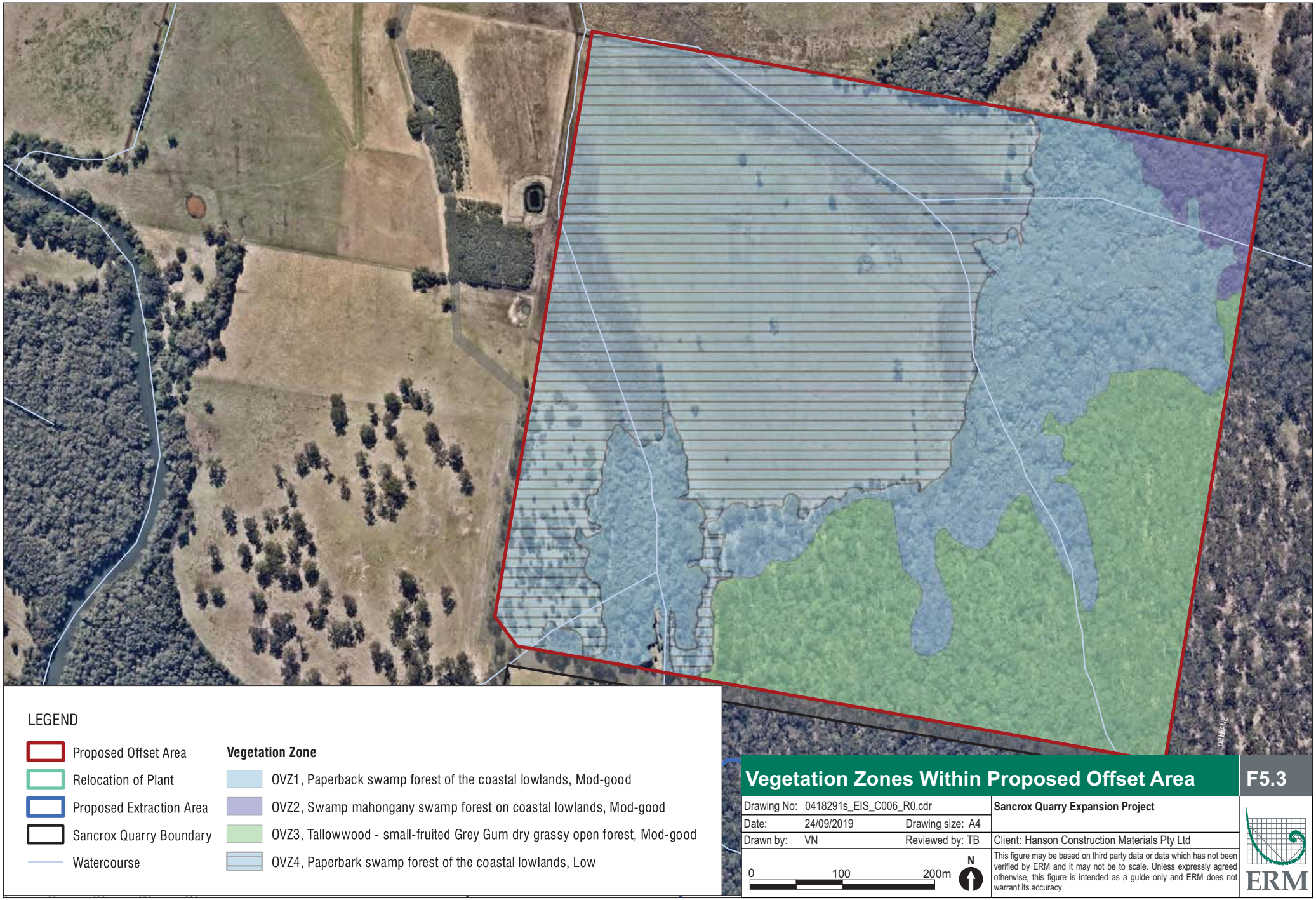
Species credits:

- No species credits required.

Proposed Offset Site

The proposed Offset Site is the northern portion of Lot DP 574308. The site is located immediately north of the proposed quarry expansion area, is approximately 49 ha and occupies low lying land containing swampy vegetation types and open cleared grassland that is used for cattle grazing, as outlined in Figure 12 of the BAR (reproduced as *Figure 5.3* below).

Table 5.5 below outlines the estimated credits calculated for the proposed Offset Site. It should be noted that the ecosystem credit estimates for the Offset Site will need to be re-calculated according to the *Biodiversity Assessment Method 2017* (BAM), including preparation of a Biodiversity Stewardship Site Assessment Report (BSSAR) to allow creation of a Stewardship Site and the associated credits. Additional information is provided in Section 7 of the BAR (SLR, 2019).


LEGEND
Proposed Offset Area
Relocation of Plant
Proposed Extraction Area
Sancrox Quarry Boundary
Watercourse
Vegetation Zone
OVZ1, Paperback swamp forest of the coastal lowlands, Mod-good
OVZ2, Swamp mahongany swamp forest on coastal lowlands, Mod-good
OVZ3, Tallowwood - small-fruited Grey Gum dry grassy open forest, Mod-good
OVZ4, Paperbark swamp forest of the coastal lowlands, Low
ORTHOMAP
Vegetation Zones Within Proposed Offset Area
F5.3
Drawing No: 0418291s_EIS_C006_R0.cdr
Date: 24/09/2019
Drawing size: A4
Drawn by: VN
Reviewed by: TB
Sancrox Quarry Expansion Project
Client: Hanson Construction Materials Pty Ltd
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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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Table 5.5 Ecosystem credits created in the proposed Offset Site

PCT	Biometric Code	Vegetation type name	BBAM[1] Credits Created
1064	NR217	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	353
1230	NR254	Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	14
1548	NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	135
		Total	**502**

[1] *BioBanking Assessment Methodology 2014* (BBAM)

A comparison of the ecosystem credits required for offsetting the proposed development and those potentially available in the Offset Site is provided in *Table 5.6* below.

Table 5.6 Ecosystem credit balance – credits required vs credits generated in offset

Biometric Code	Vegetation Type Name	FBA Credits Required	Credits in Offset	Remaining Credits to purchase
NR117	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	33	0	33
NR247	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	490	0	490
NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	1926	135	1791
NR254	Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	0	14	0
NR217	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	0	353	0
	Total	**2449**	**502**	**2314**

The ecosystem credits that form the offset obligation for the proposed development would either be sourced from the Offset Site or purchased from the BioBanking Credit Register (if available), with remainder converted into a monetary value using the Biodiversity Offset Payment Calculator (BOPC) and that value paid into the BCF. As the number and type of credits that will be available for purchase from the credit register following development approval is not known, the final payment into the Fund will be determined at the completion of the Expression of Interest (EOI) period.

No species credits are required for offsetting the proposed development. It is important to note that targeted threatened species surveys have not been conducted in the proposed Offset Site; however, given the habitats and vegetation type present, it is likely that a range of threatened species could be present in the Offset Site. Hence, the Offset Site is likely to generate species credit, although this will need to be confirmed through targeted surveys (during the appropriate season) as part of any future Stewardship Agreement application. For the purposes of the BOS, the number of species credits available in the Offset Site is presumed to be zero.

Impacts on Relevant Matters of NES

Taking into consideration all stages and components of the proposal, and all related activities and infrastructure, there is the potential for impacts, including indirect impacts, on matters of national environmental significance, being mainly loss of a potential foraging habitat for mobile threatened fauna species, including birds, bats and mammals. It is unlikely that any such species will be adversely impacted as a result of the proposed development, as:

- Suitable breeding habitat for most of the species is absent within the Study Area;
- The Study Area is not assessed as likely to contain habitat critical to the survival of a species;
- The Study Area is not likely to support an 'important population' (DoE, 2013) of any threatened species; and
- The proposed mitigation measures will mitigate or reduce impacts on threatened species.

Migratory Species

With regards to the terrestrial migratory species, the forested and open areas of the site represent potential foraging habitat. It is theoretically possible that these highly mobile species could utilise the subject temporarily during foraging, dispersal or migration. Conversely, the Study Area constitutes only a relatively small proportion of the large ranges of these species and does not contain breeding habitat for these species.

With reference to the criteria for migratory species in the *Significant Impact Guidelines 1.1*, the Study Area does not contain an area of 'important habitat' for any migratory species. Furthermore, the proposal is highly unlikely to disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

5.4 MITIGATION MEASURES

A selection of best management practices and mitigation measures will be implemented as part of the proposed development to prevent, minimise and/or manage the potential for adverse impacts upon the local environment and surrounding populace (SLR, 2019).

A site-specific Operational Environmental Management Plan (EMP) will be prepared for the Project to ensure that the commitments made within this EIS, along with relevant statutory obligations and the conditions of development consent (including Environment Protection Licence (EPL) requirements), are fully implemented and complied with (SLR, 2019). Additionally, a Landscaping Strategy will be prepared and implemented to screen the development from neighbouring landholders and generally improve the visual and environmental amenity of the development site (SLR, 2019).

On-site mitigation measures to reduce direct and indirect impacts prior to, during and after construction measures are outlined in *Table 5.7* below.

Table 5.7 – Proposed mitigation measures to be implemented prior, during and post-construction.

Action	Outcome	Timing	Responsibility
Prior to Construction			
Pre-clearance surveys.	Fauna residing within or occupying the expansion area are safely and ethically salvaged and relocated.	Prior to tree felling or other related works.	Project Ecologist.
Protection of native vegetation.	Delineate quarry expansion limit (to ensure no native vegetation outside expansion area is cleared).	Prior to and for the duration of any works.	Construction contractor.
Erosion and sediment control measures.	Install and maintain erosion and sediment control measures in accordance with the requirements of the 'Blue Book' (Landcom 2004).	Prior to and for the duration of any works.	Construction Contractor.
During Construction			
Fauna management.	Supervision of tree felling to rescue and recover any fauna (as necessary).	During clearing.	Project Ecologist.
Weed management.	• Vehicle wash-down • Site weed control program • Prepare weed control plan	Prior to and for the duration of any works.	Project Ecologist.
Rubbish management.	Rubbish (such as food scraps and building waste) are to be properly managed during construction and must not be stockpiled on areas of native vegetation.	Ongoing.	Construction team.
Exposed soil surface management.	Revegetation – re-use topsoil and seeding of pasture grasses and legumes (or as directed in relevant revegetation guidelines or management plans).	Immediately following soil disturbances.	Construction team.
Traffic management.	• Speed limits of 40 km/hr (or less if lower speed limit imposed in other environmental assessments) to be imposed within site, reducing the likelihood of animal strikes. • Educate workers on possibility of animal strike through construction management program.	Ongoing.	Construction team.
Revegetation	Design and implement a planting plan for corridor of native vegetation east and west of proposed quarry pit, to maintain north-south corridor link of canopy trees, as per sub-regional corridor in Greater Sancrox Structure Plan (PMHC 2015).	During Construction.	Proponent (with assistance from Project Ecologist).

Action	Outcome	Timing	Responsibility
Post-Construction			
Traffic management.	Speed limits of 40 km/hr (or less if lower speed limit imposed in other environmental assessments) are proposed, reducing the likelihood of animal strikes.	Ongoing.	Site operator.
Weed Management.	Limit spread of weeds in accordance to the methods provided throughout the landscape maintenance program and weed control plan.	Ongoing, half-yearly minimum.	Site operator.
Increased artificial light.	Each luminaire will be aimed downwards and only switched on during loading-unloading and servicing activities outside of daylight hours and during heavy fog.	Ongoing.	Site operator.
Waste management.	Appropriate systems will be implemented to ensure that each waste stream generated by the development is effectively managed and/or disposed of off-site (see *Chapter 16*). There will not be any on-site stockpiling or disposal of waste materials.	Ongoing.	Site operator.
Revegetation.	Maintain and monitor plantings within proposed native vegetation corridors east and west of quarry pit.	Post-construction and throughout operational life of quarry.	Proponent (with assistance from the Project Ecologist).
Surface water and run-off	An engineered surface water drainage and management strategy is to be prepared and implemented. Techniques currently proposed to manage stormwater include bunding walls, swales, underground water capture systems and dams (see *Chapter 7*).	Ongoing.	Site operator.

Source: SLR (2019) Biodiversity Assessment Report (BAR)

5.5 CONCLUSION

The results of the BAR (SLR, 2019) suggest that there will be impacts to biodiversity (mainly in the form of vegetation and habitat removal) as a result of the proposed development. However, the BOS prepared for the proposed development proposes to offset approximately 42 ha of native vegetation by investing in a nearby parcel of land (creating an estimated 502 ecosystem credits), with the remainder of the ecosystem credits being purchased in due course.

Mitigation measures are provided in *Section 5 (*and within the BAR (SLR, 2019)), to manage and offset impacts to biodiversity within the 'expanded' Sancrox Quarry and surrounding areas.

REFERENCES

DoE (2013) **Matters of National Environmental Significance**. **Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999**. Department of the Environment, Canberra, ACT.

NSW Government and OEH (2014) **Framework for Biodiversity Assessment. NSW Biodiversity Offsets Policy for Major Projects.** NSW Office of Environment and Heritage, Sydney.

NSW Government and OEH (2014b). **NSW Biodiversity Offsets Policy for Major Projects**. NSW Office of Environment and Heritage, Sydney.

PMHC (2015) **Greater Sancrox Structure Plan 2014-2034**. Port Macquarie-Hastings Council, Port Macquarie.

SLR, (2019) **Biodiversity Assessment Report. Sancrox Quarry Extension Project (SSD 7293)**. Prepared for: Hanson Heidelberg Cement Group.

6 HERITAGE ASSESSMENT

ERM was engaged by Hanson to undertake a Heritage Assessment to inform the EIS for the Project, which considered both Aboriginal and non-Aboriginal historic heritage values.

The objective of the Heritage Assessment was to meet the requirements of the SEARs, The Heritage Council of NSW and the NSW Office of Environment and Heritage. It provides a combined assessment of the tangible and intangible heritage values relating to the Project site, as identified during desk based assessment and field surveys undertaken in November 2017. This chapter provides a summary of the findings and recommendations of the Heritage Assessment (ERM, 2018a; refer to *Annex D* of this EIS).

6.1 METHODOLOGY

The assessment was undertaken using desktop analysis, archival research, field survey and Aboriginal stakeholder consultation. In addition to fulfilling relevant legislative requirements, the assessment was undertaken in accordance with the following guidelines:

- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011);
- The Burra Charter (Australia ICOMOS 2013);
- *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW 2010) (Consultation Guidelines);
- *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (DECCW 2010); and
- *Code of practice for archaeological investigation of Aboriginal objects in NSW* (DECCW 2010).

Searches of the local and state heritage registers were conducted in order to identify any historic heritage sites located within the Project site. A search of the Aboriginal Heritage Information Management System (AHIMS) site register was also conducted, to determine the location of any Aboriginal heritage sites within or surrounding the Project site.

Aboriginal Stakeholder consultation was undertaken in accordance with the Consultation Guidelines. Registration of interest in the Project was sought through public advertisement and provision of letters to relevant agencies and interested stakeholder groups. Four Aboriginal parties registered interest in the Project, including the Birpai Local Aboriginal Land Council (BLALC). Further information regarding the consultation process can be found in Chapter 3 and Annex A of the Heritage Assessment (ERM, 2018a).

The field survey was undertaken on Wednesday 15 November and Thursday 16 November 2017, by ERM Heritage Consultant Katherine Deverson and Jason Holten (representative of BLALC and Birpai Traditional Owners Indigenous Corporation). The survey focused on the identification of heritage values relating to archaeological sites, although discussion also included Aboriginal intangible values and the importance of Aboriginal sites to the local community.

6.2 *EXISTING ENVIRONMENT*

Interactions between people and their surroundings are of integral importance in both the initial formation and the subsequent preservation of the archaeological record. The nature and availability of resources, including water, flora, fauna, and stone materials had (and continues to have) a significant influence over the way in which people use the landscape. The following sections provide a brief description of the geology, topography and landscape, and flora and fauna resources of the Project site as it relates to potential heritage values only.

6.2.1 *Environmental Context*

The availability of water has significant implications for the range of resources present and the suitability of an area for human occupation. The Project site is bordered to the north and west by the alluvial flood plains of the Hastings River and Haydon's Creek. These riparian/wetland habitats would have provided food for Indigenous communities and predators such as snakes and lizards. Both the Hastings River and Haydon's Creek would have provided abundant aquatic resources and the woodland habitats of the Project site would have supported a rich and diverse resource base.

The Project site has been subject to significant land disturbances, most dramatically as a result of the hard rock quarrying. Farm dams, stock yards and abandoned farm machinery scattered within isolated clearings through the Project site provide further evidence of previous land use disturbance and indicates that much of the evidence of Aboriginal land use and occupation would no longer be visible. Few trees of suitable age to bear cultural scars remain within the Project site.

6.2.2 *Local Historic Context*

While much of the Port Macquarie hinterland was appropriated by European settlers during the first half of the 19th Century, based on the literature reviewed in the preparation of the assessment, the Project site itself experienced very little historical development. The closest historic site reported by GHD (2010) were eight hand cut sandstone kerb stones, although their original location and context were not known. Based on a review of parish maps and the historical context of the area, it is considered unlikely that relics or additional sites of historical significance will be located within the Project site.

6.2.3 Local Aboriginal Archaeological Context

A number of archaeological investigations have been conducted in the Port Macquarie region over the last twenty years, including the current Project site. The available studies give a broad picture of the wider cultural landscape and the site types, frequencies and distribution patterns that have contributed to the current understanding of the archaeological record in the region. Studies most relevant to the Project are considered in the Heritage Assessment (ERM, 2018a; refer to *Annex D* of this EIS).

A search of the AHIMS register was conducted prior to the field survey. This search identified that 92 registered sites are located within a 10 square kilometre area, although none have been recorded within the Project site itself. The numbers of recorded sites by site type are provided in *Table 6.1* and their locations are shown *Figure 6.1*.

Table 6.1 - Results from AHIMS Search - Count by Site Types

Site Types	Number of Sites	Percentage
Restricted	4	5%
Isolated Artefact	23	28%
Middens	1	1.5%
Artefacts with Potential Archaeological Deposit	4	5%
Open Camp Site	47	56%
Stone Quarry	1	1.5%
TRE (Scarred or Carved Tree)	3	3%
Total	83	100%

In summary, and as noted by Collins (1995) Area 13, which includes the current Project site, is on the whole very well-watered, with all parts of it being within easy walking distance of a potential water source. Access to fresh water is reported to be important for site placement, with no cultural materials being detected further than 350 m from either a perennial or seasonal water source. It has been reported that a ceremonial ground once existed within the Project site and it is thought to have occupied the hill crest now being worked by the quarry. Aboriginal informants were told of the site many years ago by elderly European residents who described hearing the music and chanting and seeing the many large campfires (Collins 1995 and Appleton 1996). No evidence to support the existence of a ceremonial site has been found during any of the previous archaeological studies although it is noted that any such evidence would have been removed during the removal of overburden at the site.


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
Bittrow 1
Bittrow 2
Bittrow 3
Bittrow 4
Bittrow 5
Bittrow 6
Bocal 1
Bocal 2
Bullii 1
Thrumster Sewerage 1
Thrumster PAD 1
Carkon 1
Carkon 4
Carkon 2
Carkon 3
Wirrer 2
Wirrer 3
Wirrer 4
Wirrer 1
Wattoo 3
Wattoo 2
Wattoo 1
Watoo 7
Watoo 9
Brettar 5
Brettar 7
Brettar 3
Brettar 2
Brettar 6
Brettar 4
Brettar 1
Legend
AHIMS
Site Boundary
Source: Near Map 2017, Office of Environment and Heritage
AHIMS Search Results
F6.1
Drawing No: 0418291s_EIS_G009_R0.mxd
Sancrox Quarry Expansion Project
Date: 12/12/2017
Drawing Size: A4
Drawn By: VN
Reviewed By: SDL
Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56
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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

6.3 ASSESSMENT

The following provides a summary of the results of the field survey, an outline of the significance assessment undertaken for identified heritage values, and a summary of the impacts to identified cultural heritage within the Project site. For additional information, please refer to Chapters 6 and 7 of the Heritage Assessment in *Annex D*.

6.3.1 *Field Survey Results*

The conditions encountered in the Project site during the fieldwork resulted in limited ground surface visibility due to leaf litter, which defined the opportunistic nature of the field survey. Observations were recorded using digital photography, GPS recording, as well as written field notes.

Historic heritage

Based on the desktop assessment, any surviving sites and features of non-Indigenous cultural heritage value within the Project site would be limited to portable domestic and rural artefacts, or features associated with grazing and timber extraction activities. This was confirmed during the field survey with abandoned farm machinery, stock yards and isolated clearings noted throughout. Brick piers and timber floor bracing was also recorded within the Project site and is likely to represent an abandoned farm house. These items are not of any local heritage significance and cannot be attributed to any notable local figures. They do not show any evidence of or provide additional information on the early settlement of the Sancrox area.

Photograph 1 - Evidence of previous land use and farming activities approx. 750 m north-west of current quarry (ERM 2018)

Photograph 2 - Evidence of previous land use - brick piers and timber floor bracing (ERM 2018)

Aboriginal cultural heritage

The archaeological survey did not result in the identification or recording of Aboriginal archaeological or cultural sites within the proposed extraction area, except for one potential scar tree located to the north of a small farm dam at the western extent.

The tree is located approximately 3 m from the edge of a cleared track. The scar is symmetrical, extending from the ground to 3.5 m in height. No Potential Archaeological Deposit (PAD) was recorded in association with the tree. No tool marks were noted, although the tree is of sufficient age to bear an Aboriginal scar (refer to *Photograph 3 and 4*).

Photograph 3 - Potential Aboriginal scarred tree at the western extent of the proposed extraction area. The origin of the scar is difficult to determine based on the damage from recent fires (ERM 2018)

Photograph 4 - Potential Aboriginal scarred tree noted at the western extent of the proposed extraction area. The tree is of sufficient age to bear an Aboriginal scar (ERM 2018)

6.3.2 Significance Assessment

Historic heritage

Background research into the Project site showed no heritage values or connections to significant figures. As no items of historic heritage were identified during the field survey, no further significance assessment was required for non-Aboriginal historic heritage values.

Aboriginal cultural heritage

The heritage values significance assessment for the Project site has been assessed in accordance with the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011) and encompasses the four values outlined in the *Burra Charter* (social, historical, scientific and aesthetic) (Australian ICOMOS 2013).

An assessment of the significance of the Project site according to scientific and cultural heritage values was undertaken. Social significance is determined by the Aboriginal community. The Project site has been assessed as having nil aesthetic significance based on previous land disturbance. The significance assessment is presented in *Table 6.2* below for ease of reference. Further information regarding the significance assessment can be found in Section 7.1 of the Heritage Assessment.

Table 6.2 – Significance Assessment

Element	Significance Criterion	Assessment	Level of Significance
Potential Scarred Tree	Scientific	Has not been confirmed as a scarred tree.	Low
	Cultural	No further comments provided by the RAPS	Low
Potential Ceremonial Site	Scientific	Location cannot be confirmed. No physical evidence.	Low
	Cultural	Ceremonial sites are highly significant to local communities.	High

6.3.3 Impact Assessment

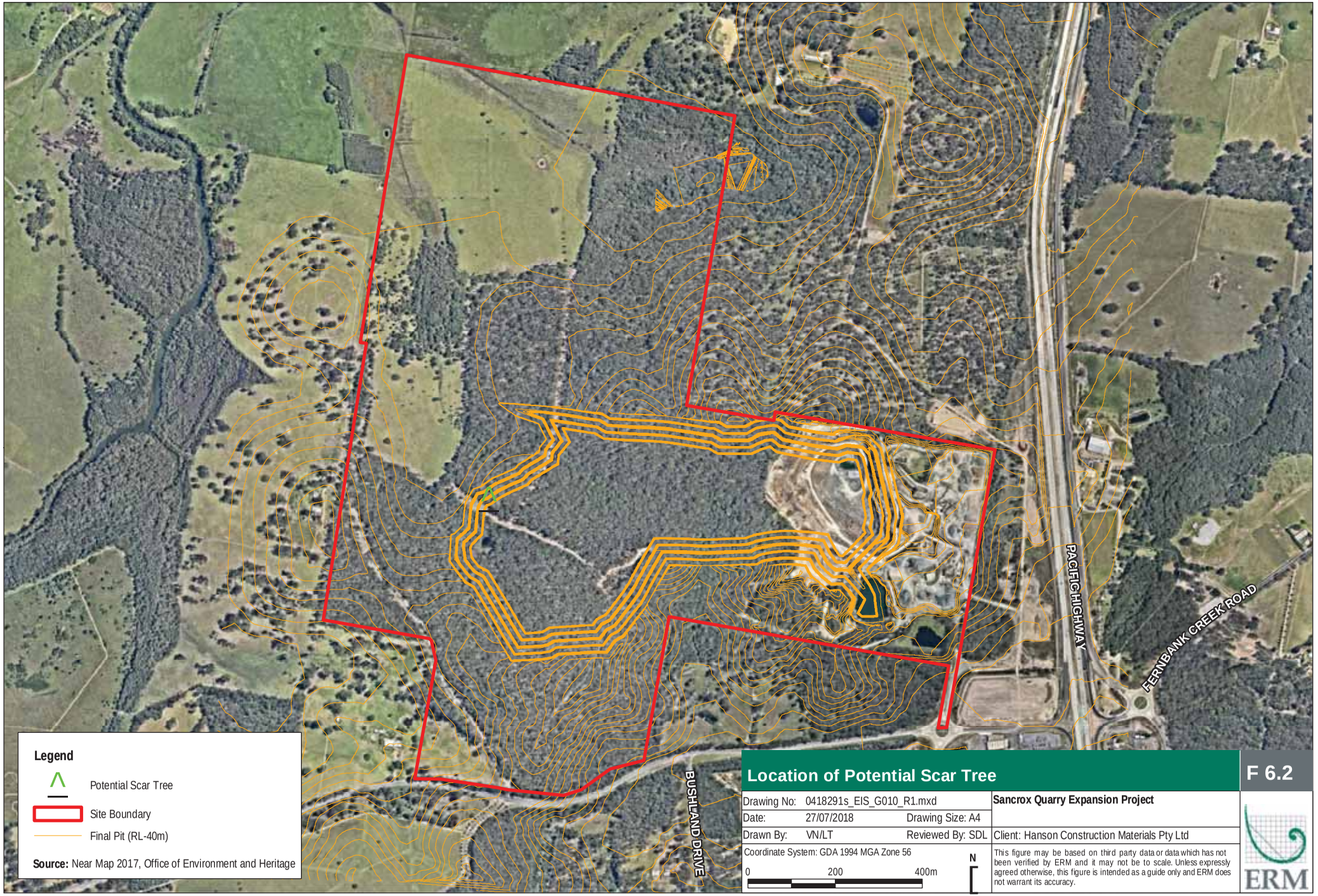
The proposed works involve the following actions that have the potential to impact on Aboriginal heritage sites and values:

- increased size of the extraction area;
- grading of roads and upgrading of existing access roads;
- vehicle movement across eroded tracks;
- development of new access roads;
- clearance of regrowth vegetation; and
- construction of ancillary facilities.

There are no historical heritage items known to occur within the Project site.

No archaeological evidence of the ceremonial site remains within the Project site.

The potential scar tree is located within the western extent of the proposed extraction area and is likely to be impacted as a direct result of the proposed extraction footprint. *Figure 6.2* shows the potential scarred tree in relation to the proposed works.


PACIFIC HIGHWAY
FERNBANK CREEK ROAD
BUSHLAND DRIVE
Legend
Potential Scar Tree
Site Boundary
Final Pit (RL-40m)
Source: Near Map 2017, Office of Environment and Heritage
Location of Potential Scar Tree
F 6.2
Drawing No: 0418291s_EIS_G010_R1.mxd
Sancrox Quarry Expansion Project
Date: 27/07/2018
Drawing Size: A4
Drawn By: VN/LT
Reviewed By: SDL
Client: Hanson Construction Materials Pty Ltd
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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

6.4 MITIGATION MEASURES

6.4.1 Historic Heritage

No historic heritage items were found during the field survey, and there are no known non-Aboriginal heritage items located within the Project site. In the unlikely event that historic heritage items are found during works, the following Unexpected Finds Protocol will be followed.

- where a potential historic heritage item is found during works, all works within the vicinity of the item, or with the potential to impact the item will cease and a temporary exclusion zone established;
- an appropriately qualified heritage consultant will examine the item to assess its significance and further archaeological potential; and
- where a relic is found, the NSW Heritage Council will be notified and approval will likely be required prior to the continuation of works. Other archaeological deposits will be recorded and assessed for significance and potential salvage by an appropriately qualified heritage consultant.

6.4.2 Aboriginal Heritage

The potential scarred tree is located within the western extent of the proposed extraction area and is likely to be impacted as a direct result of extraction. It is recommended that BLALC is afforded the opportunity to retain the scar for educational and interpretive purposes (if requested).

The ceremonial site, although now completely destroyed, is considered to have high cultural significance and recognition of its location within the Sancrox area could be considered for display in the quarry site office. The development of any cultural information will be undertaken in consultation with the BLALC.

The Unexpected Finds Protocol provided below will be followed if further Aboriginal heritage sites are encountered during works.

Unexpected Finds Protocol

An Unexpected Finds Protocol will be implemented for any locations subject to soil disturbance activities, including vegetation clearing. In the event that site workers identify any potential Aboriginal heritage sites, the protocol shall be implemented in compliance with s89 of NP&W Act. The protocol is as follows:

1. STOP WORK IMMEDIATELY. Any person that observes or uncovers potential Aboriginal heritage objects during the works must notify machinery operators immediately. All activities and/or works in the immediate area must cease (DO NOT collect samples to show someone);

2. NOTIFY. Notify the site supervisor immediately. The site supervisor will contact, notify and consult with Registered Aboriginal Parties (RAPs) and an appropriately qualified heritage professional (archaeologist);

3. AVOID DISTURBANCE of the area at and adjacent to the cultural finds;

4. PROTECT THE SITE. Any sand/soils removed must be identified and set aside for assessment. The disturbed area needs to be cordoned off as an exclusion zone so that no further disturbance occurs (include an adequate buffer area);

5. ASSESS THE FIND. The RAPs and archaeologist will investigate the nature; extent and location of the find;

6. RECORD/SALVAGE THE FIND. The RAPs and archaeologist will, in consultation with the site supervisor, arrange recording of the objects and if required salvage; and

7. RESUME WORK. Subject to the archaeologist's assessment, work may be able to recommence under the terms once the site is assessed and appropriately salvaged. Alternatively, where possible, work methods or location may be altered to minimise further harm to the find, or objects associated with the find.

In the event of the discovery of human skeletal material (or suspected human skeletal material) during Project activities, the following steps will be followed:

1. STOP WORK IMMEDIATELY. Any person that observes or uncovers human skeletal material (or suspected human skeletal material) during the works must notify machinery operators immediately. All activities and/or works in the immediate area must cease (DO NOT collect samples to show someone);

2. NOTIFY. Notify the site supervisor immediately;

3. PROTECT THE SITE. Monitor the area and keep all personal out of the area until further notice. Inform site personnel of the restricted access to that area. The disturbed area needs a to be cordoned off as an exclusion zone so that no further disturbance occurs (include an adequate buffer area);

4. ASSESS THE FIND. If human remains are suspected the site supervisor is to notify the NSW Police and provide available details of the remains and their location. The site supervisor will also notify the RAPs, an archaeologist/anthropologist and OEH;

5. POLICE INVESTIGATION. NSW Police and the Coroner will determine the nature of the suspected remains and advise on further actions.

6. RECORDING AND MANAGEMENT OF ABORIGINAL ANCESTRAL REMAINS. The RAPs must be present where it is reasonably suspected that Aboriginal burials or human remains have been encountered. Recording of Aboriginal ancestral remains must be undertaken by, or be conducted under the direct supervision of, a specialist physical anthropologist or other suitably qualified person; and

7. RESUME WORK. Subject to the archaeologist's assessment, work may be able to recommence under the terms once the site is assessed and appropriately managed. Alternatively, where possible, work methods or location may be altered to minimise further harm to the find, or objects associated with the find. Reburial of the remains to a specific location may be requested by the RAPs.

Cultural Awareness Training

In order to comply with best practice principles, all employees and subcontractors will undergo environmental awareness training as part of the site induction to ensure they understand their obligations and responsibilities. This training will include basic Aboriginal heritage awareness across the following topics:

- legal responsibilities and statutory obligations for heritage under the NP&W Act and the Heritage Act;
- outline the location and type of archaeological sites within the Project site and give instructions not to disturb these sites;
- provide the detailed locations of all known Aboriginal objects within the Project site to all relevant personnel;
- outline the procedures for the discovery of previously unrecorded Aboriginal objects; and
- provide training on how to identify stone artefacts and other Aboriginal heritage sites.

It is important to note that only information endorsed for sharing by the BLALC should be included within the induction package, alternatively a representative of the BLALC could be employed to undertake an induction session for all major contractors prior to works commencing.

REFERENCES

Appleton, J. 1996. The archaeological investigation of the site of proposed quarry operations at Sancrox Road, Wauchope, Central Coast, NSW. Unpublished report for Anthony Thorne & Associates, for CTK Constructions Pty Ltd.

Australia ICOMOS, 2013. The Australia ICOMOS Charter for Places of Cultural Significance (Burra Charter).

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7 HYDROLOGY IMPACT ASSESSMENT

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Hanson Construction Materials Pty Ltd (Hanson) to conduct a Hydrology Assessment to inform the Environmental Impact Statement (EIS) for the proposed Sancrox Quarry Expansion Project (the Project). The Project is a State Significant Development (SSD #7293) and therefore the planning approvals process is regulated under the *Environmental Planning and Assessment Act 1979* (the EP&A Act), which requires Department of Planning and Environment (DP&E) approval for development consent, supported by an Environmental Impact Statement (EIS).

The objective of this Hydrology Assessment is to meet the requirements of the Secretary's Environmental Assessment Requirements (SEARs). This chapter of the EIS provides a summary of the major findings throughout the Hydrology Assessment (ERM, 2018b; refer to *Annex E* of this EIS).

7.1 METHODOLOGY

The Hydrology Assessment was prepared to address, and meet the requirements of the following guidelines and legislation:

- SEARs;
- Environmental Protection Licence (EPL);
- Water Act 1912;
- Water Management Act 2000 (activity approvals and Water Sharing Plans);
- Landcom (2004) *Managing Urban Stormwater: Soils and Construction*; and
- NSW Water Quality and River Flow Objectives.

In order to undertake the assessment, an investigation of the site was undertaken to understand the existing hydrological aspects of the surrounding area, and the current sediment controls. The detail of this assessment can be found throughout Sections 2 – 4 of the Hydrology Assessment in *Annex E* (ERM, 2018b).

This assessment was prepared by an ERM Senior Environmental Scientist with previous experience in hydrology assessments for quarry expansions and industrial facilities.

7.1.1 Investigation Methodology

Site Investigation

A site investigation was undertaken to understand the site sub-catchments and discuss site water management with the Proponent's representative. Surface water quality sampling was also undertaken to gain an understanding of the current water quality on the site and inform the groundwater assessment (as to whether groundwater is infiltrating site surface water bodies). Surface water samples were taken from existing quarry water holding bodies and a suspected spring outside the quarry void.

Desktop Activities

To further inform the understanding gained from the site inspection, ERM undertook the following desktop activities:

- review of previous reports prepared for the quarry site; and
- review and interpretation of:
  - aerial photography;
  - site survey; and
  - Proponent and Port Macquarie Hastings Council (PMHC) supplied Geographical Information System (GIS) data.

Additionally, site hydrological data was obtained from an Intensity-Frequency-Duration (IFD) table developed for the site using the process outlined in Australian Rainfall and Runoff (Pilgrim, 1987). The BoM's web-based IFD application (BoM, 2017) was used to develop the table. A copy of the IFD table is provided in Annex A of the Hydrology Assessment (ERM, 2018b).

7.2 EXISTING ENVIRONMENT

The existing environment and environmental setting is outlined in Section 3 of the Hydrology Assessment (ERM, 2018b), and describes the local climate, temperature, rainfall, landform and elevation, surface water sources and soil and geology (including soil texture groups and dispersibility) within the surrounding area.

7.2.1 Rainfall and Evaporation Data

The mean annual rainfall recorded at Telegraph Point (060031) and mean annual rain days recorded at Port Macquarie is 1314.6 mm, and 100 days, respectively. The mean annual evaporation is 960.9mm. The evaporation and rainfall data is provided in *Table 7.1*.

Table 7.1 Monthly Precipitation and Evaporation Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean monthly rainfall (mm)[1]	138.1	175.1	167.2	127.2	104.4	109.2	66.7	58.5	59.7	83.6	109.0	114.1	1314.6
Mean monthly rain days[2]	8.9	10.4	11	9.3	8.0	7.5	6.3	5.6	5.5	7.4	10.6	9.2	99.7
Mean monthly evaporation (mm)[3]	105.4	81.2	77.5	63.0	49.6	42.0	46.5	71.3	93.0	111.6	102.0	117.8	960.9

1. Mean monthly rainfall from Telegraph Point (Farrawells Road, 060031) (1910 - present), Latitude 31.34°S, Longitude 152.79°E, Elevation 10m.

2. Mean monthly rain days from Port Macquarie Airport (060139) (1995-present), Latitude 31.43°S, Longitude 152.87°E, Elevation 4m.

3. Mean monthly evaporation from Yarras (Mount Seaview, 060085) (1970 – present), Latitude 31.39°S, Longitude 152.25°E, Elevation 155m.

7.2.2 *Landform and Elevation*

The topography surrounding the proposed Study Area is characterised by floodplains and low lying hills up to approximately 60m Australian Height Datum (mAHD), which is the highest point of the Study Area.

7.2.3 *Soil Landscapes*

The project will extend into three soil landscape groups, as named below:

- Cooperabung;
- Euroka; and
- Kundabung.

The soil landscapes are defined as being of a fine or dispersible sediment type, thus requiring wet sediment basins that require an active management (testing and dewatering) to ensure effective sediment management.

7.2.4 *Surface Water Resources*

Existing Quarry Site

Run-off from the majority of the existing quarry site flows into the pit which is pumped to existing water holding dams (WHDs) in the southeast corner of the site.

These WHDs also collect the majority of the run-off from the workshop and southern stockpile area. There is sediment basin in the northeast of the quarry site that captures surface run-off from part of the crushing and northern aggregate stockpile area (herein referred to as the 'Silt Retention Dam' and the upslope 'three tier sediment treatment train'). These features are demonstrated in *Figure 7.1.* The majority of the northern aggregate stockpile area drains to the southeast and has minimal current sediment controls, hence the proposal of a sediment basin within this catchment.

The quarry site is surrounded by a bund at its extents.

The future stages of the Project will progress into the peak to the west of the existing quarry and along the ridgeline further to the west. This will limit/avoid the requirement for upslope diversions to prevent clean run-on entering the excavation areas.

Quarry sump

Silt Retention Dam

Concrete Batching Plant & Recycling Facility

Three tier sediment treatment train

Pit Floor

Old Processing Plant (to be relocated)

New Processing Plant

New Asphalt Production Plant

New Stockpile Area

Existing Site Office, Weightbridge & Workshop

Water Holding Dam 1 (WHD1)

Water Holding Dam (WHD2)

Noise Bund

Legend

- Existing Property Ownership
- Lot Boundary
- Infrastructure
- Haul Road
- Road Network

Source:
Spatial Data: DFSI DCDB/DTDB 2017
Imagery Data: nearmap August 2017

Ancillary Infrastructure

F 7.1

Drawing No:	0418291s_HRA_G002_R3.mxd		Sancrox Quarry Expansion Project Hydrology Assessment Report
Date:	30/09/2019	Drawing Size: A4	
Drawn By:	GC	Reviewed By: ME	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

Fernbank Creek

The quarry site is located within the Fernbank Creek catchment. The quarry has the potential to discharge from two locations, the WHD 2 in the southeast and the sediment retention dam in the northern portion of the site. WHD 2 is the licenced discharge point and the sediment retention dam does not overflow as it is managed by pumps and has over designed capacity (see Section 2.3.3 of the Hydrology Assessment). Both locations would flow into separate first order streams which meet with Fernbank Creek (a third order stream), approximately 820 m and 690 m north east from each potential discharge point respectively. Fernbank Creek is located on the opposite (eastern) side of the Pacific Highway relative to the quarry site.

Haydon's Creek

Outside of the existing quarry site, the west and northwest portions of the Project site are located within the Haydon's Creek catchment. Haydon's Creek is situated approximately 360 m west from the western extent of the Project site and flows in to the Hastings River approximately 700 m to the northwest. The southern portion of the Project site is located within the Fernbank Creek catchment area, with surface flows likely to join a third order watercourse prior to meeting with those from the southern quarry site discharge location.

Hastings River

The Hastings River is one of two major rivers in the Camden Haven and Hastings River Catchment, the second being the Camden Haven River. The Hastings River rises in the Great Dividing Range and flows south east through a coastal floodplain to Port Macquarie, where it meets the Pacific Ocean. Fernbank Creek and Haydon's Creek both flow to the Hastings River.

"Due to the high density of rural settlement, the region's rivers and estuaries tend to be affected by changed runoff conditions caused by land clearing, agricultural use, human settlement and recreation. Most of the rivers and creeks in the Hastings River Basin are unregulated, without major storages to capture and control flows. Most water users rely on natural flows or small structures, such as weirs for their water supplies. As in most unregulated rivers, flows are most affected during relatively dry times, when water levels are low and demand high. In the lower reaches, important local users include livestock grazing, fishing, oyster farming grapes, tourism, and urban and rural residential. Local councils, water utilities, conservation and forestry are also major water users in the catchment" (WaterNSW, 2017).

Other Watercourses

With the exception of a third order watercourse in the far northern portion of the lot, that will not be affected by the Project, all other watercourses directly impacted by the Project are first or second order watercourses.

Previous Water Quality Monitoring

Background water quality data for nearby watercourses has been derived from The Hastings Catchment Ecohealth project (Ryder et. al., 2013) and a number of Construction Water Quality Monitoring Reports prepared by RMS for the Oxley Highway to Kempsey Upgrade Project (RMS, 2014-2017). Refer to the Hydrology Assessment (ERM, 2018b) for the surface water quality monitoring results and monitoring locations.

7.3 ASSESSMENT

7.3.1 Potential Impacts

Potential impacts have been outlined throughout the Hydrology Assessment (ERM, 2018b) and summarised in *Table 7.2*.

The potential impacts would be managed through implementation of appropriate mitigation and management measures. These would be outlined in a Soil and Water Management Plan (SWMP) prepared post approval and prior to implementing the project. *Section 7* of the Hydrology Assessment (ERM 2018b) outlines a range of management practices that would contribute to sound management of the sites soil and water resources that are also summarised in *Section 7.5*.

Table 7.2 Potential Soil and Surface Water Impacts

Construction Activities	Potential Impacts	Duration of Impact	Significance
Unsealed road network	• Creation of fugitive dust emissions due to vehicle movements. • Mud tracking at confluence of internal access roads with public road network.	Persistent during establishment of new stages and lifetime of quarrying operations. Internal road network will progressively increase as new stages are developed.	Low - access tracks created during stage establishment will be managed by sediment basins. Internal quarry roads during operation will runoff towards basins. Dust suppression measures proposed.
Establishment of future quarry stages	• Erosion of large disturbed areas during staged/progressive establishment and subsequent sedimentation of run-off. • Creation of fugitive dust emissions due to land and vegetation clearing activities. • Mulch stockpiles generating leachate run-off that may enter the surrounding surface water network.	Progressively increasing with life of quarry. Each basin for each stage will be functional until the quarrying excavates such that the run-off falls into the quarry void. This has been assumed to be no longer than three years per basin.	High – Significant area (greater than 38 ha is to be disturbed to allow for future quarry stages). It will be effectively managed by sediment basins until quarry void engulfs the catchment. Improvements to current site water management will be achieved by the establishment of the basin in the processing area and improved management in the proposed asphalt plant catchment via the conveyance of runoff to existing WHD 1.
Dewatering of site sediment basins and water accumulation points	• Introduction of contaminated water to natural surface waters, including release of water with high suspended solids during overflow events. It is noted that overflow events would only occur when rainfall exceeds the sediment basin design capacity (which would be of Blue book standard). Controlled discharges from basins following design rainfall events only following adequate management and testing of water quality, in accordance with Blue book standard.	Persistent during establishment of new stages and quarry operations. Overflow events will be intermittent only and duration / volume dependant completely on meteorological conditions. Controlled discharge events are also completely dependent on meteorological conditions, therefore the volume and frequency of water discharges (controlled or otherwise) cannot be specifically stated.	Medium – Industry Standard procedure to dewater will manage risk. Surface water monitoring program (as SWMP) and EPL variation will outline criteria for discharges/overflows from site water holding bodies, i.e. in accordance with POEO Act requirements.

Construction Activities	Potential Impacts	Duration of Impact	Significance
Stockpile management	• Erosion of stockpiles and loss of soil resource. • Introduction of contaminated water to natural surface waters.	Persistent during quarry operational activities.	Low – dust suppression and management of moisture content, along with progressive stabilisation of topsoil to be used for rehabilitation limits risk.
Concrete Batching Plant	• Contamination of waterways from water impacted by cement (washouts, cement storage areas, immediate vicinity of batch plant). • Release of water to soil and/or water bodies with increased pH, total suspended solids (TSS) and potentially other contaminants.	Lifetime of concrete batching plant	Medium – control measures as per *Section 7.5* to be implemented to manage risk and prevent negative impacts.
Asphalt Production Plant	• Introduction of hydrocarbon contamination to plant pad site, and subsequent potential contamination of run-off.	Lifetime of asphalt production	Low – industry standard practice limits potential for impacts
General site activities	• Hydrocarbon spills from machinery (burst hoses, mechanical failures, leaking machinery, etc.). • Contamination of waterways from hazardous substances due to incorrect storage (including drums and containers and spent oil filters). • Increased refuse in streams due to littering. • Contamination of soils and waterways from poor refuelling practices. • Discovery of previously contaminated sites.	Persistent throughout establishment of each stage and quarry operation	Low – risk is comparable to other construction activities. Within quarry void have very low potential for off-site contamination or surface water due to the topographical separation provided by the excavated void.
Water supply from within site	• Over-extraction of surface water or groundwater resulting in reduced environmental flows, reduced water availability for existing licensed users and impacts on water–dependent ecosystems.	Water required throughout entire lifetime of quarrying and concrete batching operations. Minimal volumes required during construction for dust suppression.	Low- Water balance undertaken to determine available water from existing and proposed water holding bodies. See *Section 7.5*.

7.3.2 *Erosion Hazard Assessment*

An Erosion Hazard Assessment (EHA) was also undertaken as part of the Hydrology Assessment (ERM, 2018b), which quantitatively assessed the potential surface water impacts based on the erosion hazard of the Project site, using the Revised Universal Soil Loss Equation (RUSLE). The RUSLE provides a prediction of the long-term average annual soil loss from erosion at a specific site according to specific management practices.

The RUSLE and the inputs utilised in this assessment are provided in Annex B of the Hydrology Assessment (ERM, 2018b). The conceptual basin designs generated by the RUSLE and location will be refined by a SWMP, with Progressive Erosion and Sediment Control Plans (PESCPs) upon approval of the Project.

7.3.3 *Flooding Potential*

PMHC provided 1 in 100 year and Probable Maximum Flood mapping data as shown in *Figure 7.2*. The quarry footprint is outside of the PMF boundary.

7.3.4 *Effluent Management*

Sewerage is treated in the council approved septic system south of the site office and workshop. Hanson has recently commissioned a new male toilet block and two concrete septic tanks. The toilet block comprises of two toilets, two hand basins, a urinal and a shower. The existing women's toilet has been plumbed into the new pump-out septic tank system, which comprises of one toilet and a hand basin. The septic tank specifications are as follows:

- 1 x 7100L Concrete Septic/Pump-out Tank
- 1 x 7100L Concrete Collection Holding Tank

The two tanks have a minimum holding capacity of 11,200L and installation was undertaken as per the relevant council approvals. Based on the site occupancy information and the AS/NZS 1547:2012 guidelines, the site wastewater management system is designed to manage a wastewater load of 1,250L/day (50L per person per day, with 25 site occupants equates to 1,250L/day).

7.4 *WATER BALANCE*

A water balance was undertaken for the site. The water balance assumed that the inputs to the production processes will be provided from on-site, non-potable water sources.

7.4.1 *Demand*

The approximate total water demand, as outlined for the purposes in *Table 7.3* is conservatively estimated at 131.1 ML/annum. Potable water will be required and will be sourced from council supply mains (and hence has not been included in the *Table 7.3*).

Table 7.3 Approximate Total Water Demand from On-site Sources

Activity	Approximate Volume of Water Required (ML) from on-site sources
Road dust suppression	45.9
Concrete manufacture	3.3
Concrete agitator washout	0.9
Crushing and screening dust suppression	75
Product moisture	4.5
Asphalt production	1.5
Total	**131.1**

7.4.2 Supply

Water supply has been calculated based on catchment yields in dry years (10-percentile), typical rainfall (median annual rainfall) and wet years (90-percentile). The volumes generated have been estimated across the life of the Project, as with on-going quarrying additional area will be available for capturing runoff. Groundwater will also contribute to supply, with modelled inflows for the final pit void estimated to generate approximately 15 to 22 ML/year. *Table 7.4* shows the volumes generated during the different rainfall years, for the progressive quarry stages.

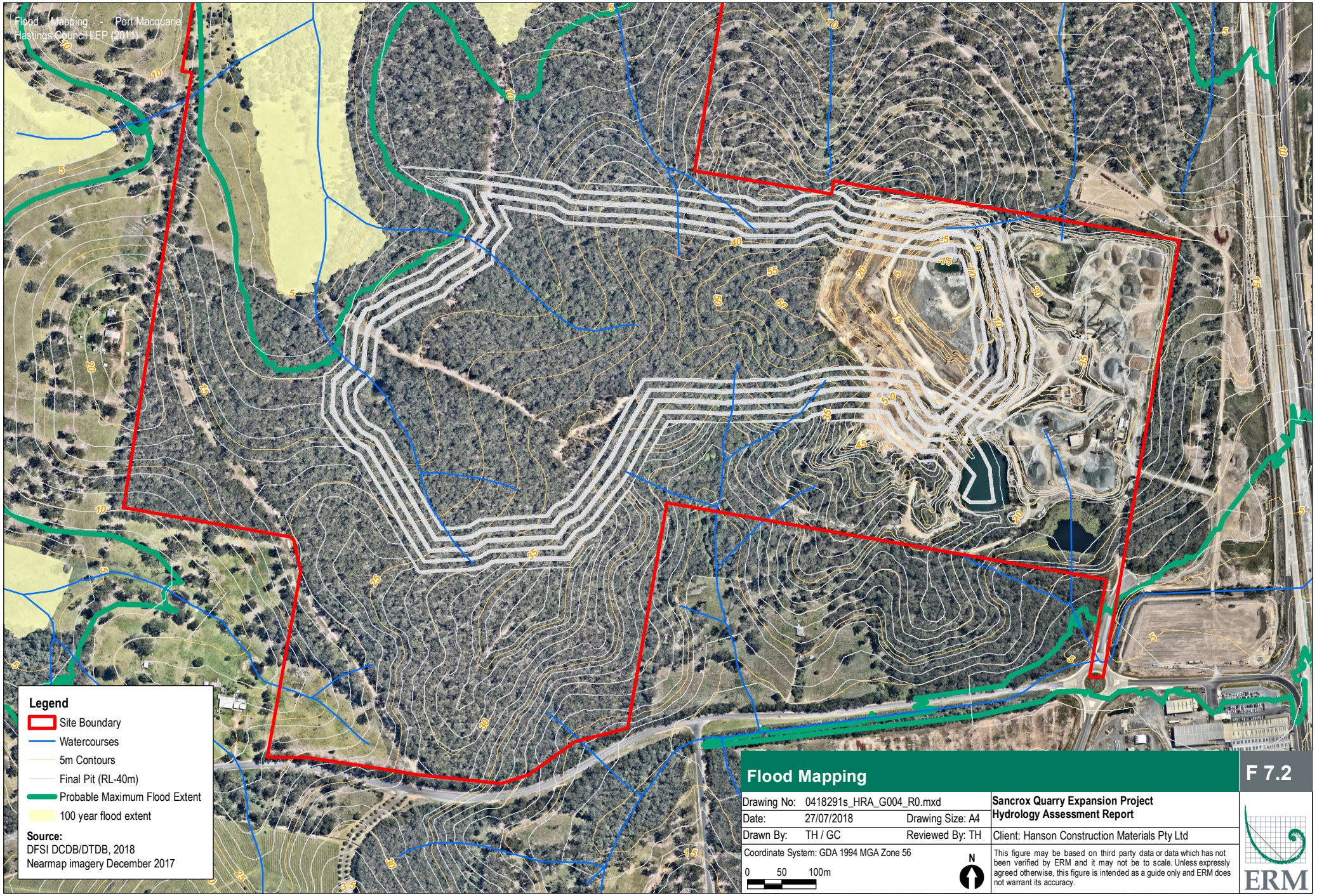
7.4.3 Balance

Current operations could provide 79 ML of water based solely on possible catchment yield with no restriction from available storage sizes during a low rainfall (10%ile year). The requirement for the Project at full operation and at final extent of disturbance is approximately 131.1 ML. With the implementation of the first stage of the Project, the additional catchment of disturbed area has the potential to generate 120.11 ML during a low rainfall (10%ile year). Hence, it is reasonable to assume that if site WHDs were managed such that all rainfall within the year could be captured, then sufficient water would be available for site activities and dust suppression as the quarrying stages progressively increase the disturbance footprint, even in a low rainfall (10%ile year). The implementation of the quarry void as an additional water holding body will provide additional buffer to the water management system, providing an additional storage for circulation of captured water throughout the site to prevent unnecessary loss and ensure available supply.

The water balance has solely been based on precipitation inputs. The groundwater assessment outlined that inputs to the quarry void (at final void stage) will be in the order of 15 to 22 ML/year. This input in addition to the surface water capture on-site could also be utilised for site water requirements and would further lessen the likelihood of the site being water deficient.

Table 7.4 Progressive Catchment Yields with On-going Quarrying

	Current Operations	Asphalt Plant and Stage 1	Stage 2	Stage 4	Final Stage
Included catchments	The current operations include: • existing pit; • Sediment Retention Dam; • Stockpile Yard and WHD; and • Asphalt Plant Catchment (currently an access track and storage area).	The asphalt plant and Stage 1 include: • Current operations; • new Processing Plant; and • all of Stage 1 catchments.	Stage 2 includes: • Asphalt plant and Stage 1; and • All of the Stage 2 catchments	Stage 4 includes: • Stage 2; and • All of the Stage 4 catchments	Final Stage includes: • Stage 4; and • All of the final stage catchments.
10%ile year (903.7 mm)	79	120.11	161.13	203.85	243.57
50%ile year (1210.8mm)	105.84	160.92	215.88	273.12	326.35
90%ile year (1825.7 mm)	159.6	242.65	325.52	411.82	492.08



Flood Mapping

F 7.2

Drawing No:	0418291s_HRA_G004_R0.mxd		
Date:	27/07/2018	Drawing Size: A4	
Drawn By:	TH / GC	Reviewed By: TH	

Coordinate System: GDA 1994 MGA Zone 56

0 50 100m

N

Sancrox Quarry Expansion Project
Hydrology Assessment Report

Client: Hanson Construction Materials Pty Ltd

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

7.5 *MITIGATION MEASURES*

The mitigation measures proposed are outlined in *Table 7.5*. Key principles are outlined below:

1. Assess the soil and water implications of a project at the planning stage;

2. Plan for erosion and sediment control and assess site constraints during the design phase and before any earthworks begin;

3. Minimise the area of soil disturbed and exposed to erosion;

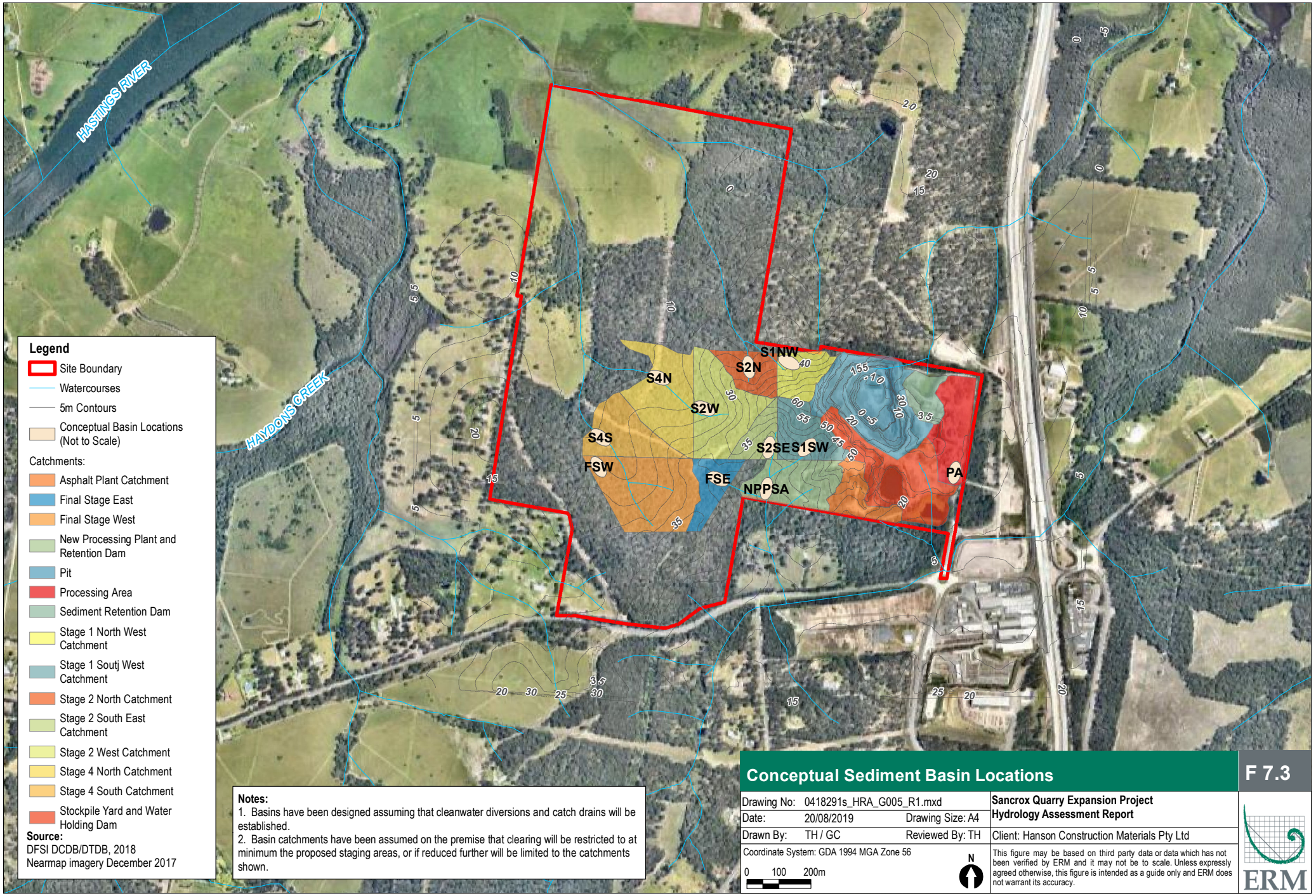
4. Conserve topsoil for later site rehabilitation/regeneration;

5. Control water flows from the top of and through the project area – divert up-slope 'clean' water away from disturbed areas and ensure concentrated flows are below erosive levels;

6. Rehabilitate disturbed lands quickly; and

7. Maintain erosion and sediment control measures for the duration of the project and until the site is successfully rehabilitated.

The predominant control method of sediment control during quarrying activities will be sediment basins, the conceptual basin locations are provided in *Figure 7.3*.


HASTINGS RIVER
HAYDONS CREEK
S1NW
S2N
S4N
S2W
S4S
S2SE
S1SW
FSW
FSE
NPPSA
PA
Legend
Site Boundary
Watercourses
5m Contours
Conceptual Basin Locations (Not to Scale)
Catchments:
Asphalt Plant Catchment
Final Stage East
Final Stage West
New Processing Plant and Retention Dam
Pit
Processing Area
Sediment Retention Dam
Stage 1 North West Catchment
Stage 1 Soutj West Catchment
Stage 2 North Catchment
Stage 2 South East Catchment
Stage 2 West Catchment
Stage 4 North Catchment
Stage 4 South Catchment
Stockpile Yard and Water Holding Dam
Source:
DFSI DCDB/DTDB, 2018
Nearmap imagery December 2017
Notes:
1. Basins have been designed assuming that cleanwater diversions and catch drains will be established.
2. Basin catchments have been assumed on the premise that clearing will be restricted to at minimum the proposed staging areas, or if reduced further will be limited to the catchments shown.
Conceptual Sediment Basin Locations
F 7.3
Drawing No: 0418291s_HRA_G005_R1.mxd
Date: 20/08/2019
Drawing Size: A4
Drawn By: TH / GC
Reviewed By: TH
Coordinate System: GDA 1994 MGA Zone 56
0 100 200m
N
Sancrox Quarry Expansion Project
Hydrology Assessment Report
Client: Hanson Construction Materials Pty Ltd
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ERM

Table 7.5 Mitigation Measures

Aspect	Mitigation Measure
Stormwater Diversion	• stormwater diversion will be required within both clean and dirty catchments throughout the development of the Project; • diversions in the form of bunds or drains, as fitted to the topography of the specific catchment, will be implemented to allow for the diversion of sediment-laden run-off to sediment basins and in a few circumstances to divert clean run-off from entering the site; • diversions within clean catchments are to be stabilised quickly (through covering of the diversion channel with geofabric or revegetation); and • diversion measures within dirty catchments will incorporate rock check dams to reduce sediment loads within the run-off prior to reaching the basin (to maximise efficiency of the basin and reduce desilting requirements) and where possible have low grade to lower flow velocities.

Erosion Control	**Mulch**
	• the mulch will be mixed with topsoil and applied to batters and other locations requiring rehabilitation, acting as both an addition of organic matter to boost the soil quality (along with other ameliorants) and act as an erosion control measure;
	• mulch will be used as a replacement to sediment fences, by creating a bund of between 300 and 500 mm high; and
	• mulch can also be applied as a blanket, of approximately 150 mm thick, to cover disturbed areas and prevent erosion.
	Site Stabilisation and Rehabilitation
	• a progressive site rehabilitation approach will be adopted, whereby stabilisation works (either by revegetation, hard armouring or allowing hard rock finishes to remain where no sediment-laden run-off will be generated) is undertaken immediately following the completion of the activity. Key principles of progressive rehabilitation include:
	  • availability of acceptable soil materials;
	  • correct site preparation and replacement of topsoil;
	  • selection of the most suitable establishment technique;
	  • selection of appropriate plant species, fertilisers and ameliorants;
	  • application of sufficient water for germination and to sustain plant growth if rainfall is insufficient;
	  • an adequate maintenance program; and
	  • areas not satisfactorily revegetated will be investigated to determine the reason for failure. Appropriate remedial action will be undertaken, including replacing any lost topsoil and re-sowing the site.

Aspect	Mitigation Measure
Sediment Control	• sediment basins are required for the management of disturbed locations. Conceptual locations are shown in *Figure 7.3*, preliminary basin sizes are provided in the Hydrology Assessment (ERM, 2018b); • the Proponent must restore the design storage capacity to each basin within five days of the cessation of a rainfall event that causes run-off to occur on the site; • a basin register will be applied to the Environment Protection Licence (EPL 5289) to allow for progressive integration of the basins to the licence as each stage of work commences; and • sediment basins will be established prior to the removal of all vegetation across each stage, where practicable. Essentially, this will require clearing a path to the basin location, removing the vegetation, constructing the basin and then clearing the remainder of the catchment. **Basin Desilting** • all sediment basins will be inspected regularly for accumulated sediment. Graduated markers placed within the basin will assist in measuring sediment depths. sediment to be removed prior to reaching capacity. **Water Treatment and Flocculation** • water quality testing will determine compliance, and identify if pH modification (through use of products such as lime or hydrochloric acid) or TSS modification (through the use of gypsum) is required.
Pollution Control	• waste receptacles will be provided for the safe and efficient storage of all construction and miscellaneous wastes, as necessary; • recyclable materials will be separated and recycled where possible. Otherwise, disposable wastes will be removed from site regularly and disposed of by approved means; • spent chemical and hydrocarbon drums will be removed from site immediately to limit the potential for spills of the remnant product; • refuelling within active quarry areas will be carried out using a mobile fuel cart fitted with an electronic fuel pump; and • routine maintenance of all plant and machinery will be carried out in the designated maintenance area adjacent to the site office to minimise the potential of accidental contamination of water. **Spill Management** • spill kits will be provided at active work locations, the workshop area, refuelling areas and adjacent to pump locations. Training of site personnel in their use will ensure that in the event of any spills appropriate action can be taken rapidly to prevent and minimise impacts to surface waters; • Material Safety Data Sheets (MSDS) for all chemicals stored on-site are to be collected and maintained by the quarry manager and made available to site personnel. Site personnel will be informed of their location as a part of the site induction; • an impervious bund will be constructed to contain any spills of more than 110% of the volume of the largest container in the bunded area, should none be present in the workshop area. Any spillage will be immediately contained and absorbed with a suitable absorbent material; • storage and transport of Dangerous Goods, Flammable and Combustible Liquids will comply with AS 1940 1993 The Storage and Handling of Flammable and Combustible Liquids and National Code of Practice for the Storage and Handing of Workplace Dangerous Goods [NOHSC: 2017 (2001)].

Aspect	Mitigation Measure
Asphalt Production Plant Controls	• clean water diversions around the asphalt production plant site to limit catchment to smallest footprint possible and prevent clean water run-on; • the proposed sediment basin will be contrasted to capture sediment-laden run-off from the plant catchment area; • a triple interceptor or similar pollution control device will be utilised as a "first flush" for the potential hydrocarbon contaminated areas in the plant site; • all oils, fuels, lubricants, liquids and chemicals will be stored in appropriately bunded areas; • bitumen, diesel and other chemicals handling will be undertaken within a contained (bunded) area. Any spillages will be immediately ameliorated; and • the sediment basin servicing the plant catchment will be fitted with a floating hydrocarbon boom as a precautionary measure to contain any potential loss of hydrocarbons from the plant catchment.

Concrete Batching Plant Controls	• the footprint of the plant will be limited to the smallest extent practicable to reduce the area from which contaminated stormwater can be generated (EPA Victoria, 1998);
	• all contaminated stormwater and process wastewater will be collected and recycled at the earliest possible opportunity (EPA Victoria, 1998);
	• a dedicated, paved and bunded washout area will be established for the following locations:
	  • truck washing and agitator drum washout area;
	  • the concrete batching area; and
	  • any other location that will generate stormwater contaminated with cement dust or residues.
	• the stormwater from these locations will be directed to a first flush system. The OEH (2015) recommended design criteria for first flush containment systems utilised for concrete batching plants must be able to contain 10 mm of rainfall;
	• a bypass to the first flush system is to be created to allow for run-off from larger storm events (greater than 20mm) to bypass the collection system for when the first flush collection is full;
	• dry cement will be stored in an area where it cannot generate fugitive dust or be exposed to water and generate run-off;
	• the sediment collected in the first flush must be regularly cleaned out; and
	• whenever wet weather discharges occur from the catchment system within the plant, pH and total suspended solid monitoring will be undertaken (EPA Victoria, 1998). EPA Victoria (1998) also states run-off after heavy rainfall (more than 20 mm over 24 hours) contains very small quantities of wastes and is unlikely to pose a significant threat to the environment.

Monitoring	• site inspection of erosion and sediment controls will be undertaken at least monthly and always following rainfall events (greater than 20mm rainfall); and • the EPL 5289, and the surface water monitoring requirements within remain relevant to the Project, the following parameters for the proposed conceptual basins.

Aspect	Mitigation Measure				
	Pollutant	**Units of Measurement**	**100%ile Concentration Limit**	**Frequency**	**Method**
	Oil and Grease	milligrams/ Litre	10 and/or not visible	<24 hours prior to a controlled/scheduled discharge and daily for any continued controlled/scheduled discharge	Visual (grab sample to be taken if sheen observed)
	pH	-	6.5 – 8.5	<24 hours prior to a controlled/scheduled discharge and daily for any continued controlled/scheduled discharge	Grab sample / calibrated field probe
	Total Suspended Solids	milligrams/ Litre	50	<24 hours prior to a controlled/scheduled discharge and daily for any continued controlled/scheduled discharge	Grab sample

7.6 CONCLUSION

The hydrology assessment identified the potential soil and water impacts and constraints related to the Project. An erosion hazard assessment was undertaken using the RUSLE to determine the potential impacts of the Project, and this in turn was utilised to design the predominant mitigation measure for managing sediment-laden run-off generated by the site - the conceptual sediment basins.

The water balance for site operations demonstrates that surface water is available to meet the demands of the Project. The additional input provided by groundwater entering in to the quarry void will further supplement the water supply available for use. An aquifer interference approval will be required for the consumption of this groundwater (refer to *Groundwater Assessment* for further details).

A surface water monitoring program has been prepared and the site EPL will need to be varied to incorporate the proposed revision to current water monitoring. The program outlines the proposed surface water monitoring regime for the sediment basins that will be installed as the staged expansion progresses. With the implementation of sediment basins, the utilisation of the mitigation measures and the development of a SWMP and PESCPs, the potential soil and water impacts of the Project can be effectively managed so that there is no significant, negative impact to the environment.

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8 GROUNDWATER IMPACT ASSESSMENT

Environmental Resources Management Australia Pty Ltd (ERM) were engaged by Hanson Construction Materials Pty Ltd (Hanson) to conduct a Groundwater Assessment to inform the Environmental Impact Assessment (EIA) for the proposed Sancrox Quarry Expansion Project (the Project). The Project is a State Significant Development (SSD #7293) and therefore the planning approvals process is regulated under the *Environmental Planning and Assessment Act 1979* (the EP&A Act), which requires Department of Planning and Environment (DP&E) approval for development consent, supported by an Environmental Impact Statement (EIS).

The objective of this Groundwater Assessment is to meet the requirements of the Secretary's Environmental Assessment Requirements (SEARs), which have been outlined within *Section 1.2* of the Groundwater Assessment (ERM, 2018c).

8.1 METHODOLOGY

In order to meet the objectives of the groundwater related aspects of the SEARs, ERM conducted the following scope of works:

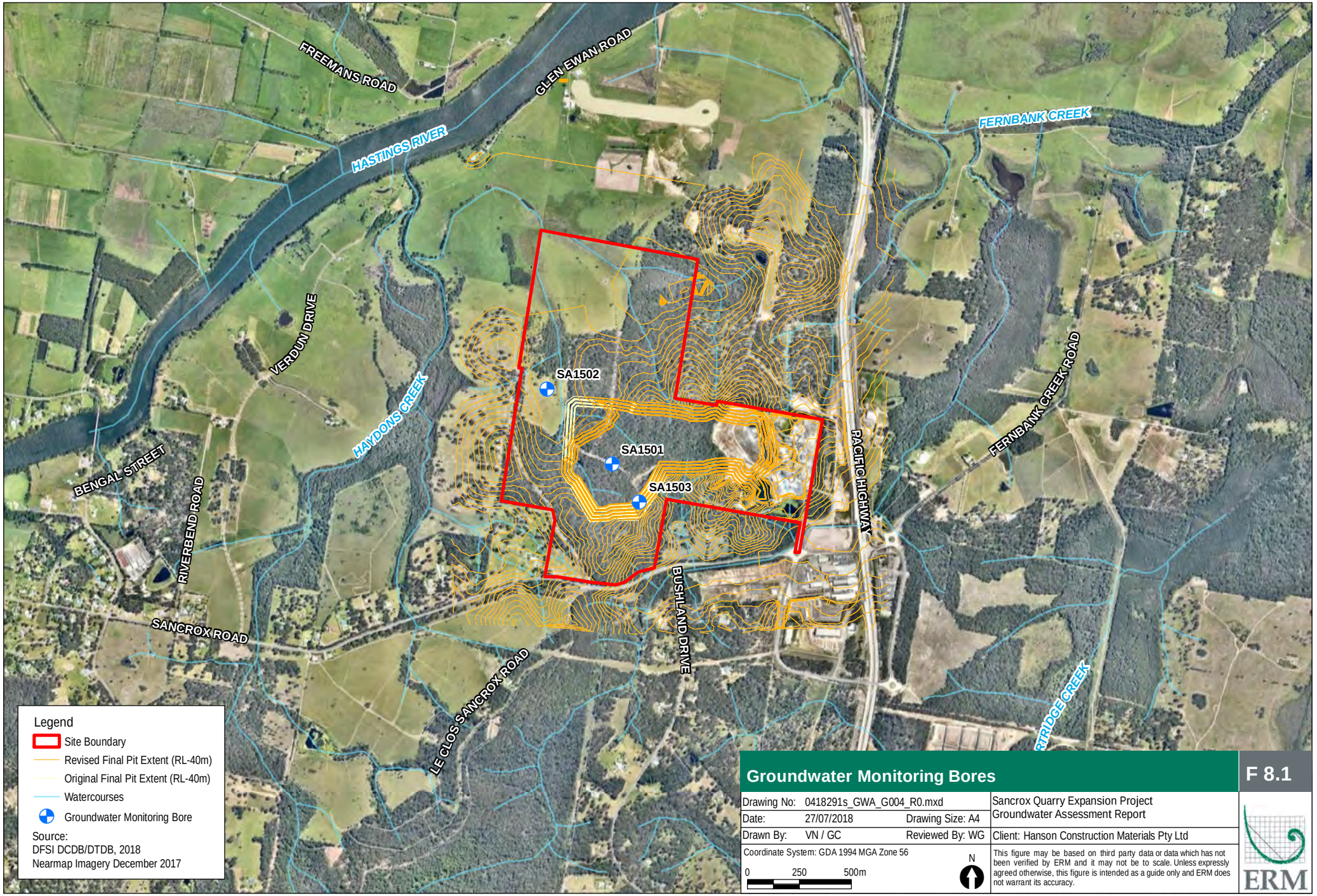
- a desktop assessment to describe the environmental site setting, including a search for groundwater users (both registered groundwater bores and groundwater dependant ecosystems) using publically available database sources;
- a groundwater field program to undertake aquifer parameter testing and groundwater and surface water sampling to characterise the aquifer system underlying the Project site; and
- groundwater modelling to evaluate groundwater inflow rates into the expanded quarry as well as potential groundwater drawdown proximal to the quarry and the potential magnitude of drawdown at identified groundwater users.

The field assessment and preparation of this report was undertaken by ERM Environmental Scientists, with the technical assessment being prepared and reviewed by hydrogeologists with extensive experience.

8.1.1 Field methodology

Pre-Pumping Test Groundwater Level Gauging

ERM undertook manual water level gauging of static water levels (SWLs) with a dip meter prior to the pumping tests commencing on 28 November 2017. In addition to the water level data gathered through manual gauging, Hanson deployed pressure transducers (automated level loggers) in three monitoring bores (SA1501 – SA1503) for the collection of long-term baseline groundwater levels. The locations of the monitoring bores are presented in *Figure 8.1*.


FREEMANS ROAD
GLEN EWAN ROAD
HASTINGS RIVER
FERNBANK CREEK
VERDUN DRIVE
HAYDONS CREEK
SA1502
SA1501
SA1503
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
BUSHLAND DRIVE
LE CLOS SANCROX ROAD
Legend
Site Boundary
Revised Final Pit Extent (RL-40m)
Original Final Pit Extent (RL-40m)
Watercourses
Groundwater Monitoring Bore
Source:
DFSI DCDB/DTDB, 2018
Nearmap Imagery December 2017
Groundwater Monitoring Bores
F 8.1
Drawing No: 0418291s_GWA_G004_R0.mxd
Date: 27/07/2018
Drawing Size: A4
Drawn By: VN / GC
Reviewed By: WG
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Groundwater Assessment Report
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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Based on data files made available by Hanson, the level loggers were deployed from:

- October 2015 to September 2017 for SA1501
- December 2016 to September 2017 for SA1502
- December 2016 to July 2017 for SA1503

At all three locations, the level loggers were programmed to collect water level measurements at 12 hour intervals.

Pumping Tests

Two short-term constant discharge pumping tests and associated recovery tests were undertaken at the site to estimate aquifer hydraulic properties. The pumping tests were undertaken on bores SA1501 and SA1502.

The constant discharge pumping test at SA1502 was undertaken on 28 November 2017 and the constant discharge test at SA1501 on 29 November 2017. Both constant discharge tests were run for a period of 3 hours, at pumping rates of 1 L/minute and 3 L/minute at SA1502 and SA1501 respectively. At this point in the pumping tests, respective groundwater level drawdowns of 28.02m and 4.89m had been achieved in SA1502 and SA1501. To maximise drawdown in the aquifer for the recovery tests, the pumping rate for the SA1502 test was increased to approximately 3 L/min for a duration of 15 minutes (achieving a total drawdown of 43.73 m), while the pumping rate for the SA1501 test was increased to 6 L/min for a further 2 hours (achieving a total drawdown of 22.49 m). From the total drawdown depths, the time period for 90% recovery to pre-test static water levels were approximately 30 minutes for the test conducted at SA1501 and 4 hours 20 minutes for the test conducted at SA1502.

Groundwater and Surface Water Sampling

Monitoring bores SA1501 and SA1502 were sampled during the pumping tests, with samples taken once field parameters measured during pumping (which included pH, electrical conductivity [EC], oxidation reduction potential [ORP], dissolved oxygen [DO] and temperature) had stabilised.

Due to a blockage encountered in SA1503, this monitoring bore could not be sampled with the submersible pump and this specific bore was sampled with a single use disposable bailer. Due to purging limitations posed by the bailer method, the sample taken with the bailer effectively represents a grab sample.

In addition to the groundwater monitoring bores, surface water samples were taken from the two surface water holding ponds on site, the in-pit sump, and a water seep located to the northeast of the existing aggregate processing and storage area.

8.1.2 Groundwater Modelling Methodology

Groundwater Modelling

A numerical groundwater flow model (Model) was created to simulate the current hydrogeological conditions and at final quarry expansion. The Model was undertaken to address the impact assessment requirements of the NSW Aquifer Interference Policy. This included:

- estimating water take through groundwater inflows to the pit; and
- predicting groundwater level drawdown associated with pit development at groundwater user locations (both registered groundwater bores and the closest identified groundwater dependent ecosystem).

While the Project will include the expansion of the existing pit in multiple stages, the modelling was undertaken for a steady state scenario taking into consideration the full extent of the final planned pit void (at which stage steady state groundwater flow to the pit will be greatest and potential groundwater level drawdown proximal to the quarry will be greatest).

The limitations and assumptions of the model are provided in ERM (2018c).

8.2 ENVIRONMENTAL SETTING

8.2.1 Site Setting

The Study Area includes the existing quarry site, the area identified for the quarry expansion and a 2 km radius from the perimeter of the final pit to identify groundwater users that may be impacted by the proposed activity. The eastern portion of the Study Area has been disturbed by active quarrying activities while the west and northwest portions of the Study Area are largely undisturbed and predominantly covered with remnant woodland vegetation and some smaller sections of ground covering pasture.

The Groundwater Assessment and Hydrology Assessment (ERM, 2018c and b) provide an outline of the environmental setting, including specific information in regards to climate, topography, geology, hydrogeology and hydrology. Please refer to *Section 3.2* of the Groundwater Assessment (ERM, 2018c) for additional information.

8.2.2 Geology

The regional geological map indicates that the Study Area is underlain by the Byabbara Beds of the Carboniferous Period. Regionally the Byabbara Beds consists of interbedded lithic sandstone, siltstone, tuff, shale and limestone. Towards the Hastings River, to the north and west of the Study Area, Quaternary age alluvial sediments consisting of sand, silt, mud and gravel overlie the Byabbara Beds (Brunker et al., 1970).

The existing pit has a defined fault line trending southwest to northeast, and the approximate location of the fault line (Hanson, 2015) is presented in *Figure 8.2* along with the regional surface geology as drawn from Brunker et al (1970). The Byabbara Beds geology has been inferred to comprise conglomerate, sandstone and siltstone to the north of the fault line and predominantly shale to the south of the fault line. Drilling completed at the Study Area further suggests that there are fault zones at depth as indicated by intervals of breccia identified in the rock core (Hanson, 2016).

8.2.3 Hydrogeology

The meta-sediments of the Byabbara Beds underlying the Study Area are considered to present a fractured rock aquifer, with groundwater storage and flow largely controlled by secondary porosity. While at a regional scale the groundwater flow direction would be expected to be similar to the slope of the topography. Influence on local groundwater flow directions would include the orientation and connectivity of the fracture network, as well as the influence of the existing open pit on hydrodynamics. Quarrying in the existing open pit has proceeded to below the groundwater level in the surrounding bedrock and groundwater flow in the immediate vicinity of the quarry workings would be towards the pit. According to site management, no active dewatering takes place at the pit with groundwater seepage into the pit being negligible, indicating that the permeability of the meta-sediments is low.

The Quaternary alluvial sediments overlying the Byabbara Beds sediments to the north and west of the Study Area (in proximity to the Hastings River) present an unconsolidated aquifer where water storage and flow is governed by the primary porosity of the sediments.

The alluvial sediments would be expected to be in direct hydraulic connection with surface water features such as the Hastings River, with the direction of water flow controlled by relative water levels in the surface water features and surrounding alluvial sediments. When compared the Quaternary alluvial sediments would be expected to present a significantly more productive aquifer than the consolidated meta-sediments.

Legend

- Site Boundary
- Revised Final Pit Extent (RL -40m)
- Original Final Pit Extent (RL -40m)
- Inferred Fault Line
- Qa - Quaternary Alluvial Sediments (Sand, Silt, Mud, Gravel)
- Cb - Byabbara Beds (Lithic Sandstone, Siltstone, Tuff, Shale, Limestone)

Sources:

- Geology map reference: Brunker R.L., Offenberg A.C. and Cameron R.G., 1970: Hastings 1:250 000 Geological Sheet SH/56-14, 1st edition, Geological Survey of New South Wales, Sydney.
- Reference for inferred fault line: Hanson, 2016: Geology Report - Geology, Drill Results and Resources 2015. Sancrox Quarry, NSW.

Regional Surface Geology

F8.2

Drawing No: 0418291s_GWA_C002_R0.cdr		Sancrox Quarry Expansion Project Groundwater Assessment Report
Date: 19/07/2018	Drawing size: A4	
Drawn by: GC	Reviewed by: WG	Client: Hanson Construction Materials Pty Ltd
Drawing Not to Scale	N	This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

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Groundwater Dependent Ecosystems

The Australian groundwater dependent ecosystems (GDE) toolbox (National Water Commission, 2011) identifies the following three types of GDEs:

- Type 1 – Aquifer and Cave Ecosystems (inhabited by subterranean fauna including troglofauna and stygofauna).
- Type 2 – Ecosystems Dependent on the Surface Expression of Groundwater (such as wetlands and creeks/rivers fed by baseflow).
- Type 3 – Ecosystems Dependent on the Subsurface Expression of Groundwater (with groundwater typically encountered within the rooting zone).

The BoM Atlas of GDEs (BoM, 2018) was used for the identification of groundwater environmental receptors in the Study Area. The Atlas was used to search a 2 km radius from the perimeter of the final pit and the following GDEs were identified:

- Type 2 – Ecosystems: The Hastings River, located approximately 1.3 km to the northwest of the perimeter of the final pit (at its closest distance from the pit).
- Type 3 – Ecosystems: Multiple ecosystems with high to moderate GDEs potential including:
    - several areas of Paperbark ecosystems with the closest located approximately 500 m to the west of the outer perimeter of the final pit (and adjacent to Haydon's Creek). Additional occurrences of Paperbark ecosystems have been mapped by BoM approximately 800 m to the north east, 900 m to the east north east and 1,700 m east south east of the perimeter of the final pit.
    - Low Relief Coastal Blackbutt ecosystems located approximately 1,100 m to the east and 1,300 m to the south east on the perimeter of the final pit.

No Type 1 ecosystems were identified through the BoM GDE Atlas.

While the Project does not currently fall within a gazetted Water Sharing Plan (WSP) area, a *Draft Water Sharing Plan for the Hastings Unregulated and Alluvial Water Sources 2016* (NSW Government, 2016) has been developed which includes a *High priority Groundwater-Dependent Ecosystem Map* (GDE011_Version 1). This map was reviewed as part of the groundwater assessment and no high priority GDEs were identified within a 2km radius of the perimeter of the final pit. Note that groundwater dependent culturally significant sites were under investigation at the time of the development of the draft WSP and the locations of any such sites had not been identified.

Existing groundwater use

A desktop search was conducted to identify existing groundwater users through the NSW Department of Primary Industries (DPI) Office of Water Groundwater Bore Database (NSW DPI, 2018). The search area included a 2 km radius from the perimeter of the final pit.

A total of 13 registered groundwater bores were identified. The locations of the bores relative to the quarry are presented in *Figure* 8.3.

8.3 ASSESSMENT

The results of the Groundwater Assessment have been outlined throughout *Section 4.2* of the Groundwater Assessment (ERM, 2018c). Summation of the results or conclusions drawn from monitoring are provided below.

8.3.1 Fieldwork assessment results

Pre-Pumping Test Groundwater Levels

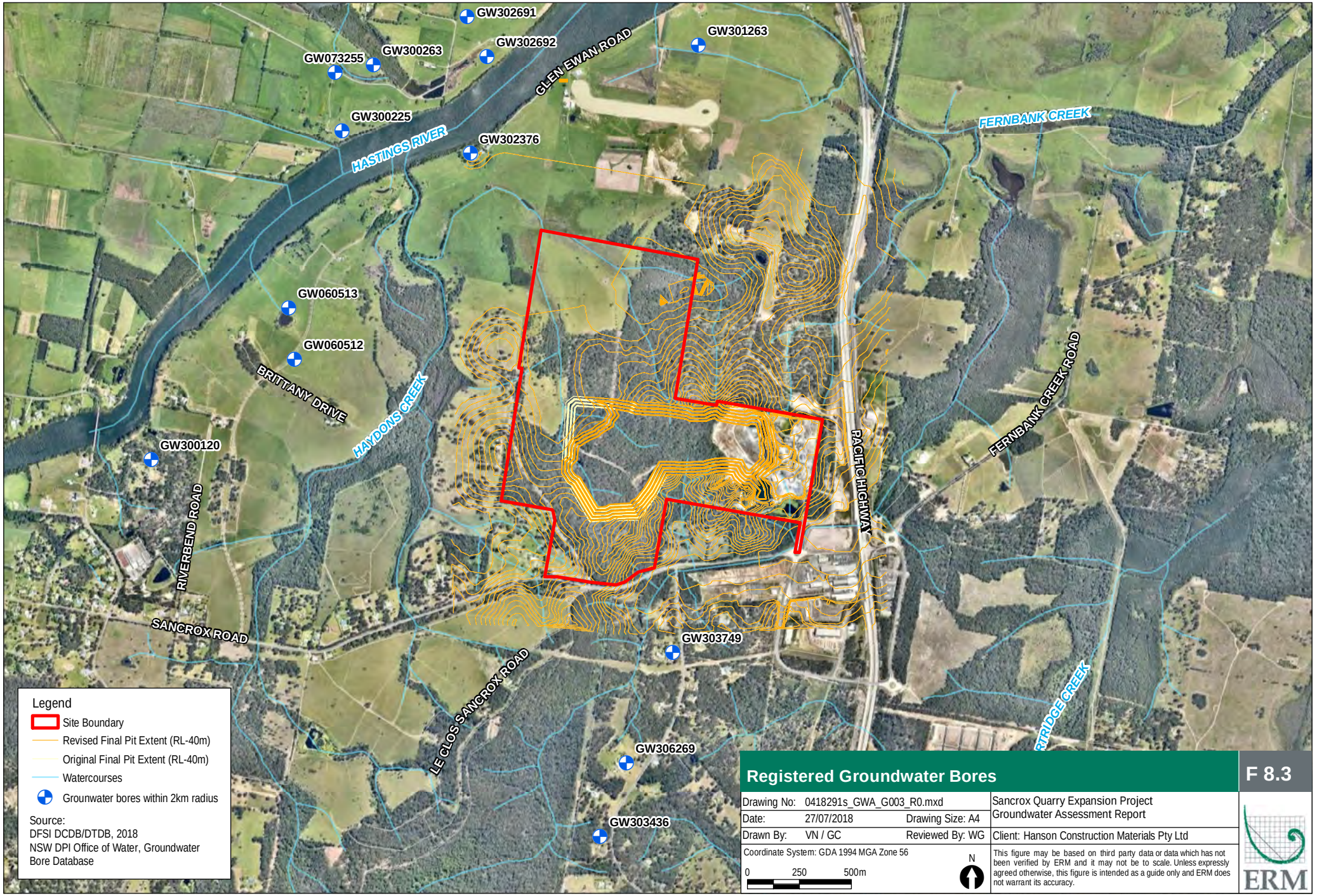
The baseline groundwater levels gauged by the level loggers are summarised in *Table 8.1* below.

Table** 8.1 **Level Logger Baseline Groundwater Levels

Monitoring Bore	Date Range	Groundwater Level					
		m BGL[1]			m AHD[2]		
		Min Depth	Max Depth	Av Depth	Min Depth	Max Depth	Av Depth
SA1501	10/2015 – 9/2017	9.69	10.67	10.52	12.81	11.83	11.98
SA1502	12/2016 – 9/2017	1.42	2.26	1.74	1.98	1.14	1.66
SA1503	12/2016 – 7/2017	0.39	12.11	9.69	32.61	20.89	23.31

1 = metres below top of casing

2 = metres Australian Height Datum (approximate values with an accuracy of ~1m).


GW302691
GW301263
GW302692
GW300263
GW073255
GLEN EWAN ROAD
GW300225
FERNBANK CREEK
HASTINGS RIVER
GW302376
GW060513
GW060512
BRITTANY DRIVE
HAYDONS CREEK
FERNBANK CREEK ROAD
PACIFIC HIGHWAY
GW300120
RIVERBEND ROAD
SANCROX ROAD
GW303749
LE CLOS SANCROX ROAD
GW306269
GW303436
Legend
Site Boundary
Revised Final Pit Extent (RL-40m)
Original Final Pit Extent (RL-40m)
Watercourses
Grounwater bores within 2km radius
Source:
DFSI DCDB/DTDB, 2018
NSW DPI Office of Water, Groundwater Bore Database
Registered Groundwater Bores
F 8.3
Drawing No: 0418291s_GWA_G003_R0.mxd
Date: 27/07/2018
Drawing Size: A4
Drawn By: VN / GC
Reviewed By: WG
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Groundwater Assessment Report
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ERM

The available groundwater level elevation data indicate a groundwater flow direction towards the northwest. While monitoring bores SA1501 - SA1503 are located in a near straight line (see *Figure 8.1*), which is not ideal for tri-angulating and inferring groundwater flow direction, the inferred groundwater flow direction does align with general expectations of regional groundwater flow which would be from elevated elevations towards the Hastings River.

Pumping Test Results

Based on the recovery phase derived transmissivity values of 0.07 m^2/day and 0.01 m^2/day and assumed aquifer thicknesses of 70 m and 36 m for SA1501 and SA1502 respectively, the estimated hydraulic conductivity of the screened lithology at SA1501 would be 0.001 m/day and 0.0003 m /day at SA1502. In units of m/sec this would equate to hydraulic conductivities of approximately $1 X 10^{-8}$ m/sec and $3 X 10^{-9}$ m/sec for the tests conducted at SA1501 and SA1502 respectively. These low hydraulic conductivity values align with the observations from the existing pit where groundwater seepage to the pit is reportedly negligible with no active dewatering required according to site management.

Groundwater Quality

The water quality sampling results indicate that the geology intersected by the quarry and targeted during quarry expansion (based on sampling results from SA1501 – SA1503) is largely inert, with no acidity impact identified at the existing quarry operations and no exceedances of trace metals in any of the samples identified. Potential water quality impacts are considered to be associated primarily with salinity, with the groundwater sampling indicating that groundwater within the Byabbara Beds is brackish.

A simplified mass balance calculation was undertaken to determine the potential impact associated with brackish groundwater. The mass balance identified a relatively low TDS concentration (170mg/L) within the water captured within the pit. Brackish groundwater seeping into the pit is therefore expected to have limited impact on the overall quality of water that may be discharged from the Project.

8.3.2 Groundwater Modelling Outcomes

Estimated Water Take from Modelling

The groundwater flow modelling indicates a steady state groundwater inflow rate of approximately 40 to 60 m^3/day to the final pit void, which equates to approximately 15 to 22 ML/year. The predicted steady state inflows are modest for a pit void of the proposed size, and the relatively low predicted inflow rates align with observations from the existing quarry where no active dewatering takes place and groundwater seepage into the pit is reportedly negligible.

Drawdown

Taking into consideration the impact assessment requirements of the NSW Aquifer Interference Policy, the predicted 2 m level drawdown contour for the stabilised cone of depression is of particular significance (as the minimal impact considerations specify a maximum of a 2 m decline at any water supply network). The modelling indicates that at its furthest extent (from the outer perimeter of the final pit) the 2 m drawdown contour may extend to approximately 800 to 1,100 m from the final pit (based on the base case and sensitivity run scenarios respectively), as outlined in *Figure 8.4* below.

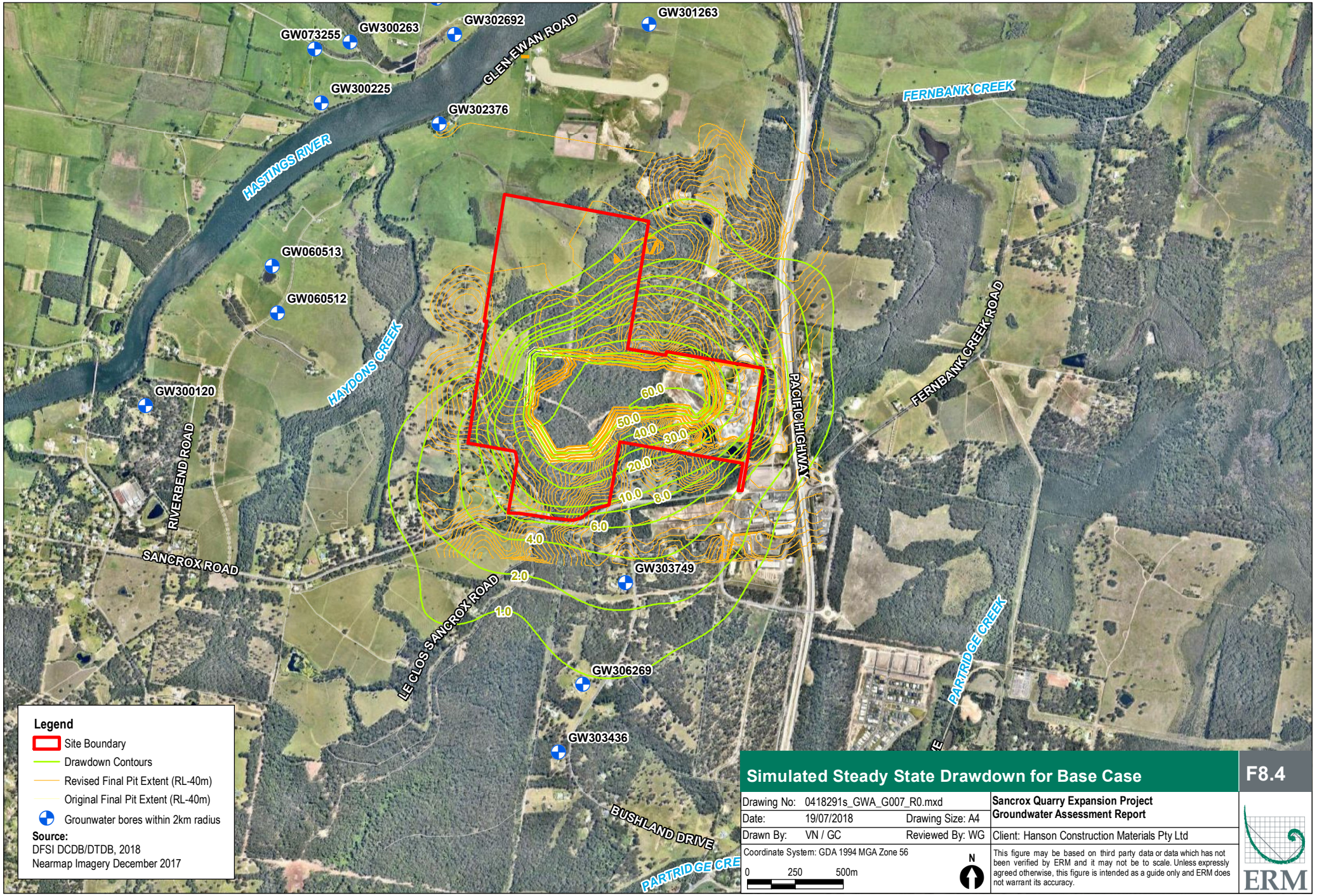
When considering the locations of the identified groundwater bores, 1 of the 13 bores fall within the footprint of the > 2 m drawdown contour for the base case scenario (GW303749), and 2 of the 13 bores for the sensitivity run scenario (GW303749 and GW306269). The modelling outputs indicate that the magnitude of drawdown may vary between approximately 3 m and 7 m at GW303749, and 1 m to 3 m at GW306269. The likely impacts of this potential drawdown would depend on the:

- pump installation specifics at each bore (specifically pump depth in relation to the pre-quarry water level and total bore depth);
- intensity of use of the bore (the rates the bore is pumped at and how frequently water is drawn from the bore); and
- remaining water column within the bore following potential drawdown.

Potential impacts may vary from negligible (if drawdown does not affect the operation and use of the bore) to significant if water level drawdown is such that it affects the useability of the bore.

Groundwater Dependant Ecosystems

The predicted drawdown at the GDE located closest to the Project is considered negligible.


GW073255
GW300263
GW302692
GW301263
GLEN EWAN ROAD
GW300225
GW302376
FERNBANK CREEK
HASTINGS RIVER
GW060513
GW060512
HAYDONS CREEK
FERNBANK CREEK ROAD
PACIFIC HIGHWAY
GW300120
RIVERBEND ROAD
60.0
50.0
40.0
30.0
20.0
10.0
8.0
6.0
4.0
2.0
1.0
SANCROX ROAD
GW303749
LE CLOS SANCROX ROAD
PARTRIDGE CREEK
GW306269
GW303436
BUSHLAND DRIVE
PARTRIDGE CRE
Legend
Site Boundary
Drawdown Contours
Revised Final Pit Extent (RL-40m)
Original Final Pit Extent (RL-40m)
Grounwater bores within 2km radius
Source:
DFSI DCDB/DTDB, 2018
Nearmap Imagery December 2017
Simulated Steady State Drawdown for Base Case
F8.4
Drawing No: 0418291s_GWA_G007_R0.mxd
Date: 19/07/2018
Drawing Size: A4
Drawn By: VN / GC
Reviewed By: WG
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
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8.4 MITIGATION MEASURES AND RECOMMENDATIONS

8.4.1 Licencing Requirements

The NSW Aquifer Interference Policy specifies that all water taken during an activity must be accounted for, and that a water licence is required irrespective of whether the water is taken for consumptive use or whether water is taken incidentally in the course of undertaking the activity. In line with the WMA, aquifer interference activities taking water outside of water sharing plan areas require a license under the *Water Act 1912*. Hanson currently hold a Water Access Licence (WAL42524) for water supply works undertaken on site.

8.4.2 Water Level Drawdown

Mitigation measures for the potential impacts associated with drawdown on bores GW303749 and GW306269 will vary dependant on the extent of the impact, but would include (if deemed necessary):

- lowering the bore pump in the bore casing;
- drilling a deeper bore; or
- providing an alternative water source as part of "make good" arrangements.

Monitoring recommendations have been provided throughout the Groundwater Assessment (ERM, 2018c) and have been summarised below.

8.4.3 Groundwater Monitoring Program

The NSW Aquifer Interference Policy specifies that monitoring requirements need to be developed that allow for the monitoring of actual impacts compared to predicted impacts, allowing for contingency plans to be enacted in a timely manner if actual impacts are higher than predicted and these impacts are found to be significant. It is recommended that a groundwater monitoring plan be developed that includes specifics of such a monitoring program, including threshold trigger values as well as a contingency strategy if triggers are exceeded. While the development of such a plan falls outside the scope of this assessment, recommendations for monitoring requirements are outlined below.

Water Take

It is recommended that monitoring of inflows be undertaken to the extent feasible as part of water balance activities. This can be done by metering water being pumped from the in-pit sumps. An estimation of rainfall contribution to water being pumped from the in-pit sumps can then be made on an annual basis by factoring in rainfall data and the pit extent after which the groundwater component can be estimated. Groundwater take will be estimated and reported in this manner on an annual basis.

If geological/hydrogeological observations during quarry extension vary significantly from that considered for the groundwater flow model the groundwater flow model will be re-evaluated. The model re-evaluation may include running the existing groundwater model for different stages of pit development and including transient analysis in the modelling to evaluate contributions from aquifer storage (which may require additional pumping tests and observations bore installation).

Water Levels

The groundwater monitoring program will include monitoring of water levels at the potentially affected groundwater bores. In order to be able to identify over or under predictions by the modelling in a reasonable way, it is recommended that all bores showing a > 0.5 m of simulated drawdown be included in the monitoring program. This would include bores GW303436, GW303749 and GW306269.

As the predicted drawdown is based on steady state drawdown associated with the final stage of pit extension (the maximum drawdown expected over the life of the Project), initial monitoring of water levels can serve as a baseline against which to compare future water level measurements. Monitoring frequency should be adaptable (depending on trends observed and stages of the quarry development) with twice annual monitoring recommended for the first year of monitoring. Water level data will be reported on an annual basis along with the reporting of the water take estimates.

Water Quality

Water quality monitoring is recommended at the in-pit sump(s) and existing monitoring bores while they remain accessible. Parameters monitored will include standard field parameters (pH, EC, temperature, ORP and DO) and laboratory analysis of TDS. Monitoring frequency of these sampling locations should be adaptable (depending on trends observed) with twice annual monitoring recommended for the first year of monitoring. Water quality results will be reported on an annual basis along with the reporting of the water take estimates.

Monitoring water quality of water discharges from the site will continue as per the conditions specified in the site Environmental Protection Licence (EPL). In addition to the current suite of parameters, it is recommended that consideration be given to including EC and TDS in the EPL related compliance monitoring.

ERM (2018c) outlines that pit lake modelling may be required prior to closure of the quarry.

8.5 CONCLUSION

Based on the findings presented throughout this chapter, and the results outlined throughout the Sancrox Quarry Expansion Groundwater Assessment (ERM, 2018c), it is concluded that impacts to groundwater as a result of the proposed development are expected to be minimal. This conclusion is based under the assumption that the mitigation measures outlined above (and throughout the Groundwater Assessment) are adhered to during and post construction.

REFERENCES

BoM (2018) *Groundwater Dependant Ecosystems Atlas.* Bureau of Meteorology. Sourced from http://www.bom.gov.au/water/groundwater/gde/

Brunker R.L., Offenberg A.C. and Cameron R.G. (1970) *Hastings 1:250 000 Geological Sheet SH/56-14, 1st edition*, Geological Survey of New South Wales, Sydney

ERM, 2018b. *Hydrology Assessment*. Sancrox Quarry Expansion. Prepared for Hanson Construction Materials Pty Ltd.

ERM, 2018c. *Groundwater Assessment*. Sancrox Quarry Expansion. Prepared for Hanson Construction Materials Pty Ltd.

Hanson (2015). *Geology, drill results and Resources 2015 – Sancrox Quarry, Stubbs Extension***.** Hanson Construction Materials Pty Ltd.

9 SOIL AND LAND RESOURCES

9.1 METHODOLOGY

9.1.1 Agricultural Land Capability

The agricultural land capability of the Study Area (defined by the full extent of the void to be excavated upon completion of quarrying) was assessed using the most relevant available online databases as detailed in the Department of Primary Industries (DPI) *Agricultural Land Use Mapping Resources in NSW – Users guide* (2017). DPI resources utilised included:

- Land and Soil Capability mapping;
- Biophysical Strategic Agricultural Land mapping; and
- Regional Farmland mapping;

The DPI (2017) guidance document also references Important Agricultural Land and Critical Industry Cluster mapping, however neither are applicable to the Study Area as the mapping is only relevant to the Hunter Valley and regions to the south.

In addition to the land capability mapping outlined above, the following resources were also investigated.

- Soil Landscape mapping (Atkinson, 1999); and
- Local Environmental Plan (PMHC, 2011) zoning mapping.

9.1.2 Soils, Geology and Landform

The geology of the Study Area was described by previous geological assessments undertaken by the Proponent and publically available local geology and soil landscape mapping. Landform was assessed by review of topographical mapping, survey of the area and site visit.

9.1.3 Contamination

A desktop investigation of potential contamination sources was undertaken by:

- reviewing historic aerial imagery;
- conducting searches of contamination registers; and
- obtaining Planning Certificates for the two lots comprising the Study Area.

9.2 EXISTING ENVIRONMENT

9.2.1 Landform and Elevation

The topography of the Study Area is characterised by floodplains and low lying hills up to approximately 60 m Australian Height Datum (m AHD), which is the highest point of the Study Area.

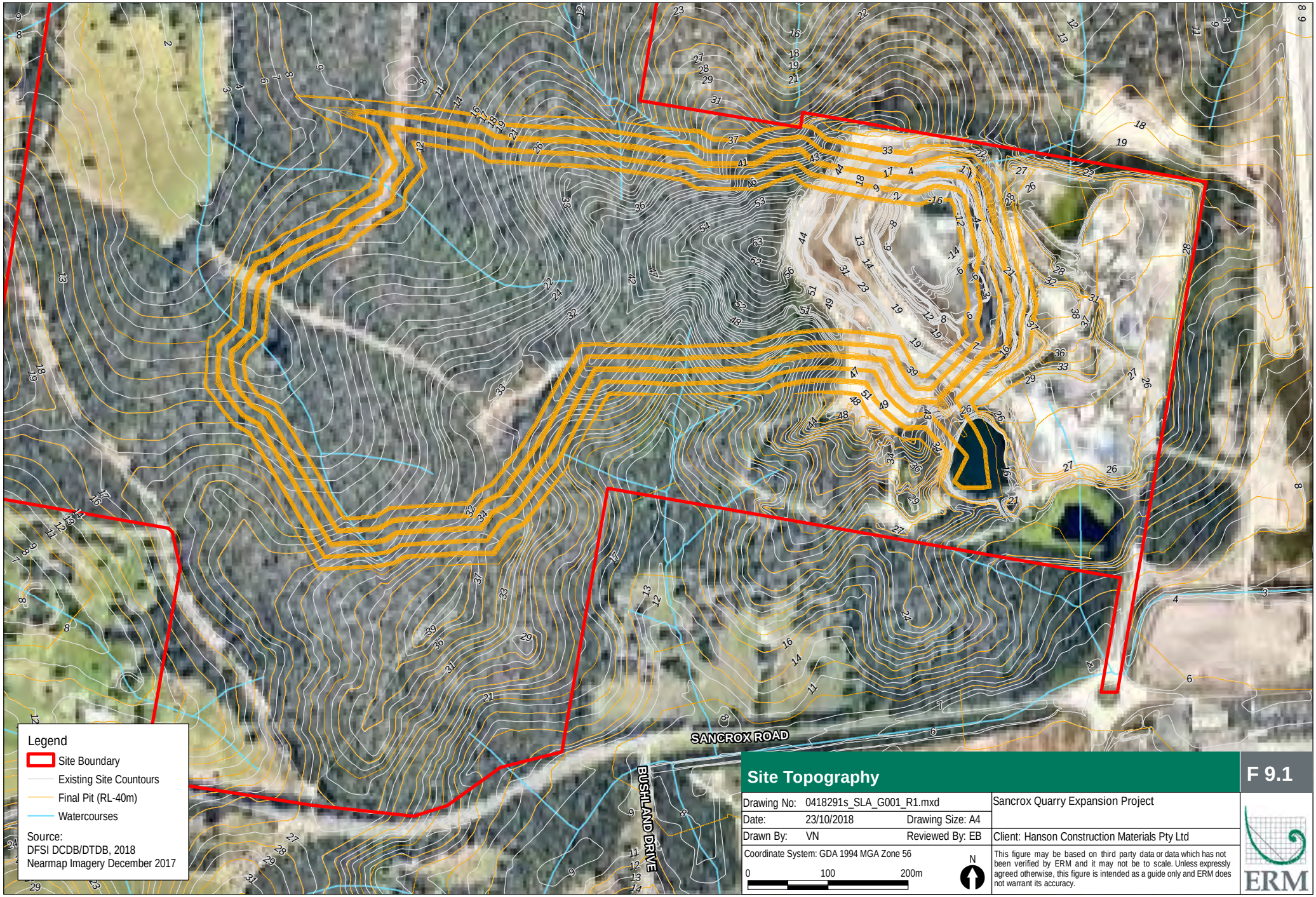
The eastern portion of the Study Area has been disturbed by quarrying activities, while the west and northwest portions of the Study Area are largely undisturbed and predominantly covered with remnant native open forest vegetation and some smaller sections of ground covering pasture.

Run-off from the majority of the existing quarry site flows into the pit which is pumped to existing dams in the south east corner of the site. These dams also collect the majority of the run-off from the workshop and southern stockpile area. There is a sediment basin in the northeast of the quarry site that captures surface run-off from part of the crushing and northern aggregate stockpile area. The majority of the northern aggregate stockpile area drains to the south east and has minimal current sediment controls, with improvements to be implemented outlined in the hydrology assessment (ERM 2018). The quarry site is surrounded by a bund at its extents.

The future stages of the Project will progress into the peak of the hill to the west of the existing quarry and along the ridgeline further to the west. This will limit/avoid the requirement for upslope diversions to prevent clean run-on entering the excavation areas.

The location of the Project site is such that only the upper extent of first order watercourses will be bisected. A farm dam is present in the western portion of the Study Area. This dam is within the footprint of the final stage of the quarry, so will be dewatered and removed as part of the Project.

The topography and surface water flow paths of the Study Area are presented in *Figure 9.1.*



Site Topography

F 9.1

Drawing No:	0418291s_SLA_G001_R1.mxd		Sancrox Quarry Expansion Project
Date:	23/10/2018	Drawing Size: A4	
Drawn By:	VN	Reviewed By: EB	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 100 200m

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9.3 SOILS AND GEOLOGY

The 1:250,000 Hastings Geological Map Series SH 56-14 indicates that the Project site is situated over the Byabbara Beds Formation of the Carboniferous Period and Palaeozoic Era. The Byabbara Beds are characterised by lithic sandstone, siltstone, tuff, shale and limestone.

9.3.1 Geological Assessments

Previous geological assessment includes:

- 1997 - a geological assessment was undertaken by R. W. Corkery & Co. The assessment included three diamond drill boreholes and a number of shallow percussive boreholes.
- 2004 – Pells Sullivan Meynink performed a slope stability study of the central area of the existing pit, identifying a slope failure. The report provided a management plan to ameliorate the issue in the short and long term.
- 2009 – drilling was undertaken by Hanson with some of the boreholes undertaken in this assessment being located in the Project site.

Investigation of the potential resource for the quarry expansion was undertaken by Hanson in 2015. Hanson developed diamond drill bore holes and percussion drill bore holes at the Project site.

The Hanson (2015) report states 'the overburden has been modelled on the clay or deep weathering in the upper part of each drill hole. The depth varies over the site. The overburden volume based on the drill hole lithology depth is 1.4 million bank cubic metres'. Total available resource was calculated at 24.5 million bank cubic metres. The report also stated that the current pit has a defined fault line trending north east to south west and that there is also joint sets observed in the current pit. Hanson (2015) states that these joint sets cause wedges that need to be considered in the pit design and that another report has been prepared addressing this issue. The Hanson (2015) report outlines that the shale bands are softer than the more competent conglomerate and mudstone beds and this may contribute to geotechnical issues.

9.3.2 Soil Properties

The soils at the Project site have predominately been removed prior to the excavation of the quarry in search of 'hard rock'. The highly disturbed extraction area is characterised by exposed rock and crushed particles of rock and clays. Several stockpiles of crushed material were present across the Project site during the site inspection. The stockpiles are not covered to protect from erosive forces, though run-off generated from the stockpiles predominately drains towards sediment treatment devices.

According to the soil landscapes described by Atkinson (1999), the majority of undisturbed portions of the Project site are part of the Cooperabung Soil Landscape. The western and southern extent of the Project site extends into the Euroka Soil Landscape. A small portion of the western extent of the Project site comprises the Kundabung Landscape. Each of the soil landscapes are described below, along with limitations. The soil landscapes of the Study Area are shown in *Figure* 9.2.

Cooperabung Soil Landscape

Soils of the Cooperabung Soil Landscape range from shallow to moderately deep with well-structured red, brown and yellow clay subsoils. The Cooperabung Soil Landscape is under forested lands in the Study Area and State forests with minor areas cleared for grazing in the tributary valleys to the Hastings River. Under the present land use, the Cooperabung Soil Landscape is subject to minor sheet erosion, with evidence of gully erosion associated with roads and past clearing.

Atkinson (1999) details that the soils of this type are shallow, stony soils with moderate to high erodibility and are dispersible. The soils have low water holding capacity and low fertility.

Euroka Soil Landscape

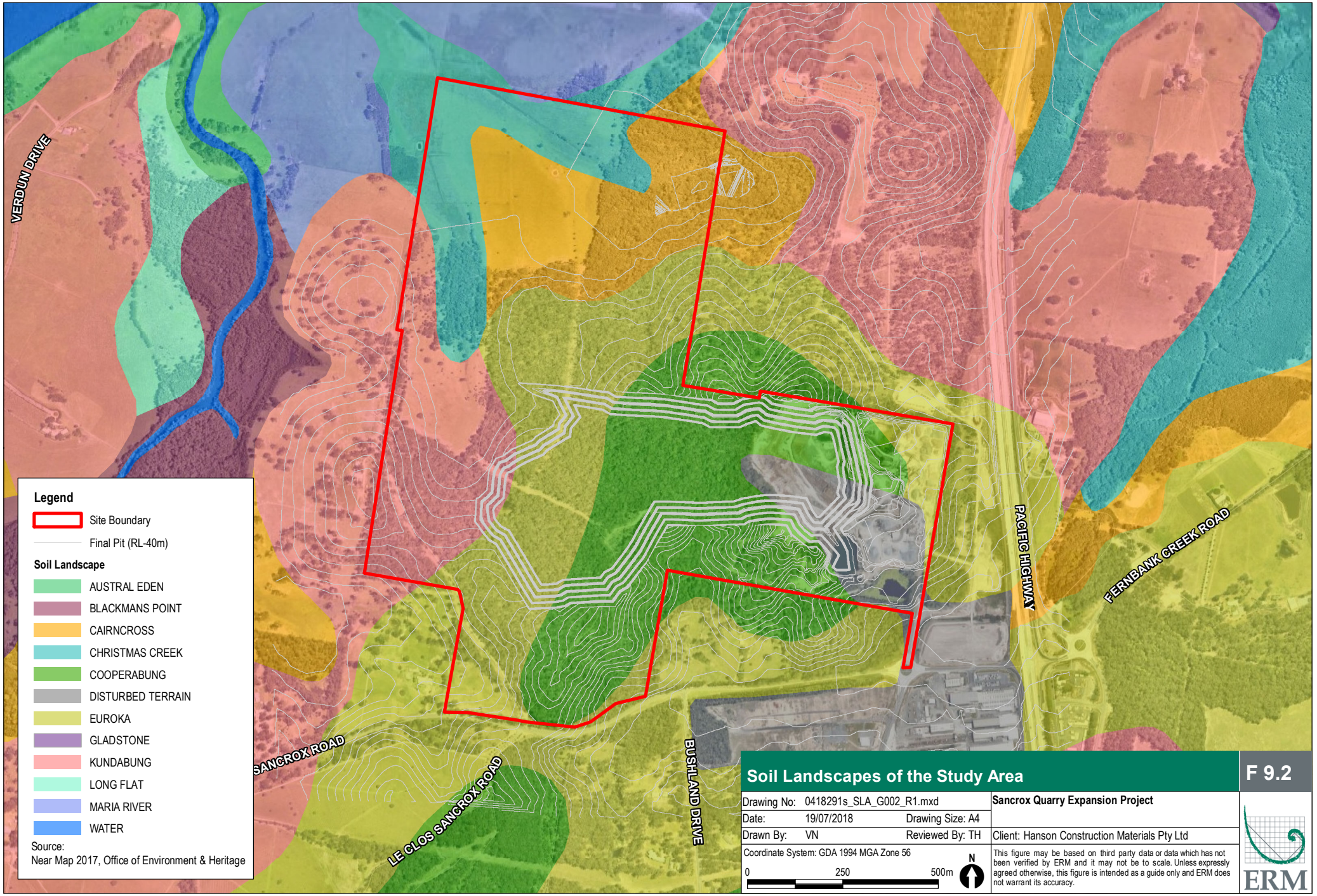
The Euroka soil landscape comprises shallow Red, Yellow and Brown Podzolic soils. The topography of the landscape is rolling low hills with slopes most commonly ranging from 10-15% at elevations of 20-90m. Within the Study Area the soil landscape is under open sclerophyll forest. The Euroka landscape grades into the Kundabung landscape on slopes less than 10% and to the Cooperabung landscape on steeper slopes.

Atkinson (1999) details that the soils are hard setting infertile soils with poor drainage. Very strong acidity is also a limiting factor for potential productivity and can cause high aluminium toxicity. Large applications of Lime will be required to address this acidity problem and improve permeability issues.

Kundabung Soil Landscape

Soils of the Kundabung landscape are Shallow to deep (<100 - >300cm), poorly drained hardsetting soloths and grey- brown, yellow and red podzolic soils. Gleyed podozolic soils with humic gleys in drainage depressions. The limitations of this soil landscape include:

- seasonal waterlogging;
- water erosion hazard;
- highly erodible, highly acidic soils with low permeability; and
- high aluminium toxicity potential


VERDUN DRIVE
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
Legend
Site Boundary
Final Pit (RL-40m)
Soil Landscape
AUSTRAL EDEN
BLACKMANS POINT
CAIRNCROSS
CHRISTMAS CREEK
COOPERABUNG
DISTURBED TERRAIN
EUROKA
GLADSTONE
KUNDABUNG
LONG FLAT
MARIA RIVER
WATER
Source:
Near Map 2017, Office of Environment & Heritage
Soil Landscapes of the Study Area
F 9.2
Drawing No: 0418291s_SLA_G002_R1.mxd
Date: 19/07/2018
Drawing Size: A4
Drawn By: VN
Reviewed By: TH
Coordinate System: GDA 1994 MGA Zone 56
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Sancrox Quarry Expansion Project
Client: Hanson Construction Materials Pty Ltd
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9.3.3 Soil Texture Group and Dispersibility

Cooperabung Soil Landscape

Landcom (2004) states that the Cooperabung soil landscape is characterised as the Type F or Type D sediment type; being fine and dispersible. The Revised Universal Soil Loss Equation (RUSLE) includes a factor for soil erodibility, the K-Factor. K-factors range from 0.075 (very high) to 0.005 very low. The range of K-factors observed for the Cooperabung landscape range between 0.024 to 0.05. The soil Hydrologic Group is Group B (low-moderate run-off potential) /Group C (moderate to high run-off potential).

Euroka Soil Landscape

Landcom (2004) states that the Euroka soil landscape is characterised as the Type F or Type D sediment type; being fine and/or dispersible. The K-factor for this landscape ranges between 0.011 to 0.037. The soil Hydrologic Group is Group C (moderate to high run-off potential).

Kundabung Soil Landscape

Landcom (2004) states that the Kundabung soil landscape is characterised as the Type F or Type D sediment type; being a fine/and or dispersible. The K-factor for this landscape ranges between 0.017 and greater than 0.094. The soil Hydrological Group is Group C/Group D (high to very high runoff potential).

9.3.4 Acid Sulphate Soils

Potential acid sulphate soils (PASS) are naturally occurring sediments and soils containing iron sulfides (principally pyrite) and/or their precursors or oxidation products. The exposure of the sulfides to oxygen by drainage or excavation leads to the formation of actual acid sulphate soils (ASS) and generation of sulphuric acid which can have many unacceptable environmental impacts, including acidification of waterways, major fish kills, habitat destruction, loss of agricultural productivity, geotechnical instability and corrosion of concrete and steel structures.

PASS are concentrated in coastal environments, typically within estuarine sediments of relatively recent (Holocene and Pleistocene) age and at elevations mostly less than 5m AHD. There is however potential for other acid sulphate materials (ASM) (e.g. rocks containing sulphide minerals) to have wider distribution in the landscape.

Reference to the PASS mapping in the area (DLWC, 1997) indicates there is a high probability of ASS occurring at or near to the ground surface along the low lying watercourses present within the northern portion of Lot 2 DP 574308. Department of Land and Water Conservation (DLWC) (1997) indicates potential for severe environmental risk if these materials are disturbed by activities such as shallow drainage, excavation or clearing. These areas are

identified as alluvial backplain's at 1 – 2m above mean sea level (ASL). This location is outside of the proposed area of disturbance associated with the Project site.

Based on review of DLWC (1997) there are no known or expected occurrences of ASS thought to be present within the remainder of the Project site.

9.3.5 Naturally Occurring Asbestos

Review of naturally occurring asbestos mapping (NSW T&I, 2015) identified that no naturally occurring asbestos occurs in the Project site.

9.4 EXISTING LAND USE

The Project site is situated in remnant open sclerophyll forest that is not currently used for agricultural production. An unsealed access track is located in the west of the Project site that provides access to the adjacent areas that have previously been cleared of vegetation and are used for cattle grazing.

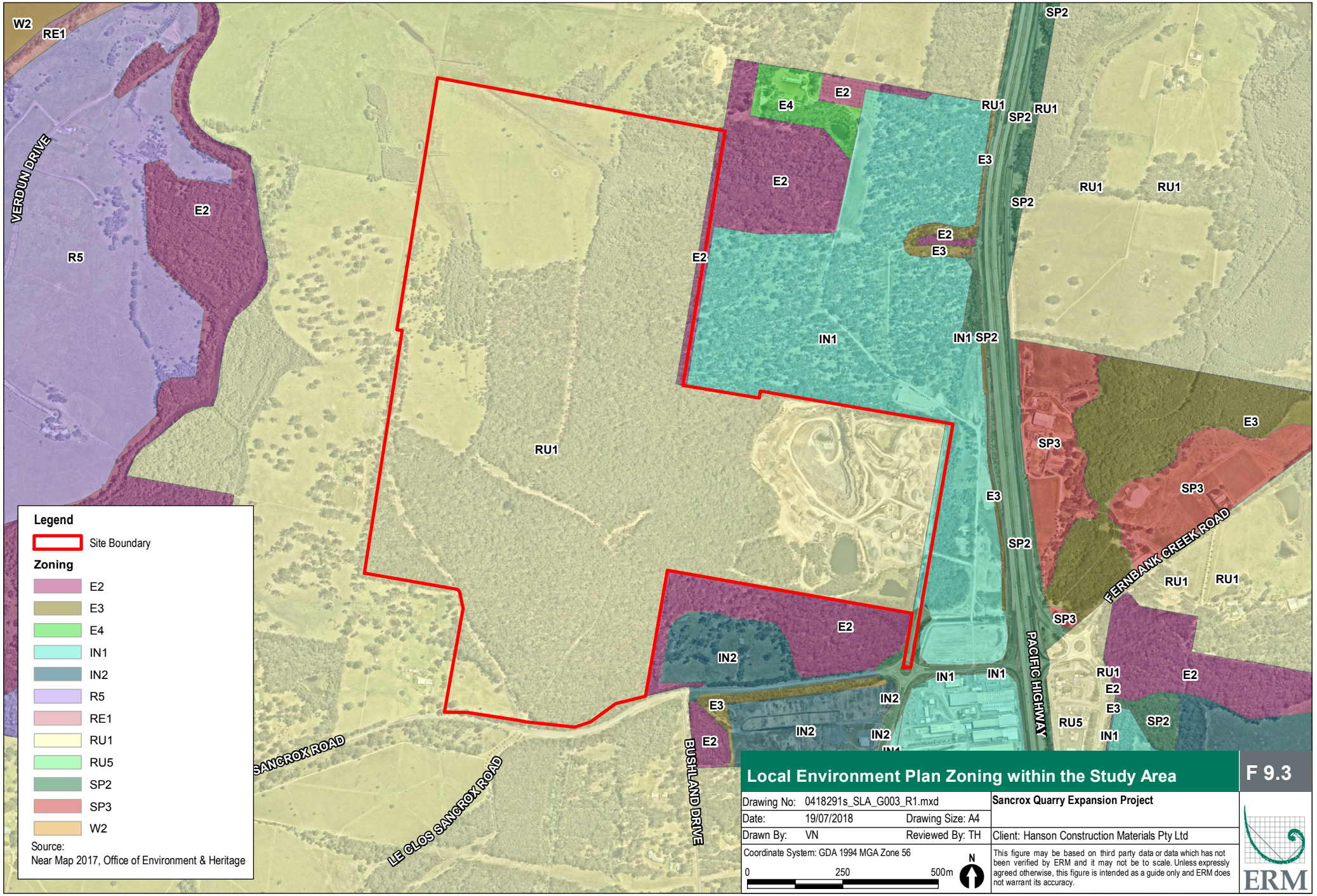
9.5 ASSESSMENT

9.5.1 Land Use Zoning

The Project site is zoned as RU1 - Primary Production under the 2011 Port Macquarie Hastings Local Environmental Plan. To the north and south of the Project site the land continues as RU1 – Primary Production. This is similar to the west, though there is also E2 - Environmental Conservation and R5 - Large Lot Residential with continued distance from the quarry. To the north and east of the Project site the land is classified as IN1 - General Industrial. Directly adjacent to the southern perimeter of the Project site is an area zoned as E2 - Environmental Conservation. The zoning is demonstrated in *Figure 9.3*.

The land to the east and north of the Project site is currently being filled to create level ground for the development of an industrial area. South of Sancrox Road the Expressway Spares Laydown/ Storage Yard is zoned as IN2 - Light Industrial, while the workshop area within the Sancrox Interchange is classed as IN1 - General Industrial. The current zoning is not restrictive to the Project.

Potential impacts to the existing and proposed industrial areas to the south, north and east of the Project site and the large lot residences to the west have been considered in the relevant technical studies for the EIS (refer to *Chapter 10* and *Chapter 11* for noise and air quality impacts respectively).


W2
RE1
VERDUN DRIVE
E2
R5
E4
E2
E2
E2
RU1
SP2
RU1
E3
RU1
RU1
SP2
E2
E3
IN1
IN1
SP2
RU1
E3
SP3
SP3
E3
SP2
FERNBANK CREEK ROAD
RU1
RU1
SP3
E2
IN2
IN1
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IN2
E3
IN2
IN2
E2
BUSHLAND DRIVE
PACIFIC HIGHWAY
RU1
E2
E3
RU5
SP2
IN1
SANCROX ROAD
LE CLOS SANCROX ROAD
Legend
Site Boundary
Zoning
E2
E3
E4
IN1
IN2
R5
RE1
RU1
RU5
SP2
SP3
W2
Source:
Near Map 2017, Office of Environment & Heritage
Local Environment Plan Zoning within the Study Area
F 9.3
Drawing No: 0418291s_SLA_G003_R1.mxd
Sancrox Quarry Expansion Project
Date: 19/07/2018
Drawing Size: A4
Drawn By: VN
Reviewed By: TH
Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56
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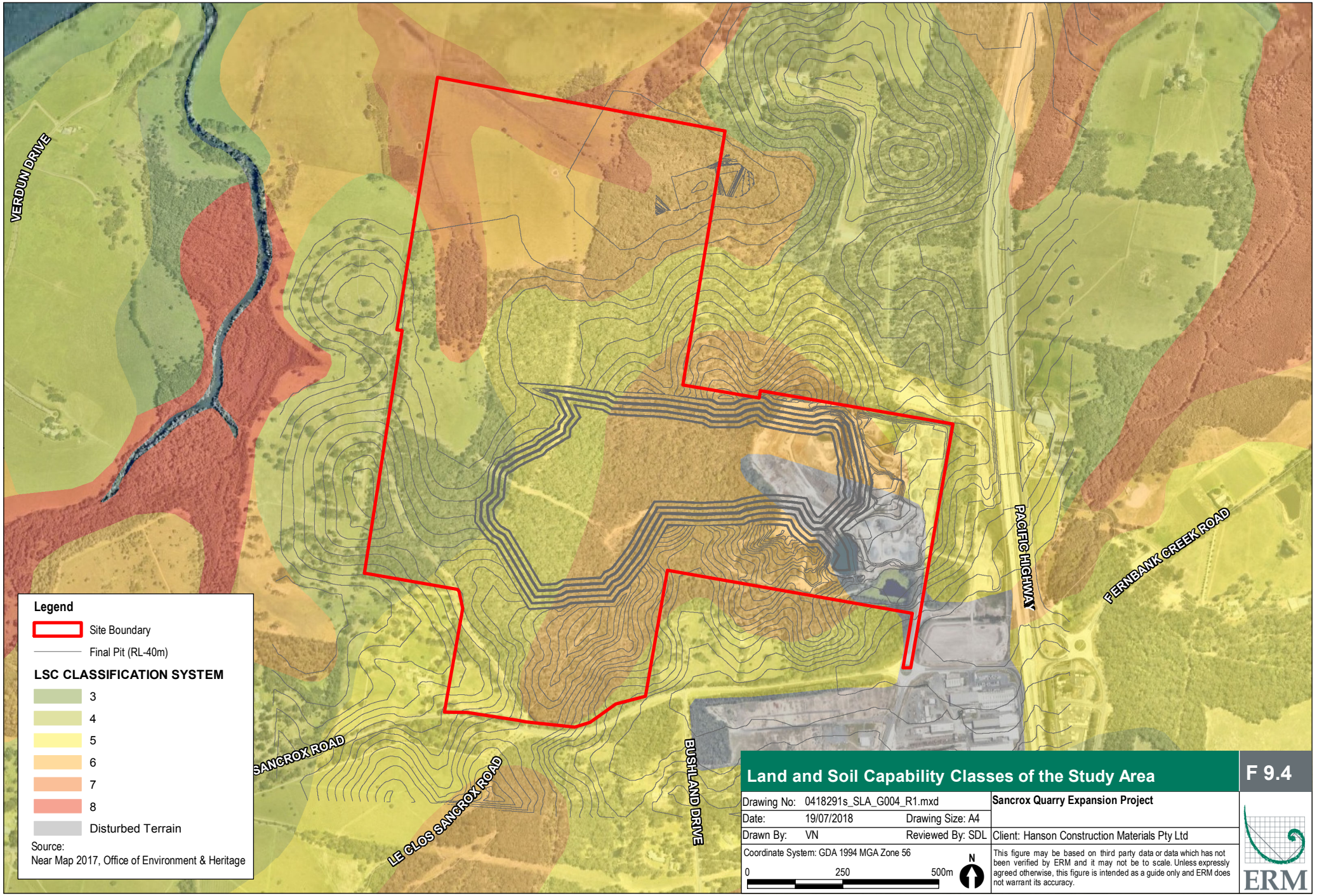
9.5.2 Land and Soil Capability Assessment

Table 9.1 provides the definition of Land and Soil Capability (LSC) classes based on the assessment scheme outlined in OEH *The Land and Soil Capability Assessment Scheme, Second Approximation* (2012). *Figure 9.4* shows the LSC classes of the Study Area.


VERDUN DRIVE
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
Legend
Site Boundary
Final Pit (RL-40m)
LSC CLASSIFICATION SYSTEM
3
4
5
6
7
8
Disturbed Terrain
Source:
Near Map 2017, Office of Environment & Heritage
Land and Soil Capability Classes of the Study Area
F 9.4
Drawing No: 0418291s_SLA_G004_R1.mxd
Sancrox Quarry Expansion Project
Date: 19/07/2018
Drawing Size: A4
Drawn By: VN
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The classifications across the Study Area range from:

- the disturbed terrain of the existing quarry footprint;
- LSC Class 4 land for a small area at the western extent of the Project site that would be impacted by Stage 4 of the proposed quarry expansion;
- LSC Class 5 land of approximately 30% of the total Project site that would be impacted by Stage 4; and
- LSC Class 6 land approximately 50% of the Project site that would be impacted by Stages 1 and 2.

None of the land within the Project site is in the highest LSC classes of land that is capable of a wide range of land uses. The largest percentage of the land within the Project site is LSC Class 6, low capability land that is capable of limited land uses. The next largest area is LSC Class 5 land that is moderate to low capability land. The small area of land in the western portion of the Project site is LSC Class 4 land of moderate capability.

The land has not previously been used for agriculture and has remained under native open forest. The land is predominately moderate to low suitability and does not restrict utilising the land for quarrying activities. The stockpiling of topsoils will ensure that the soils mapped with higher capability (Class 4 and 5 lands) are given preference for storage. These higher capability soils are considered more likely to facilitate successful rehabilitation than the lower capability Class 6 lands.

Table 9.1 Land and Soil Capability Scheme Classification

LSC Class	General definition
Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, nature conservation)	
1	**Extremely high capability land:** Land has no limitations. No special land management practices required. Land capable of all rural land uses and land management practices.
2	**Very high capability land:** Land has slight limitations. These can be managed by readily available, easily implemented management practices. Land is capable of most land uses and land management practices, including intensive cropping with cultivation.
3	**High capability land:** Land has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation.
Land capable of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)	
4	**Moderate capability land:** Land has moderate to high limitations for high-impact land uses. Will restrict land management options for regular

LSC Class	General definition
	high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.
5	**Moderate–low capability land:** Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.
Land capable for a limited set of land uses (grazing, forestry and nature	
6	**Low capability land**: Land has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation
Land generally incapable of agricultural land use (selective forestry and nature conservation)	
7	**Very low capability land**: Land has severe limitations that restrict most land uses and generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations not managed. There should be minimal disturbance of native vegetation.
8	**Extremely low capability land**: Limitations are so severe that the land is incapable of sustaining any land use apart from nature conservation. There should be no disturbance of native vegetation.

1. Sourced from OEH (2012) *The Land and Soil Capability Assessment Scheme, Second Approximation.*

9.5.3 Strategic Regional Land Use Policy

Review of the Strategic Regional Land Use Policy (SRLUP) mapping (NSW Department of Planning and Infrastructure, 2013) available on the NSW Government Sharing and Enabling Environmental Data (SEED) website identified that the Study Area does not interact with any mapped Strategic Agricultural Land. The nearest mapped Strategic Agricultural Land is to the west of the Project site adjacent to the Hastings River and to the south, south of Frogs Road of the Sancrox Interchange. The SRLUP mapping in the vicinity of the Project site is shown in bright green in *Figure 9.5*.

Figure 9.5 ***Strategic Regional Land Use Policy Mapping in Vicinity of Project Site (DPE, 2013)***

The Study Area is located outside of mapped Strategic Agricultural Land, therefore no associated land use constraints apply to the Project.

9.5.4 Regional Farmland Mapping

The Project site and the industrial zoned land immediately to the north and east are mapped as 'proposed employment lands' within the Mid North Coast Regional Farmland Mapping. The Project site falls entirely within lands classed as 'other rural land'. To the east of the Project site towards Haydon's Creek, the land remains predominately mapped as other rural land, with a small area of rural residential. The closest Regionally Significant Farmland is approximately 740m to the north of the Project site. This Regionally Significant Farmland is a band that follows the Hastings River. The Project site is located outside of mapped regionally significant farmland, and activities will not affect the farmland, therefore no associated land use constraints apply to the Project.

9.5.5 Compatibility with Other Land Uses

Clause 12 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* requires assessment of compatibility of the Project with other land uses in the vicinity, particularly agricultural land use. The investigation of the agricultural mapping databases above identified that there is no conflict with the Project site and adjacent agricultural lands.

The Project site is zoned as primary production under the 2011 Port Macquarie Hastings Local Environmental Plan, though historic aerial imagery reveals it has remained predominately unchanged (with the exception of an access track construction, a small dam and small plot of clearing between 1969 and 1989) as native open forest vegetation for approximately 58 years.

Significant public benefit will be provided by the alteration of this currently unutilised land by the Project, with a longer term, reliable supply of rock for local development projects becoming available.

The Sancrox Employment Precinct is being established to the immediate east and north of the site. The proposed expansion of quarrying activities and production of concrete and asphalt is compatible with the industrial development within the Precinct. The recent road network upgrades servicing this Precinct and the Project are of the highest standard and thus sufficient for increased truck movements created by the Project and Precinct.

The Project site will extend to the west towards rural residential areas, with mitigation measures to minimise the impacts of the quarry expansion outlined in *Chapter 18*.

Table 9.2 includes the Clause 12 considerations and details of the proposed development.

Table 9.2 Clause 12 Considerations

Clause 12 Considerations	Proposed Development
(a) (i) Consider the existing uses and approved uses of land in the vicinity of the development	The Project expansion site is situated in remnant open sclerophyll forest that is not currently used for agricultural production. An unsealed access track is located in the west of the Project site that provides access to the adjacent areas that have previously been cleared of vegetation and are used for cattle grazing. The existing quarry operates in accordance with following approvals: DA 1995/193 as modified; DA 2004/206 as modified; and DA 2006/497. The Project site is zoned as RU1 – Primary Production. To the north and south of the Project site the land continues as RU1. This is similar to the west, though there is also E2 - Environmental Conservation and R5 – Large Lot Residential with continued distance from the quarry. To the north and east of the Project site the land is classified as IN1 - General Industrial. Directly adjacent to the southern perimeter of the Project site is an area zoned as E2 – Environmental Conservation. The proposed quarry development is consistent with the zoning provisions of the RU1 zone. Extractive industries are permitted within the zone with development consent. The land to the east and north of the Project site is currently being filled for the development of an industrial precinct. The Sancrox Interchange upgrades connecting to the Pacific Highway was strategically considered for the development of the area into an Employment Precinct, including the proposed quarry expansion.

Clause 12 Considerations	Proposed Development
(a) (ii) Consider whether or not the development is likely to have a significant impact on the uses that, in the opinion of the consent authority having regard to land use trends, are likely to be the preferred uses of land in the vicinity of the development	The Sancrox Interchange upgrades connecting to the Pacific Highway was strategically considered for the development of the area into an Employment Precinct, which included the proposed quarry expansion. The trend for land use in the vicinity of the quarry expansion is towards developing an industrial precinct given the vicinity's location and strategic connection to the Pacific Highway. The proposed expansion of quarrying activities and production of concrete and asphalt is considered compatible with the industrial development within the Precinct.
(a) (iii) Consider any ways in which the development may be incompatible with any of those existing, approved or likely preferred uses	There remains small allotments of Environmental Conservation zones to the northeast, south east and further west from the site boundary. However the land uses of these areas are not directly impacted by the proposal. The impacts to the rural residential land to the west are addressed Chapter 18, with mitigation measures identified to minimise the impacts of the quarry expansion, predominantly associated with noise and air quality impacts to these receptors and traffic impacts to road users.
(b) evaluate and compare the respective public benefits of the development and the land uses referred to in paragraph (a) (i) and (ii), and	The proposed expansion of quarrying activities and production of concrete and asphalt offers additional employment opportunities to the Port Macquarie region and an on-going supply of high quality construction materials. The development of the concrete batching plant and asphalt production plant provides more competition in the market and a more local source of asphalt than is currently available. The consolidation of the concrete batching plant within the quarry significantly reduces transportation requirements for the aggregate constituents compared to an offsite plant. The reduced transportation requirements has a positive net effect on the associated fuel consumption and greenhouse gas emissions compared to a separate quarry and plant operations. Furthermore, the planned industrial development in the vicinity will become a consolidated industrial hub. Expansion of the quarry and consolidation of the proposed facilities within the site reduces the likelihood of greenfield disturbance to provide similar resources. An additional concrete recycling facility in the town of Port Macquarie increases competition and thus potential cost savings for consumers. The development of the facility to allow for recycling of concrete is considered to be ecologically sustainable development. The connected nature of the site, with the Sancrox interchange in close proximity, offers ease for access for vehicular transportation of quarry materials.
(c) evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).	Mitigation measures are outlined in Chapter 18.

9.5.6 Land Slippage

Geotechnical issues such as internal slope failure and slippages are an inherent risk to quarrying activities. The Project site has had a previous slope failure identified and specific actions developed for short and long-term management. Quarry operation management plans detail practices to be undertaken to manage such risks, including implementing the standard geotechnical stability controls outlined in *Section 9.6.4* and regular site inspections.

9.5.7 Contamination

Historical Aerial Imagery

Historical aerial imagery was obtained to ascertain the previous activities that have occurred at the Project site. The aerial imagery obtained were from:

- 8 April 1969; and
- 26 August 1989.

Historical aerial imagery available in Google Earth Pro was also reviewed, with imagery available from the following dates:

- 19 October 2009;
- 8 July 2011;
- 25 March 2013;
- 10 May 2016; and
- 15 May 2017.

The 1969, 1989 and a recent aerial are provided in *Figure 9.6*.

The review of the aerial imagery identified that the quarry site has evolved from a small area of disturbance in 1969 to a much larger operation in 1989. The dams in the south eastern and northern portions of the Project site are identifiable in the 1989 image. Evidence of quarrying is noted in the current water holding pond location. The quarry site office appears to be in a similar location as currently. The quarry void location had predominately been cleared, with quarrying undertaken in the southern most area of the current void location. Between 1969 and 1989, the area encompassed by the proposed expansion remained vegetated.

Comparison of the 1969 and 1989 images in the Study Area identified:

- the proposed expansion area remained heavily vegetated with limited human alteration;
- house paddocks as they exist today where created adjacent to Sancrox Road;

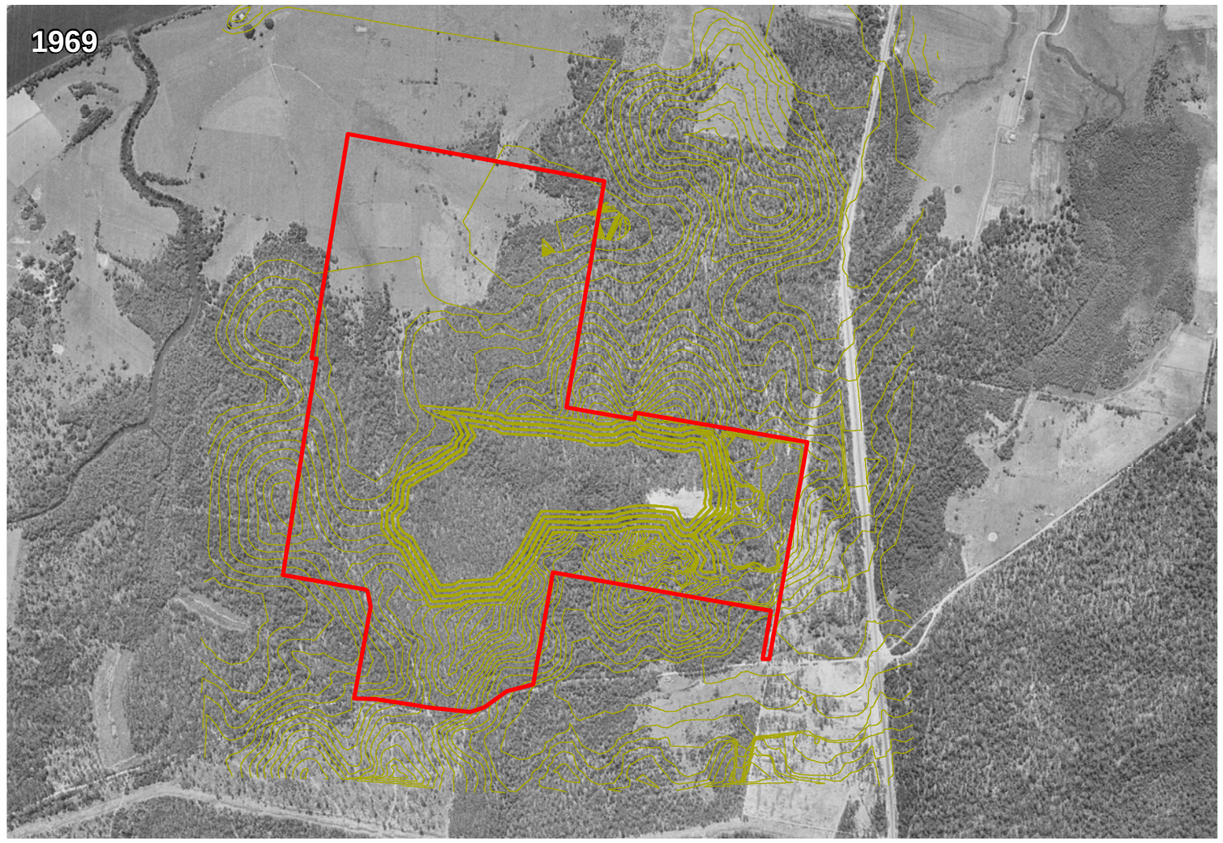
- access tracks that were present in 1969 evolved to the arc shaped more formalised track with the small cleared area at the apex of the arc (the northern part of the track and the cleared area fall within Stage four of the proposed quarry expansion and the final pit extent); and

- the dam at the western extent of the arc track was established between 1969 and 1989. The dam will be encompassed by stage four of the expansion.

There is negligible noticeable alteration to vegetation and the landscape from 1989 to the current day within the Project site.

The current level of disturbance in the proposed expansion area is limited to the creation of an unsealed access track, a dam, and small area of clearing. Limited additional vegetation clearing or human disturbance is noticeable throughout the historical aerial imagery and therefore a low likelihood for contamination exists.

There is the potential for waste materials to be present in 'dumps' within the Project site. Farmers sometimes discard unwanted items within gullies and headcuts on properties to avoid paying landfill fees. Hence, it is recommended that a site walkover be undertaken prior to clearing activities taking place to ensure that any refuse is identified and can be removed from site and disposed of at an appropriate licenced location.



Historic and Current Aerial Imagery

F 9.6

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Drawn By:	VN	Reviewed By: ME	Client: Hanson Construction Materials Pty Ltd

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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

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Section 149 Certificates

Section 149 (s149) certificates were obtained from Port Macquarie Hastings Council for Lot 353 DP 754434 and Lot 2 DP 574308. The s149 certificate contamination information for each lot is provided in *Table 9.3*.

Table 9.3 Contamination Items Discussed in the s149 Certificates

Contamination item addressed in the s149 certificates	Lot 353 DP 754434 (existing quarry lot)	Lot 2 DP 574308 (lot that quarry expansion will encompass)
Is the land to which this certificate relates significantly contaminated land within the meaning of the Contaminated Land Management Act 1997?	No	No
Is the land to which this certificate relates subject to a management order within the meaning of the Contaminated Land Management Act 1997?	No	No
Is the land to which this certificate relates subject to a management order within the meaning of the Contaminated Land Management Act 1997?	No	No
Is the land to which the certificate relates subject to an ongoing maintenance order within the meaning of the Contaminated Land Management Act 1997?	No	No
Is the land to which this certificate relates the subject of a site audit statement within the meaning of the Contaminated Land Management Act 1997 that has been provided to Council?	No	No

1. Information sourced from Port Macquarie Hastings Council supplied s149 certificates.

The s149 Certificates identify that contamination is not present at either lot. In addition, neither lot is listed on the register that is maintained for properties with loose fill asbestos insulation.

NSW EPA Contaminated Land Register

The NSW EPA contaminated land record (accessed on 26 January 2018 at http://app.epa.nsw.gov.au/prclmapp/searchregister.aspx) identified that there were no contaminated land records for the suburb of Sancrox or the wider Port Macquarie Hastings LGA.

RMS Contamination Assessment (during construction of the Sancrox Interchange)

RMS carried out a targeted contamination investigation of the Sancrox Interchange prior to commencing works in the area. The investigation was completed by GHD (2013) and identified areas of hydrocarbon contamination within soils to the south of Sancrox Road at the Expressway Spares Facility and south of Fernbank Creek Road at the RMS depot. Works undertaken during the construction of the interchange removed the area of contamination within the interchange project footprint to the south of the north western roundabout, and the contamination at the north eastern roundabout of the interchange. Underground Storage Tanks (USTs) were also identified within the Expressway Spares site that had caused hydrocarbon and heavy metal contamination to local groundwater and soils. The extent of groundwater contamination was unknown when last reported (GHD 2013) and the current status of these USTs is also unknown.

9.6 MITIGATION MEASURES

9.6.1 Soils

The stockpiling of topsoils will ensure that the soils mapped with higher capability (Class 4 and 5 lands) are given preference for storage. These higher capability soils are considered likely to improve the success of rehabilitation.

Application of lime is required to address high levels of acidity and aluminium toxicity associated with the Euroka landscape. Amelioratives will be added to other soils to address issues associated with the other landscapes. A soil sampling program will be undertaken prior to topsoil stripping to understand acidity concentrations and receive advice from the laboratory on proposed liming and ameliorative application rates.

9.6.2 Contamination

No contamination risk is present or will be introduced by the Project that would warrant not undertaking the activity. Chemical and hydrocarbon management, spill prevention and control mitigation measures as outlined in *Chapter 7* and *18* to be implemented.

A site walkover will be undertaken prior to clearing activities taking place to ensure that any refuse is identified and can be removed from site and disposed of at an appropriate licenced location.

Should unexpected contamination be identified, works will cease and an appropriately experienced contamination specialist engaged to develop a strategy to manage the contamination.

9.6.3 Erosion and Sediment Controls

Erosion and sediment controls outlined in *Chapter 7* and *18* will be implemented to prevent loss of soil and impacts to adjacent watercourses.

9.6.4 Land Slippage

Standard geotechnical controls will be implemented as required to avoid or minimise impact of land slippage including:

- Batter slope trimming - The angle of batter slopes will be reduced to the extent considered safe based on localised geology and hazardous blocks of rock removed.
- Bunds - installed as necessary at batter bases to control falling rocks
- Future bunds and material stockpiles - will be located away from top of benches where they may be subject to instability.
- Void progression - will progress along a ridgeline such that any potential inflow of surface water runoff over batter faces will be minimal. Benching will also be implemented during quarry progression.

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10 NOISE AND VIBRATION

Environmental Resources Management Australia Pty Ltd (ERM) on behalf of Hanson Construction Materials Pty Ltd (Hanson) has completed a noise and vibration impact assessment (NVIA) for the expansion of the Sancrox Quarry, located on Sancrox Road, Sancrox New South Wales (NSW).

Hanson proposes to extend the life of the quarry by expanding the approved extraction boundary to facilitate the extraction and distribution of high quality construction materials for use in civil infrastructure and road construction projects. The project will provide vital construction resources to accommodate further regional development in the Port Macquarie Hastings region. A summary of the Project and its features relative to the noise and vibration assessment are presented in *Chapter 1* of the NVIA (ERM, 2018d).

The NVIA has been prepared to document the findings of the assessment of environmental (noise, overpressure and vibration) factors, that was conducted in response to the assessment requirements specified for key issues as presented in the revised Secretary's Environmental Assessment Requirements (SEARs), dated 18 September 2017 for the Sancrox Quarry Extension Project (SSD 7293).

It should be noted that during the preparation of this report the quarry pit layout was modified in the north western corner, due to the risk of flooding identified in the Hydrology Assessment (ERM, 2018b). The updated staging layout is presented in *Chapter 2* of this EIS. Based on these minor changes to the pit layout, it is not anticipated that noise impacts will alter significantly. Therefore the original noise modelling results have been retained for this assessment.

10.1 METHODOLOGY

The assessment was conducted to achieve a scope of works that allowed for the successful identification of potential receptors situated in the vicinity and potential area of influence of site emission sources and identification of significant noise and vibration generating plant, equipment and/or activities associated with the Project and their likely/known emissions. The overall assessment methodology is presented in *Chapter 2* of the NVIA (ERM, 2018d).

The existing ambient and background noise level of the area was measured and quantified via long-term unattended noise logging and short-term operator attended noise measurements. The existing conditions at and near the project site and the measured existing ambient and background noise levels are presented in *Chapter 3* of the NVIA (ERM, 2018d).

Noise and vibration criteria (refer to *Chapter 4* of the NVIA) were developed with due regard to and in accordance with recognised NSW standards and guidelines as applicable to the quarry activities. The focus of the assessment was establishing construction noise compliance with due regard to the NSW

Department of Environment and Climate Change (DECC) – *NSW Interim Construction Noise Guideline (ICNG), July 2009*, and then operational noise compliance with regard to the NSW Environment Protection Authority (EPA) – NSW Environmental Noise Management – *Industrial Noise Policy (INP), January 2000.* The relevant INP application notes were considered as applicable to the factors being assessed. The relationship between the INP (EPA 2000) and the EPA – *Noise Policy for Industry* (NPI) that was released in October 2017 is discussed in *Section 2.4* of the NVIA.

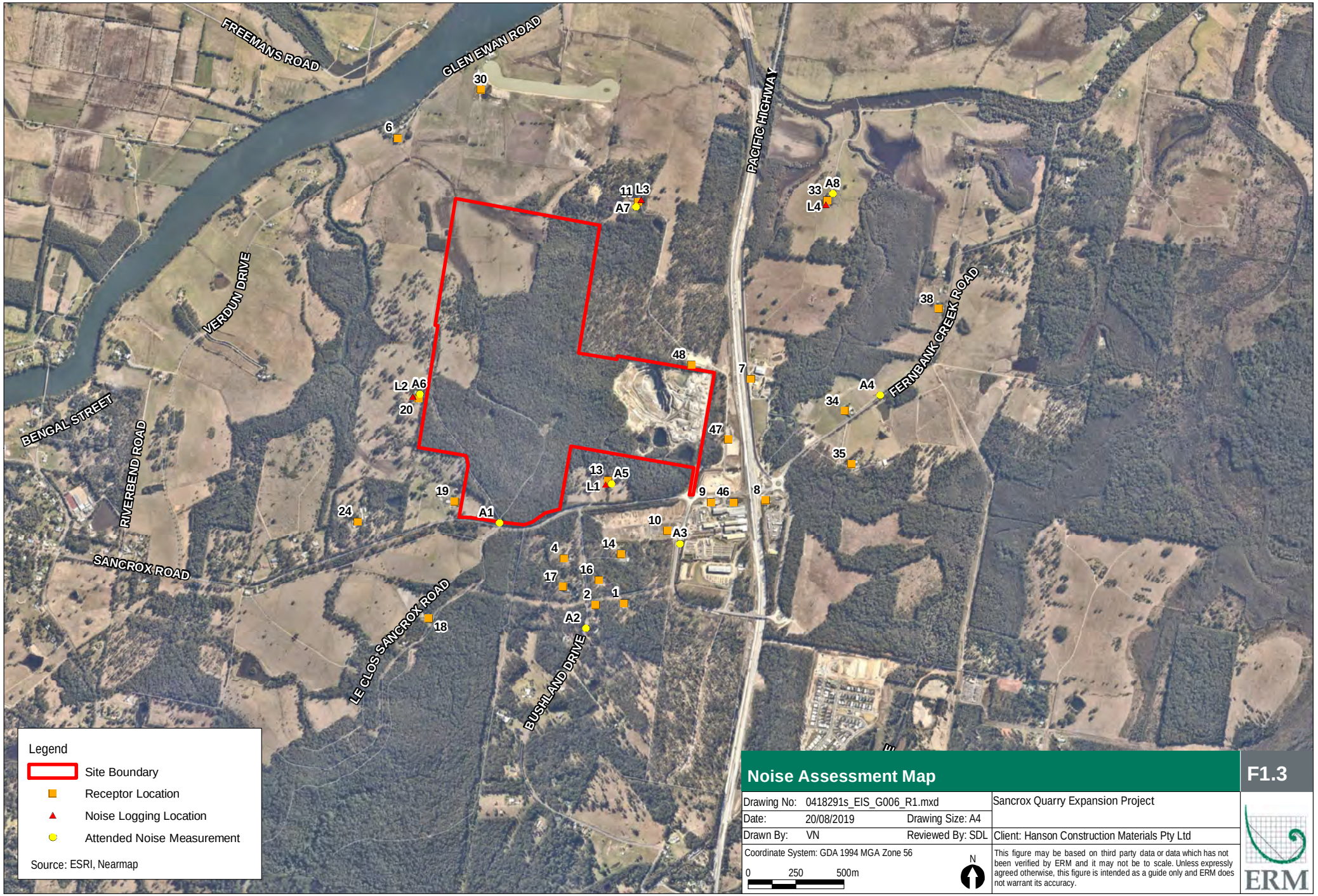
The focus of the (blasting) overpressure and vibration assessment was establishing compliance with regard to the **Standards Australia AS2187.2-2006™ (AS2187.2) – Explosives—Storage and Use Part 2: Use of Explosives.**

Applicable construction, operational and blasting assessment scenarios were developed based on project information provided by Hanson and likely noise, overpressure and vibration levels were predicted, and compared to criteria to establish compliance, evaluate potential impacts and establish potential mitigation measures if necessary to reduce levels and minimise impacts.

10.2 EXISTING ENVIRONMENT

A key element in assessing environmental noise impacts is an understanding of the existing ambient and background noise levels in the vicinity of the closest and/or potentially most affected receptors situated in proximity to the site, which are outlined in *Figure 10.1* below. The noise environment in the vicinity of the Project receptors is best described as 'rural' - defined by the INP as '*an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic.*

Despite the predominantly rural setting of the Project site, the existing noise environment of the surrounding area is under the influence of traffic noise from the nearby Pacific Highway. The existing background noise levels considered in the assessment are therefore much higher than would typically be experienced in a rural environment.


FREEMANS ROAD
GLEN EWAN ROAD
PACIFIC HIGHWAY
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
FERNBANK CREEK ROAD
30
6
11
L3
A7
33
A8
L4
38
48
7
L2
A6
20
A4
34
47
35
13
A5
L1
19
9
46
8
24
A1
10
A3
4
14
16
17
2
1
A2
18
Legend
Site Boundary
Receptor Location
Noise Logging Location
Attended Noise Measurement
Source: ESRI, Nearmap
Noise Assessment Map
F1.3
Drawing No: 0418291s_EIS_G006_R1.mxd
Sancrox Quarry Expansion Project
Date: 20/08/2019
Drawing Size: A4
Drawn By: VN
Reviewed By: SDL
Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

10.2.1 Existing Background Noise Levels

The results of long-term unattended noise logging conducted between Monday 6 November and Wednesday 22 November 2017 were analysed and compared to the short-term operator attended measurements conducted on Monday 6 November, Tuesday 7 November and Wednesday 22 November 2017. Results for both unattended and attended noise monitoring are provided in *Chapter 3.3* of the NVIA (ERM, 2018d).

In summary, the measured ambient and background noise levels presented in *Table 3.3* of the NVIA (ERM, 2018d) vary significantly, with background noise levels ranging between 36 and 48 dBA and ambient noise levels ranging between 42 and 60 dBA. However, most measurements were dominated by Pacific Highway traffic, wind-blown vegetation, some local traffic, birds and insects.

10.3 ASSESSMENT

10.3.1 Preparation of Noise Management Levels and Criteria

Both Construction and Operational Noise Management Levels (NML) were established as part of the NVIA (ERM, 2018d) based on the representative RBL values presented in Table 3.4 (where relevant) of the NVIA and in accordance with the ICNG and INP, respectively.

10.3.2 Qualitative Assessments

Potential impacts associated with **construction road traffic** and **ground-borne noise**, and impacts associated with **construction and operational vibration** were qualitatively assessed. Due to the type of equipment in use, activities that will be undertaken in the known sensitivity/distance offset to nearby receptors no impacts are anticipated and as such no further recommendations for noise and vibration mitigation, management measures or monitoring options are warranted. Further information regarding these qualitative assessments is presented in Chapter 5 of the NVIA (ERM, 2018d).

10.3.3 Construction and Operational Noise Assessments

A quantitative construction and operational noise impact assessment was then conducted by predicting noise levels via modelling. The predictions were completed for the applicable assessment scenarios and resultant noise levels compared to project-specific criteria and/or management levels at each receptor location, and any significant or characteristic features identified. These construction and operational noise assessments are the focus of the NVIA and the details of each assessment is presented in Chapter 6 (for construction) and Chapter 7 (for operation) of the NVIA. The predicted construction noise levels for each scenario and the comparison to the day time NML at each receptor location is reproduced from the NVIA as *Table 10.1* below.

The assessment has identified that both construction and operational noise levels have the potential to exceed the applicable criteria, limits and thresholds of the INP and ICNG if they are not suitably mitigated. The assessment also identified the blasting overpressure and vibration levels have only a limited potential to exceed the applicable AS2187 criteria and thresholds, as long as normal blast design planning and consideration for potential environmental impacts occurs.

Operational road traffic noise was assessed, which also included conservative calculations to determine additional permissible quarry truck trips per hour during the strictest night time road traffic noise criteria, beyond the typical operations.

Table 10.1 Predicted Construction Noise Levels – All Scenarios (SCN01 to SCN03, Lmax)

ID[1]	Type	Predicted Noise levels, $L_{eq,\ 15\ minute}$ in dBA						Comparison to Daytime NML					Sleep Disturbance
		SCN01	SCN02a	SCN02b	SCN03a	SCN03b	Lmax[2]	SCN01	SCN02a	SCN02b	SCN03a	SCN03b	
13	Residential[3]	41	37	**52**	36	**50**	38 - **57**	-7	-11	**4**	-12	**2**	**10**
14	Residential[3]	46	40	**49**	39	47	43 - **53**	-2	-8	**1**	-9	-1	**6**
1	Residential[3]	43	38	44	36	43	40 - **48**	-5	-10	-4	-12	-5	**1**
16	Residential[3]	44	39	46	37	45	41 - **51**	-4	-9	-2	-11	-3	**4**
2	Residential[3]	42	37	45	36	43	40 - **49**	-6	-11	-3	-12	-5	**2**
17	Residential[3]	43	38	46	36	44	40 - **50**	-5	-10	-2	-12	-4	**3**
4	Residential[3]	42	37	48	35	46	40 - **52**	-6	-11	0	-13	-2	**5**
18	Residential[3]	35	32	28	30	27	29 - 32	-11	-14	-18	-16	-19	-16
19	Residential[3]	37	36	36	34	35	30 - 40	-9	-10	-10	-12	-11	-8
24	Residential[3]	36	27	32	26	30	33 - 35	-10	-19	-14	-20	-16	-13
20	Residential[3]	27	25	36	24	34	24 - 28	-19	-21	-10	-22	-12	-20
6	Residential[3]	34	32	23	31	22	29 - 38	-17	-19	-28	-20	-29	-12
30	Residential[3]	38	35	26	34	25	26 - 38	-13	-16	-25	-17	-26	-12
11	Residential[3]	43	40	34	39	33	34 - 44	-8	-11	-17	-12	-18	-6
48	Potential Future Industrial	57	60	41	58	40	36 - 64	-18	-15	-34	-17	-35	-
33	Residential[3]	45	42	34	40	33	37 - 45	-7	-10	-18	-12	-19	-11
38	Residential[3]	44	40	34	39	33	36 - 43	-8	-12	-18	-13	-19	-13
7	Commercial	57	54	43	53	41	44 - 57	-13	-16	-27	-17	-29	-
47	Potential Future Industrial	56	49	46	48	45	47 - 53	-19	-26	-29	-27	-30	-
34	Residential[3]	50	46	41	44	39	41 - 50	-2	-6	-11	-8	-13	-6
35	Residential[3]	49	45	41	43	40	44 - 48	-3	-7	-11	-9	-12	-8
8	Industrial	52	48	48	46	46	48 - 52	-23	-27	-27	-29	-29	-

ID[1]	Type	Predicted Noise levels, $L_{eq,\ 15\ minute}$ in dBA						Comparison to Daytime NML					Sleep Disturbance
		SCN01	SCN02a	SCN02b	SCN03a	SCN03b	Lmax[2]	SCN01	SCN02a	SCN02b	SCN03a	SCN03b	
46	Commercial	56	51	50	49	48	50 - 55	-14	-19	-20	-21	-22	-
9	Industrial	52	47	46	45	44	47 - 50	-23	-28	-29	-30	-31	-
10	Industrial	46	39	49	37	48	44 - 53	-29	-36	-26	-38	-27	-

1. Receptor ID's have been derived from the Air Quality and Greenhouse Gas Assessment (Annex G) to ensure consistency across receptors throughout the EIS.
2. Lmax noise level in dBA.
3. The HNAML ($L_{eq,\ 15\ minute} \leq 75$ dBA) applies.
4. Sleep disturbance criterion not applicable for Commercial and Industrial receptors (i.e. not a residence/dwelling).
5. " – " indicates that an assessment of this feature does not apply for this circumstance/receptor.

10.4 POTENTIAL CUMULATIVE IMPACTS

10.4.1 Construction

As noted in *Chapter 4* of the NVIA (ERM, 2018d), the NML are based on existing noise levels measured at locations surrounding the site and focus on the direct impacts from the site under assessment. Furthermore, cumulative construction noise impacts are beyond the control of Hanson, are temporary in most circumstances and are best managed by local or state consent authorities for significant projects.

Although cumulative impacts are unlikely, as there are other construction projects proposed for the area, due care may be required of the local or state consent authorities to manage any works occurring concurrently. Where issues arise, Hanson will be able to assist by scheduling certain works or activities to minimise cumulative impacts. Given that the majority of predicted construction noise levels are compliant during the recommended standard hours of construction, cumulative impacts are highly unlikely to occur or to be dominated by this Project, if construction is limited to standard hours.

10.4.2 Operation

As noted in Section 4 of the NVIA (ERM, 2018d), the operational noise criteria (i.e. project specific noise level, PSNL) are based on existing noise levels measured at locations surrounding the Project site, such that existing conditions and industrial noise contributions are considered as part of the assessment approach. The criteria are designed to prevent any long-term increase in cumulative industrial noise. By complying with these PSNL the quarry's noise contribution, combined with that of the existing industrial noise of the area is unlikely to generate any significant cumulative noise impacts. Future cumulative impacts (i.e. due to other new developments approved in the future) are beyond the control of Hanson and are best managed by local or state consent authorities for significant projects.

10.5 MITIGATION MEASURES

Based on the findings summarised above noise mitigation, management measures and/or monitoring options were established as considered suitable to the magnitude and extent of the predicted construction and operational impacts. They are designed to reduce noise levels and minimise impacts as far as is commonly feasible and reasonable to do so and practical to implement. These measures and options are presented in Chapter 8 of the NVIA (ERM, 2018d).

Construction

Construction noise levels will be reduced and impacts (if any) minimised with the successful implementation of the recommendations provided in Section 8.1 of the NVIA. Construction noise impacts may not be reduced to imperceptible or negligible levels for all receptors during all construction activities; however the recommendations presented here will ensure that any residual impacts are minimised as far as is commonly achievable.

To ensure noise emissions associated with construction works and activities are kept to acceptable levels, the following noise mitigation and management measures are recommended:

- Noise generating work and activities will be carried out during the ICNG recommended standard hours (i.e. 7am to 6pm Monday to Friday and 8am to 1pm Saturdays), with no work on Sundays or public holidays. Any work that is required outside the recommended standard hours must be suitably managed with a goal of achieving compliant noise levels at all residential receptors or undertaken with agreement from any potentially affected neighbours.

- Where unforeseen works will occur in close proximity (<100m) to a receptor and these works are anticipated to generate high levels of noise e.g. >75 dBA, potential respite periods e.g. three hours of work, followed by one hour of respite will be considered. Respite will be implemented if it is the preference of the affected receptors and if it is feasible and reasonable to achieve during the works. In some circumstances, respite may extend the duration of works and inadvertently increase noise impacts, hence due care should be taken when considering this management measure.

- During construction planning, choose appropriate machines for each task and adopt efficient work practices to minimise the total construction period and the number of noise sources on the site. Select the quietest item of plant available where options that suit the design permit.

- During the works, avoid unnecessary noise due to idling diesel engines and fast engine speeds when lower speeds are sufficient.

- During the works, instruct drivers to travel directly to site and avoid any extended periods of engine idling at or near residential areas, especially at night.

- During any night works, any activity that has the potential to generate impulsive noise will be avoided. These types of events are particularly annoying; especially at night and have the limited potential to generate sleep disturbance or awakening impacts. Any impulsive or transient noise events expected to exceed the sleep disturbance criteria at residential receptors will be strictly avoided at night.

- During the works, ensure all machines used on the site are in good condition, with particular emphasis on exhaust silencers, covers on engines and transmissions and squeaking or rattling components. Excessively noisy machines will be repaired or removed from the site.

- During the works, ensure that all plant, equipment and vehicles movements are optimised in a forward direction to avoid triggering motion alarms that are typically required when these items are used in reverse.

- If any validated noise complaints are received, operator attended noise measurements will be undertaken to measure and compare the site noise level contributions ($L_{eq,\ 15\ minute}$ and L_{max} in dBA) to:
    - the predicted values; and
    - the NMLs presented in this report.
- All site noise levels will be measured in the absence of any influential source not associated with the site. If the measured site noise levels are below the predicted values and comply with the NMLs presented in this report, no further mitigation or management measures are required. If the measured site noise levels are above the predicted noise levels or NML presented in this report, further mitigation and/or management measures will be considered.
- Prior to commencement of works, a Construction Noise Management Plan (CNMP) will be prepared and implemented, and will consider all potential acoustical factors identified in this report including those addressed in Chapter 5 and Chapter 6 of the NVIA. The CNMP will detail any noise monitoring and take into consideration measures for reducing the source noise levels of construction equipment by construction planning and equipment selection where reasonable and feasible.

Operational

Based on preliminary noise modelling results, it was evident that operational noise levels have the potential to exceed the PSNL during daytime, evening, night time and morning shoulder periods at residential receptors to the south of the Project site across all stages of the proposed quarry expansion.

Following preliminary noise modelling Hanson was consulted to determine suitable mitigation that could be incorporated into the project design to assist in reducing noise impacts. Based on the consultation with Hanson, reasonable and feasible mitigation measures have been discussed and conceptual mitigation was modelled to achieve compliance with the PSNL for all operational assessment scenarios. This mitigation involves the following measures:

- Boundary Mitigation:
    - Earth Bunding (approximately 25 m in height, 450 m in length and 75 m in width) is required along the southern boundary of the site to provide additional shielding from the processing plant and asphalt production plant.
    - Earth Bunding (approximately 20 m in height, 250 m in length and 60 m in width) is also required at the western boundary of the pit to provide shielding from in pit activities from Stage 2 of the quarry expansion when in pit activities progress closer to Receptor 20 to the west.

- Plant / Equipment Procurement:
  - During the operational design, choose appropriate machines for each task and adopt efficient work practices to minimise the total number of noise sources on the site. Select the quietest item of plant available where options that suit the design permit, with consideration to offensive noise characteristics such as tonality, low frequency noise or impulsiveness.
  - The key items of plant/equipment are presented in Table 2.3 of the NVIA. Table 2.3 of the NVIA also details the required LW deductions for these specific items of equipment/plant and the LW required to meet most stringent night time PSNL.
  - Operational LW emissions should be at or below those presented in Table 2.3 and Table 7.1 of the NVIA. Where items of procured plant generate offensive noise characteristics, INP penalties would be applied prior to meeting the LW values presented above.
- At Source Mitigation:
  - Where LW values for plant/equipment outlined in Table 2.3 of the NVIA are not reasonable or feasible, the operational design will incorporate acoustic enclosures / barriers to assist in reducing the noise emission of identified plant/equipment. Design of acoustic enclosures / barriers would also consider offensive noise characteristics as tonality, low frequency noise or impulsiveness.

In addition to the mitigation measures outlined above, the following management measures are recommended to ensure noise emissions associated with the operation of the quarry are kept to acceptable levels:

- Avoid unnecessary noise due to idling diesel engines and fast engine speeds when lower speeds are sufficient.
- Instruct drivers to travel directly to site and avoid any extended periods of engine idling at or near residential areas, especially at night.
- During any night works, any activity that has the potential to generate impulsive noise will be avoided. These types of events are particularly annoying; especially at night and have the limited potential to generate sleep disturbance or awakening impacts. Any impulsive or transient noise events expected to exceed the sleep disturbance criteria at residential receptors will be strictly avoided at night.
- Ensure all machines used on the site are in good condition, with particular emphasis on exhaust silencers, covers on engines and transmissions and squeaking or rattling components. Excessively noisy machines will be repaired or removed from the site.
- Ensure that all plant, equipment and vehicles movements are optimised in a forward direction to avoid triggering motion alarms that are typically required when these items are used in reverse.
- Noisy plant and equipment will be located as far as possible from noise sensitive areas.

- The location of activities, plant and equipment will optimise attenuation effects through measures such as topography, natural and purpose built barriers.
- If any validated noise complaints are received, operator attended noise measurements will be undertaken to measure and compare the site noise level contributions (Leq, 15 minute and Lmax in dBA) to:
  - the predicted values; and
  - the PSNLs presented in the NVIA.

All site noise levels will be measured in the absence of any influential source not associated with the site. If the measured site noise levels are below the predicted values and comply with the PSNLs presented in the NVIA, no further mitigation or management measures are required. If the measured site noise levels are above the predicted noise levels or PSNLs presented in the NVIA, further mitigation and/or management measures will be considered.

A Detailed Design Noise Impact Assessment will be undertaken during the final stages of the project design to ensure that noise emissions from the Processing Plant and Asphalt Production Plant can be effectively reduced to compliant levels through plant / equipment procurement and construction of acoustic enclosures / barriers. An Operational Noise Management Plan (ONMP) will also be prepared based on the detailed design, which will detail any noise monitoring and take into consideration measures for reducing the source noise levels of operational equipment by equipment selection, management and mitigation where reasonable and feasible.

In accordance with the SEARs, this assessment has considered the characterisation of impacts and potential treatment as per the INP and with due regard to the principles presented in the Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum Production and Extractive Industry Developments (VLAMP, September 2018). As stated in Section 7.2 of the NVIA (ERM, 2018d), noise has been assessed at receptor locations in accordance with the INP i.e. the most-affected point on or within the property boundary or, if that is more than 30 m from the residence, at the most-affected point within 30 m of the residence. The objective of the noise assessment and broader EIS is to identify that emissions from the quarry will comply (with noise reducing mitigation implemented) at the most affected location for all receptors assessed. Hence, further assessment regarding the VLAMP as demonstrated in the Figure 2.1 of the NVIA, including assessment of noise exceedance over more than 25% of a property is not necessary.

Operational noise levels will be reduced and impacts (if any) minimised with the successful implementation of the recommendations provided in Section 8.2 of the NVIA (ERM, 2018d). Operational noise impacts may not be reduced to imperceptible or negligible levels for all receptors during all operations; however the recommendations presented here will assist to ensure that any residual impacts are minimised as far as is commonly achievable.

Operational road traffic noise levels were predicted to comply with the relevant RNP criteria. Conservative calculations to determine permissible night time truck volumes determined that the total number of truck trips permissible on a local road during the night time period is 18 truck trips (36 movements). The total number of trips permissible within any hour during the night time period is 12 trips/ hour (24 movements/hour), noting that the truck trip limit for the total night time period cannot be exceeded. The estimated allowable hourly night truck movements, based on road traffic noise criteria, is well in excess of the anticipated typical quarry vehicle trips used in the modelling on typical operating hours.

Operational road traffic noise from the quarry may be audible at times but noise levels will be reduced and impacts (if any) minimised with the successful implementation of the recommendations provided in Section 8.2 of the NVIA.

10.5.1 Potential Monitoring Options

Blast Monitoring

As outlined in Section 4.3.2 of the NVIA monitoring is required for all blast events carried out in or on the premises. Air-blast overpressure and ground vibration levels must be measured at any point within one metre of any affected residential boundary or other noise sensitive location, such as a school or hospital for all blasts carried out in or on the premises. In addition, the licensee must monitor all blasts carried out in or on the premises at or near the nearest residence or noise sensitive location that is likely to be most affected by the blast.

Construction / Operational Noise Monitoring

Construction and operational noise monitoring will also be undertaken for the Project however, the type and frequency could be adapted according to type of work. Noise monitoring would occur in the form of attended noise measurements and/or unattended real-time noise monitoring.

As stated above the details of these monitoring measures would be outlined in the Construction Noise Management Plan and the Operation Noise Management Plan.

Key Technical Features

All noise measurement procedures adopted for the Project will be conducted in accordance with the requirements of Australian Standard (AS) 1055:1997 *Acoustics - Description and Measurement of Environmental Noise*.

Attended noise measurements would be conducted by an operator using a hand held Type 1 or Type 2 'integrating-averaging' sound level meter. All measurements would be completed with the sound level meter mounted to a tripod (if possible) and with a windscreen fitted. The preferred measurement height is 1.2 m to 1.5 m above the ground.

The device will be calibrated prior to and after all measurement rounds, with any change in calibration levels noted. Instantaneous noise levels for all noted noise emission sources (extraneous or otherwise), meteorological conditions (average and maximum wind speeds, temperature, precipitation and cloud cover etc.) would be recorded during all measurements. The location of monitoring, time of measurement and all relevant measurement parameters (i.e. L_{eq}, L_{min}, L_{max}, L_1, L_{10} and L_{90}) would also be recorded. Noise monitoring would not be completed during periods where wind speeds exceed 5 m/s at the microphone or during any rain events.

Unattended noise measurements would be conducted using a Type 1 or Type 2 environmental noise logger. The device will be calibrated prior to and after installation, with any change in calibration levels noted. Measurements will be completed with a windscreen fitted.

Noise monitoring would not be completed within 3.5 m of any reflective structure or wall, if possible. Where it is not possible to measure more than 3.5 m from any reflective structure or wall, a reduction of up to 2.5 dB would be applied to the measured ambient and site noise contribution ($L_{eq, 15minute}$) to account for the likely increase in noise associated with reflective surfaces.

Monitoring will be conducted with due regard to AS1055; AS61672, AS1259 (or similar); IEC60942; or the NSW Vibration Guideline as relevant to the monitoring being conducted.

All noise samples would be recorded using the "fast" time response of the sound level meter or environmental noise logger. Site activity records would be maintained during any noise (or vibration) monitoring events.

Noise Monitoring Locations

Noise measurements would be undertaken at the potentially most affected receptor locations identified in this report (dependant on phase of works/scenario). Monitoring would occur at the following receptors at minimum to represent receptors surrounding the site: Receptors 13 and 14 to the south, receptor 20 to the west, receptor 11 to the north and receptor 34 to the east (refer *Figure 10.1*).

Recommendations

It is recommended that within the first three months of commercial operation, noise verification and compliance monitoring be conducted to measure and compare the site noise level contributions ($L_{eq, 15minutes}$ in dBA) to a) the predicted values, and b) the criteria presented in this report.

The same would occur if any validated noise complaints are received. All site noise levels would be measured in the absence of any influential sources not associated with the project. If the measured site noise levels are below the predicted values and noise levels comply with the criteria presented in this report, no further mitigation or management measures would be required. If the measured site levels are above the predicted noise levels and/or criteria presented in this report, further mitigation and/or management measures will be required.

10.6 CONCLUSION

The assessment has identified that both construction and operational noise levels have the potential to exceed the applicable criteria, limits and thresholds of the INP and ICNG if they are not suitably mitigated. The assessment also identified the blasting overpressure and vibration levels have only a limited potential to exceed the applicable *AS2187* criteria and thresholds, as long as normal blast design planning and consideration for potential environmental impacts occurs.

Based on the findings summarised above noise mitigation, management measures and monitoring options were recommended as considered suitable to the magnitude and extent of the predicted construction and operational impacts. They are designed to reduce noise levels and minimise impacts as far as is commonly feasible and reasonable to do so and practical to implement. These measures and options are presented in *Section 10.5*.

Construction noise levels will be reduced and impacts (if any) minimised with the successful implementation of the recommendations provided in *Section 10.5*. Construction noise impacts may not be reduced to imperceptible or negligible levels for all receptors during all construction activities; however the recommendations will ensure that any residual impacts are minimised as far as possible and commonly achievable via good construction management practices.

Preliminary operational noise levels were predicted to exceed the applicable INP operational noise criteria and limits for all modelled conditions. As such, noise mitigation and management measures were established to assist in achieving compliance with the INP. These measures are presented in *Section 10.5*.

Australian and New Zealand Environment Council (ANZEC) – 1990, **Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration**, September 1990.

Department of Planning and Environment (DPE) - **Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments**, September 2018.

Environmental Resources Management Australia (ERM) - **Sancrox Quarry Expansion Noise and Vibration Impact Assessment,** February 2018.

International Organisation for Standardisation (ISO) 9613-2:1996 (ISO9613:2) - **Acoustics - Attenuation of Sound during Propagation Outdoors - Part 2: General Method of Calculation.**

German Institute for Standardisation – DIN 4150 (1999-02) Part 3 (DIN4150-3) – **Structural Vibration - Effects of Vibration on Structures.**

NSW Environment Protection Authority – **NSW Environmental Noise Management – Industrial Noise Policy** (INP), January 2000 and relevant application notes.

NSW Department of Environment and Climate Change – **NSW Interim Construction Noise Guideline** (ICNG), July 2009.

NSW Department of Environment, Climate Change and Water – **NSW Road Noise Policy** (RNP), March 2011.

NSW Department of Environment and Conservation – **NSW Environmental Noise Management – Assessing Vibration: a Technical Guideline** (the NSW vibration guideline), February 2006.

NSW Government – Transport for NSW (TfNSW) **Construction Noise Strategy** (7TP-ST-157/2.0), dated April 2013.

Standards Australia AS1055–1997™ (AS1055) – **Description and Measurement of Environmental Noise**: Parts 1, 2 and 3 as applicable.

Standards Australia AS IEC 61672.1–2004™ (AS61672) – **Electro Acoustics - Sound Level Meters Specifications Monitoring** or Standards Australia AS1259.2-1990™ (AS1259) – **Acoustics – Sound Level Meters – Integrating Averaging as relevant to the devic**e.

Standards Australia AS/IEC 60942:2004/IEC 60942:2003 (IEC60942) – Australian Standard™ – **Electroacoustics – Sound Calibrators.**

Standards Australia AS2187.2-2006™ (AS2187.2) – **Explosives—Storage and Use Part 2: Use of Explosives.**

Standards Australia AS 2436–2010™ (AS2436) – **Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites.**

United Kingdom (UK) – **Calculation of Road Traffic Noise** (CoRTN) calculative methods, adapted to Australia conditions.

11 AIR QUALITY AND GREENHOUSE GAS

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by Hanson Construction Materials Pty Ltd (Hanson) to undertake specialist assessments to inform the Environmental Impact Statement (EIS) for the proposed Sancrox Quarry Extension Project (the 'Project').

The Air Quality and Greenhouse Gas (GHG) Assessment (*Annex G* of this EIS) has been prepared in accordance with the latest version of Secretary's Environmental Assessment Requirements (SEARs) for the preparation of an EIS for the Sancrox Quarry Extension Project (Department of Planning and Environment, 2017) and forms the air quality assessment for the EIS to be submitted to the NSW Department of Planning and Environment (DP&E).

The general scope of works undertaken throughout the assessment include:

- Assessment of potential for ambient air quality impacts and greenhouse gas emissions from construction and operation of the proposed Project;
- Provision of mitigation measures to minimise impacts to the surrounding land use; and
- Recommendations for ambient monitoring to ensure compliance with legislation.

This chapter summarises the methodology, results, adopted mitigation measures and recommendations outlined throughout the Air Quality and GHG Assessment (ERM, 2018e).

11.1 METHODOLOGY

The Project has the potential for ambient air quality impacts and greenhouse gas emissions from the construction and operation of the following:

Quarry, including:	Concrete Batching Plant, including:	Concrete Recycling Plant, including:	Asphalt Plant, including:
• Drilling;	• Dry product delivery;	• Product delivery;	• Bitumen delivery and storage;
• Blasting;	• Product storage;	• Product storage;	• High quality aggregate delivery and storage;
• Product handling;	• Product transfer;	• Product handling;	• Dryer emissions;
• Rock processing;	• Pneumatic unloading of moist product;	• Crushing, using primary crusher; and	• Truck load out; and

Quarry, including:	Concrete Batching Plant, including:	Concrete Recycling Plant, including:	Asphalt Plant, including:
• Wheel generated dust; and	• Weight hopper and mixer unloading; and	• Wheel generated dust.	• Wheel generated dust.
• Wind generated dust.	• Wheel generated dust.		

The following sections provide the summary of the methodologies adopted in Air Quality and GHG assessments.

11.1.1 Air Quality Assessment

The primary emissions from the sources considered in the assessment were TSP, PM_{10}, $PM_{2.5}$ and deposited dust. Concrete batching and asphalt plants however have the potential to emit additional species. All potential species emitted to atmosphere from the Project sources were identified through consideration of published emission factor databases including:

- NPI Emission Estimation Technique Manual for Mining Version 3.1 (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012);
- NPI Emission Estimation Technique Manual for Mining and Processing of Non-Metallic Minerals Version 2.1 (Australian Government Department of the Environment, 2014);
- United States Environment Protection Agency AP-42 Air Emissions Factors and Quantification, Chapter 11: Mineral Products Industry, Section 11.12 Concrete Batching (United States Environmental Protection Agency, 2006); and
- United States Environment Protection Agency AP-42 Air Emissions Factors and Quantification, Chapter 11: Mineral Products Industry, Section 11.1 Hot Mix Asphalt Plants (United States Environmental Protection Agency, 2004).

The criteria for all the emitted species were established through consideration of the following legislation and guidelines:

- POEO Clean Air Regulation 2010 (New South Wales Government, 2017);
- Approved Methods for the Assessment of Air Pollutants in NSW (State of NSW and Environment Protection Authority, 2016);
- National Environment Protection Measures (Australian Government, 2016);

- Other international legislations:
    - Ontario Regulation 419/06: Air Pollution – Local Air Quality (Government of Ontario, 2017);
- Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (NSW Government, 2018); and
- Protocol for Environmental Management Mining and Extractive Industries (Environment Protection Authority Victoria, 2007).

Initially, a screening assessment was undertaken for the species other than particulate matter, using the 'UK Air emissions risk assessment for your environmental permit' guidance (UK Guidance). The species that could not be screened out using the criteria provided in the UK Guidance were further considered through the use of atmospheric dispersion modelling.

Atmospheric dispersion modelling was undertaken using the California Puff (CALPUFF) dispersion model for the latest five year period (2012 to 2016 inclusive). The dispersion modelling was completed using site-specific meteorology predicted using a two-step process:

- Prognostic modelling using TAPM (developed by CSIRO); and
- Diagnostic modelling using CALMET (the meteorological pre-processor for the CALPUFF dispersion model).

The configuration of the emission sources within the CALPUFF dispersion model comprised a combination of volume, point and road sources.

The assessment adopted background values for PM_{10} and $PM_{2.5}$ from Wyong air quality monitoring stations, which was considered to be the most representative of background concentrations for the project area from the data available.

11.1.2 GHG Assessment

GHG emissions from the Project have been estimated based on the methods outlined in the following documents:

- The World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard Revised Edition ("the GHG Protocol") (World Business Council for Sustainable Development, World Resources Institute, 2015);
- The National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Australian Government Department of the Environment and Energy, 2011);

- The Australian Government Department of Environment and Energy National Greenhouse and Energy Reporting Scheme Measurement – Technical Guidelines for the estimation of emissions by facilities in Australia (Australian Government Department of the Environment and Energy, 2017a);

- The Australian Government Department of Environment and Energy National Greenhouse Accounts (NGA) Factors July 2017 (Australian Government Department of the Environment and Energy, 2017b);

- The Mining Association of Canada Towards Sustainable Mining – Energy and GHG Emissions Management Reference Guide (The Mining Association of Canada, 2014); and

- Australia Transport Authorities Greenhouse Group, Greenhouse Gas Assessment Workbook for Road Projects (Transport Authorities Greenhouse Group Australia and New Zealand, 2013).

In the absence of Project specific requirement under the SEARs and in line with the NGER legislation, the estimation of GHG emissions from the Project was limited to Scope 1 and Scope 2 emissions, as defined in Australian GHG reporting and measurement methods (Australian Government Department of the Environment and Energy, 2011).

11.2 RESULTS

Air Quality Assessment

A summary of the air quality modelling predictions against all applicable criteria at each receptor location is presented in *Table 11.1* below. Sensitive receptors within the vicinity of the proposed project are outlined in *Figure 11.*1 below. Predicted concentrations for all other species other than PM_{10} and $PM_{2.5}$ are outlined in Section 8.3 of the Air Quality and GHG Assessment (ERM, 2018e).

Table 11.1 Dispersion model results and comparison to assessment criteria.

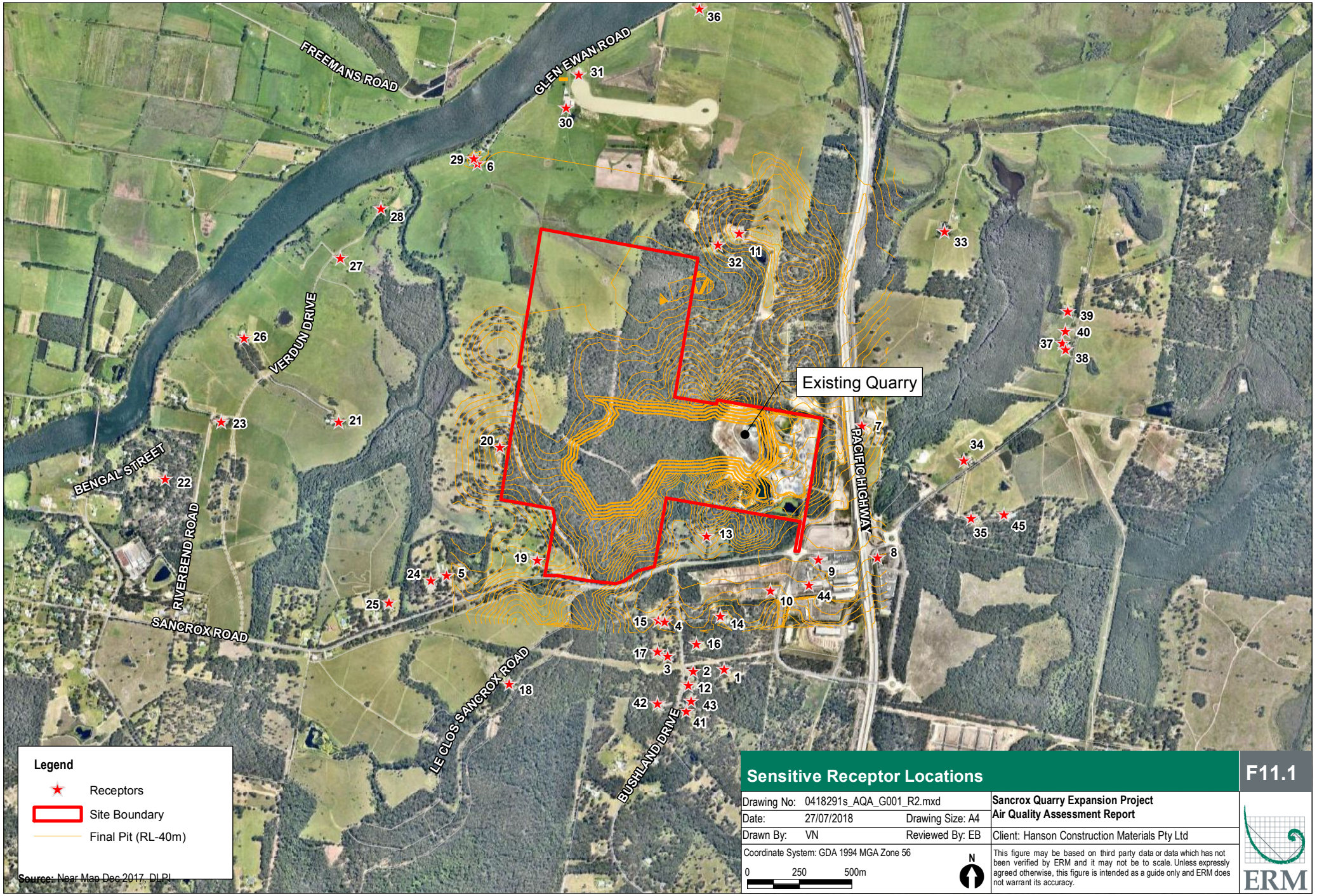
Receptor ID	Level 1 Assessment of PM10 concentrations		Level 2 Assessment of PM10 concentrations		Level 1 Assessment of PM2.5 concentrations		Level 2 Assessment of PM2.5 concentrations	
	Predicted PM10 Concentrations (µg/m3) Maximum impact (increment)		Predicted 24 Hour PM10 Concentrations (µg/m3)		Predicted PM2.5 Concentrations (µg/m3) Maximum impact (increment)		Predicted 24 Hour PM2.5 Concentrations (µg/m3)	
	24 Hour Average	Annual Mean	Maximum Cumulative impact	Maximum Site Contribution (incremental impact)	24 Hour Average	Annual Mean	Maximum Cumulative impact	Maximum Site Contribution (incremental impact)
1	52.7 (3.4)	17.4 (0.76)	50.1	3.4	25.04 (0.9)	6.9 (0.2)	23.3	0.9
2	53.7 (4.2)	17.4 (0.78)	50.1	4.2	25.04 (0.9)	6.9 (0.2)	23.3	0.9
3	56.7 (7.2)	17.5 (0.91)	51.0	7.2	25.6 (2)	6.9 (0.2)	23.3	2.0
4	59.6 (10.1)	18 (1.37)	51.7	10.1	26.6 (4.2)	7 (0.3)	23.3	4.2
5	53.1 (3.6)	16.8 (0.22)	49.6	3.6	24.7 (1.1)	6.8 (0.1)	23.3	1.1
6	50.5 (1.2)	16.7 (0.05)	49.4	1.2	24.3 (0.3)	6.7 (0)	23.3	0.3
7	56.2 (6.7)	17.5 (0.97)	49.4	6.7	26 (2.6)	6.9 (0.2)	23.3	2.6
8	52.3 (3.7)	17.1 (0.65)	49.4	3.7	24.9 (1.1)	6.8 (0.2)	23.3	1.1
9	55.6 (6.1)	17.5 (1.07)	49.7	6.1	25.7 (2.3)	6.9 (0.3)	23.3	2.3
10	53.9 (4.4)	17.5 (1)	49.9	4.4	25.3 (1.1)	6.9 (0.2)	23.3	1.1
11	52.1 (3.5)	16.8 (0.28)	49.4	3.5	25.6 (2)	6.8 (0.1)	23.6	2.0
12	54.1 (4.6)	17.3 (0.65)	50.1	4.6	24.99 (0.8)	6.9 (0.2)	23.3	0.8
13	60.6 (16.8)	20.2 (4)	56.5	16.8	26.8 (3.1)	7.6 (1)	23.4	3.1
14	53 (3.8)	17.6 (0.98)	50.6	3.8	24.96 (0.8)	6.9 (0.2)	23.3	0.8
15	57.3 (7.8)	17.9 (1.33)	51.5	7.8	26.3 (3.7)	7 (0.3)	23.3	3.7
16	52.5 (3.3)	17.4 (0.83)	50.4	3.3	24.95 (0.8)	6.9 (0.2)	23.3	0.8
17	56.3 (6.8)	17.6 (0.97)	51.3	6.8	25.9 (2.9)	6.9 (0.2)	23.3	2.9
18	52.4 (3.6)	16.9 (0.35)	50.4	3.6	24.97 (1)	6.8 (0.1)	23.3	1.0
19	56.1 (14.5)	17.4 (0.76)	50.5	14.5	25.6 (2.3)	6.9 (0.2)	23.3	2.3
20	54.6 (7.3)	16.8 (0.25)	49.4	7.3	25.3 (1.8)	6.8 (0.1)	23.3	1.8

Receptor ID	Level 1 Assessment of PM10 concentrations		Level 2 Assessment of PM10 concentrations		Level 1 Assessment of PM2.5 concentrations		Level 2 Assessment of PM2.5 concentrations	
	Predicted PM10 Concentrations (µg/m3) Maximum impact (increment)		Predicted 24 Hour PM10 Concentrations (µg/m3)		Predicted PM2.5 Concentrations (µg/m3) Maximum impact (increment)		Predicted 24 Hour PM2.5 Concentrations (µg/m3)	
	24 Hour Average	Annual Mean	Maximum Cumulative impact	Maximum Site Contribution (incremental impact)	24 Hour Average	Annual Mean	Maximum Cumulative impact	Maximum Site Contribution (incremental impact)
21	50.8 (2.2)	16.7 (0.06)	49.4	2.2	24.5 (0.6)	6.7 (0)	23.3	0.6
22	49.97 (0.8)	16.6 (0.02)	49.4	0.8	24.3 (0.2)	6.7 (0)	23.3	0.2
23	49.98 (1.5)	16.6 (0.03)	49.4	1.5	24.4 (0.3)	6.7 (0)	23.3	0.3
24	52.4 (2.9)	16.8 (0.18)	49.5	2.9	24.6 (0.9)	6.7 (0)	23.3	0.9
25	51.2 (1.8)	16.7 (0.12)	49.5	1.8	24.5 (0.6)	6.7 (0)	23.3	0.6
26	50.4 (1.4)	16.6 (0.04)	49.4	1.4	24.4 (0.5)	6.7 (0)	23.3	0.5
27	50.6 (1.8)	16.6 (0.04)	49.4	1.8	24.4 (0.4)	6.7 (0)	23.3	0.4
28	50.8 (1.8)	16.6 (0.04)	49.4	1.8	24.3 (0.2)	6.7 (0)	23.3	0.2
29	50.4 (1.2)	16.7 (0.05)	49.4	1.2	24.3 (0.3)	6.7 (0)	23.3	0.3
30	51 (1.5)	16.7 (0.08)	49.4	1.5	24.9 (0.7)	6.7 (0)	23.3	0.7
31	50.8 (1.3)	16.7 (0.07)	49.4	1.3	24.9 (0.7)	6.7 (0)	23.3	0.7
32	52.4 (3.7)	16.9 (0.32)	49.4	3.7	25.7 (2.1)	6.8 (0.1)	23.8	2.1
33	50.8 (1.6)	16.8 (0.2)	49.4	1.6	24.8 (0.8)	6.8 (0.1)	23.3	0.8
34	52.1 (3.5)	17.2 (0.59)	49.4	3.5	24.9 (1.1)	6.8 (0.1)	23.3	1.1
35	51.8 (2.6)	17 (0.49)	49.4	2.6	24.8 (0.8)	6.8 (0.1)	23.3	0.8
36	50.5 (1)	16.7 (0.09)	49.4	1.0	24.6 (0.5)	6.7 (0)	23.5	0.5
37	51.1 (1.7)	16.8 (0.2)	49.4	1.7	24.6 (0.7)	6.8 (0.1)	23.3	0.7
38	51 (1.7)	16.8 (0.19)	49.4	1.7	24.6 (0.6)	6.8 (0.1)	23.3	0.6
39	51.3 (1.8)	16.8 (0.2)	49.4	1.8	24.6 (0.8)	6.8 (0.1)	23.3	0.8
40	51.1 (1.6)	16.8 (0.2)	49.4	1.6	24.6 (0.8)	6.8 (0.1)	23.3	0.8
41	52.8 (3.3)	17.1 (0.47)	49.99	3.3	24.8 (0.6)	6.8 (0.1)	23.3	0.6
42	51.9 (2.9)	17.1 (0.54)	50.5	2.9	25.1 (1.3)	6.8 (0.1)	23.3	1.3

Receptor ID	Level 1 Assessment of PM10 concentrations		Level 2 Assessment of PM10 concentrations		Level 1 Assessment of PM2.5 concentrations		Level 2 Assessment of PM2.5 concentrations	
	Predicted PM10 Concentrations (µg/m3) Maximum impact (increment)		Predicted 24 Hour PM10 Concentrations (µg/m3)		Predicted PM2.5 Concentrations (µg/m3) Maximum impact (increment)		Predicted 24 Hour PM2.5 Concentrations (µg/m3)	
	24 Hour Average	Annual Mean	Maximum Cumulative impact	Maximum Site Contribution (incremental impact)	24 Hour Average	Annual Mean	Maximum Cumulative impact	Maximum Site Contribution (incremental impact)
43	**53.1 (3.6)**	**17.1 (0.54)**	**49.98**	**3.6**	**24.8 (0.6)**	**6.8 (0.1)**	**23.3**	**0.6**
44	**53.3 (4.4)**	**17.4 (0.89)**	**49.6**	**4.4**	**25.1 (1.4)**	**6.9 (0.2)**	**23.3**	**1.4**
45	**51.7 (2.3)**	**17 (0.41)**	**49.4**	**2.3**	**24.8 (0.6)**	**6.8 (0.1)**	**23.3**	**0.6**
Criterion	**50[1]**	**25[1]**	**50[1]**	**50[2]**	**25[1]**	**8[1]**	**25[1]**	**-**

1. Source: (State of NSW and Environment Protection Authority, 2016)

2. Source: (NSW Government, 2018)


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
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Legend
Receptors
Site Boundary
Final Pit (RL-40m)
Source: Near Map Dec 2017, DLPI
Sensitive Receptor Locations
F11.1
Drawing No: 0418291s_AQA_G001_R2.mxd
Date: 27/07/2018
Drawing Size: A4
Drawn By: VN
Reviewed By: EB
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Sancrox Quarry Expansion Project
Air Quality Assessment Report
Client: Hanson Construction Materials Pty Ltd
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The results of the air quality modelling indicate the following:

- The cumulative annual mean concentrations of PM_{10} are below the Approved Methods criterion at all sensitive receptors;
- Contemporaneous analysis identified that the cumulative (background plus project contribution) PM_{10} 24-hour average predicted concentrations indicate exceedances of the Approved Methods Criterion at 13 sensitive receptors.
- Where exceedance of the Approved Methods Criterion occurs, a state significant extractive development may be assessed against the criteria contained in the Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (NSW Government, 2018). As the predicted incremental project impacts at the sensitive receptor locations do not exceed particulate matter mitigation criteria contained in the Policy, the level of impact to surrounding sensitive receptors is considered to be acceptable.
- The cumulative annual mean concentrations of $PM_{2.5}$ are below the Approved Methods criterion at all sensitive receptors;
- Contemporaneous analysis of the $PM_{2.5}$ 24-hour average predicted concentrations are below the Approved Methods Criterion at all sensitive receptors;
- The predicted concentrations for all other species are below the adopted criteria at all sensitive receptor locations.

11.2.1 GHG Assessment

The Project over its entire life cycle is estimated to release approximately 48.4 million tonnes of CO_2-e into the atmosphere with scope 1 and scope 2 emissions accounting for 74% and 26% respectively of the total emissions. The main GHG emission sources over the life of the project representing 99% of all emissions are:

- Operations – Diesel for transport related purposes (38%)
- Operations – Electricity (26%)
- Operations – LNG (16%)
- Construction – Vegetation clearing (12%)
- Operations – Diesel for stationary energy purposes (6%)

Peak Scope 1 and Scope 2 emissions from the Project (approximately 0.0054 Mt CO_2-e during Year 7/Year8) represent approximately 0.0010% of Australia's commitment for annual emissions under the Kyoto Protocol (550.2 Mt CO2-e/annum for 2016-17). In comparison to the 2015 GHG emissions in NSW, the project emissions account for approximately 0.0041%. When compared to the 2015 GHG emission levels from all Mining sources in Australia (74.5 Mt CO_2-e), the Project accounts to 0.0073%.

11.3 MITIGATION MEASURES

The Air Quality and GHG Assessment considered all reasonable and feasible mitigation measures to minimise the emissions from the proposed activities at the site, including:

- Roads, which are likely to remain unchanged throughout the Project stages and to be frequently used by machinery, will be sealed using asphalt and swept daily to minimise wheel-generated dust emissions;
- Full dust extraction system for drilling;
- Utilisation of water sprays during truck rear dumping;
- The use of mobile sprinkler systems during the operation of FELs;
- Dust suppression measures such as water sprays in place at the crushers and screeners;
- Water sprays used on all conveyor transfer points;
- The conveyor loading to be enclosed by a shroud;
- Level 2 watering (more than 2 litres/m^2/hour) applied to unsealed roads to minimise impact from hauling;
- Water sprays to be utilised to minimise wind erosion from stockpiles during wind speeds of over 5.4 metres per second;
- The dry product delivered to the concrete batching, concrete recycling and asphalt plants to be stored in aggregate storage bins enclosed on three sides. The walls to extend one metre above the height of the maximum quantity of raw material, and two metre beyond the front of the stockpile. The aggregate storage bins to be fitted with water sprays to keep the stored material damp at all times;
- Cement and cement supplement to be delivered to the concrete batching plant in the agitator trucks and pneumatically fed to the bottom-loaded silos;

- Concrete batching loading point to be totally enclosed with all particulate matter emissions generated by the facility captured by one bag filter located above the pan mixer;

- Concrete recycling facility outloading to be directly to processed material storage bins enclosed on three sides. The walls to extend one metre above the height of the maximum quantity of raw material, and two metre beyond the front of the stockpile. The recycled concrete storage bins to be fitted with water sprays to keep the stored material damp at all times;

- Vapour balancing system to be installed for the delivery of bitumen at the asphalt plant;

- Asphalt plant will be totally enclosed. All particulate matter emissions generated at the plant will be captured by one fabric filter associated with the natural-gas fired dryer; and

- Vapour recovery system to be employed for transfer of asphalt to trucks.

11.4 RECOMMENDATIONS

It is recommended that the Site additionally employs a real-time ambient air quality monitoring system. This will allow staff to identify when additional mitigation measures are to be implemented to minimise impact from the onsite activities on days when the background concentrations of PM_{10} and $PM_{2.5}$ exceed the criteria set by the Approved Methods.

Given the proximity of Receptor 13 to the site boundary and moderate occurrence of winds from the north-western and north-eastern directions (Figure 4.1 of *Annex G* of this EIS), it is recommended that one real-time monitor is placed along the southern boundary of the Site to capture the Site emissions and another monitor is placed along the northern boundary to obtain background concentrations when the winds are blowing from offsite.

Additionally, Table 10.1 of the Air Quality and GHG Assessment provides recommendations to ensure minimisation of air quality impact to the surrounding land use as a result of construction activities. These mitigation measures are to be considered in the event that a Construction Air Quality Management Plan (or similar) is required during construction of the proposed project.

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12 TRAFFIC AND ACCESS

12.1 METHODOLOGY

The Austroads (2005) *Guide to Traffic Engineering Practice- Part 5: Intersections at Grade* was referred to in the development of this traffic and access assessment.

A previous traffic assessment that included peak hour counts was undertaken by TTM in 2013 for the previous quarry expansion. Information from the TTM (2013) traffic assessment is used in this assessment where considered relevant. Port Macquarie Hastings Council identified that no traffic count data has been collected for the Sancrox Road in the vicinity of the quarry since the upgrade in the locality to the Sancrox Interchange. Local road traffic volume data was sourced from the aforementioned TTM (2013) report, with extrapolation as required.

Accident data was supplied by Transport for New South Wales.

Increases in traffic volumes associated with the proposed production increase were estimated by Hanson staff, and by extrapolation of truck count data collected over the course of one year by Hanson.

A road safety audit was not undertaken due to the recent upgrades of the Sancrox Interchange and the Pacific Highway, which were constructed to modern quality and safety requirements. The Sancrox Interchange design considered the increase in heavy vehicle traffic associated with the development of the area into an Employment Precinct, as well as the proposed quarry expansion.

The assessment was prepared by Senior Environmental Scientist Tim Haydon. Tim has over ten years consulting experience in the local region and has prepared numerous traffic and intersection assessments for proposed developments across NSW.

12.2 EXISTING CONDITIONS

12.2.1 Current Road Conditions

The existing road network surrounding the Project is provided in *Figure 12.1*.

Sancrox Interchange

The quarry is serviced by the Sancrox Interchange, which is a two lane (one in each direction) loop road comprising of Sancrox Road off the Orleans Road (herein referred to as the Quarry Access Road), Frogs Road, Wambuyn Drive and Fernbank Creek Road. There is an overpass bridge providing passage for Frogs Road over the Pacific Highway and three roundabouts at the intersections of:

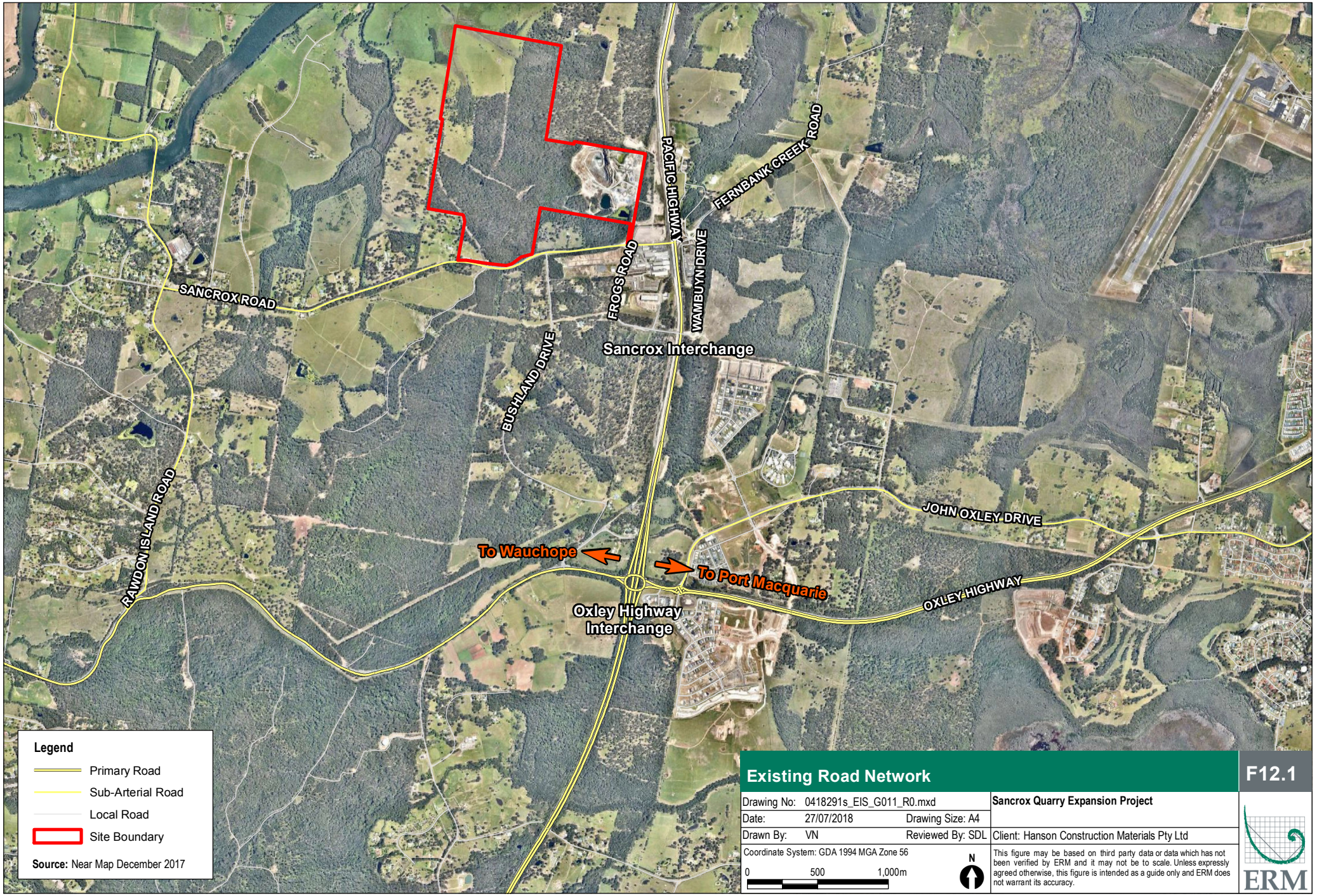
- Wambuyn Drive and Fernbank Creek Road in the north eastern portion of the interchange;

- Wambuyn Drive and undeveloped access points in the south eastern portion of the interchange; and

- the Quarry Access Road, Sancrox Road and Frogs Road in the north western portion of the interchange.

The Sancrox Interchange connects to the Pacific Highway which services northern, southern and eastern movements from the quarry and was opened to the public on 30 November 2015. The Interchange was designed to cater for the existing industry and businesses in the area, as well as servicing the area which is planned for development as an industrial precinct. As the industrial estate is developed, more vehicles will utilise the Interchange. A service road has recently been constructed and opened to the public (Winery Drive). Winery Drive and connects to the Sancrox Interchange at the north eastern roundabout, linking to the existing Hastings River Drive to the east of the new upgraded Pacific Highway. Winery Drive is the old Pacific Highway with minor additions and will provide a route for trucks to deliver product to the northern parts of Port Macquarie via Hastings River Drive. The location of the new service road (Winery Drive) is shown in *Figure 12.2.*

Hastings River Drive is a sealed, two way connector road that provides access to the Pacific Highway. Currently, the intersection of the old Pacific Highway and Hastings River Drive is a channelised T-intersection, where a deceleration lane is provided for traffic entering Hastings River Drive from the old Highway. Traffic on Hastings River Drive has to stop prior to accessing the old Pacific Highway. An acceleration lane is provided in both the southbound and northbound lanes of the old Pacific Highway.


SANCROX ROAD
BUSHLAND DRIVE
FROGS ROAD
PACIFIC HIGHWAY
WAMBUYN DRIVE
FERNBANK CREEK ROAD
Sancrox Interchange
RAWDON ISLAND ROAD
JOHN OXLEY DRIVE
To Wauchope
To Port Macquarie
OXLEY HIGHWAY
Oxley Highway Interchange
Legend
Primary Road
Sub-Arterial Road
Local Road
Site Boundary
Source: Near Map December 2017
Existing Road Network
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Drawing No: 0418291s_EIS_G011_R0.mxd
Sancrox Quarry Expansion Project
Date: 27/07/2018
Drawing Size: A4
Drawn By: VN
Reviewed By: SDL
Client: Hanson Construction Materials Pty Ltd
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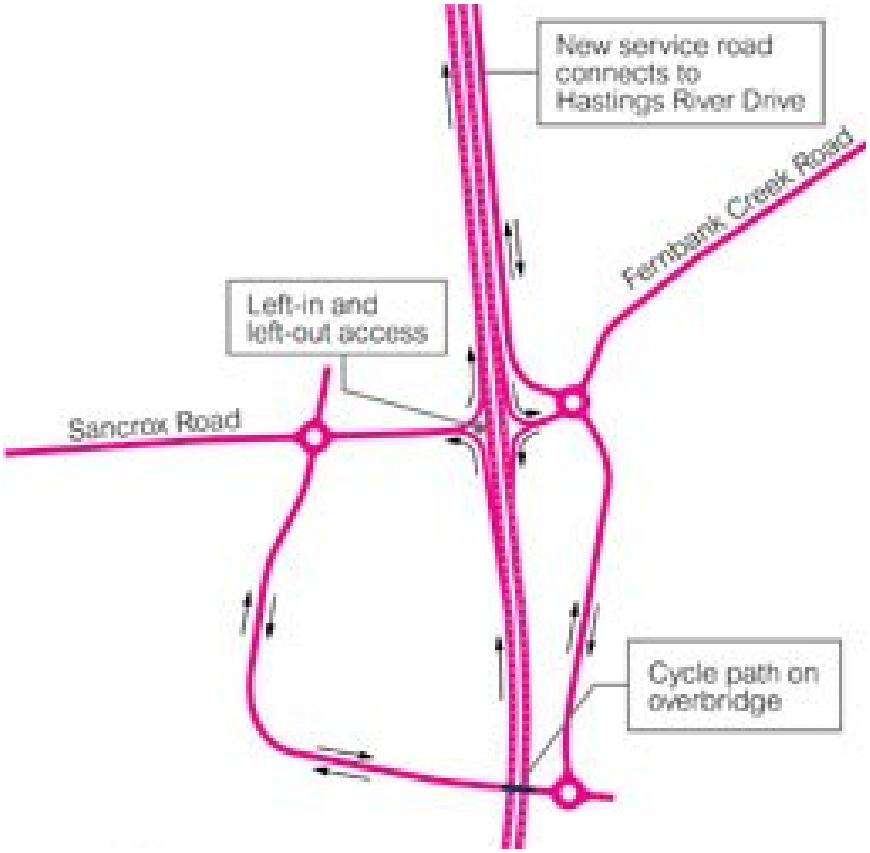


Figure 12.2 ***New Service Road (recently constructed and named Winery Drive) connecting to Hastings River Drive off North Eastern Roundabout of Sancrox Interchange (RMS 2018)***

Frogs Road Bridge is a service road overbridge that is 12m wide and 68m long (GHD, 2010). It spans the Pacific Highway and includes provision for pedestrian movements on the southern side.

The speed limit on the Sancrox Interchange is 60 km/hr. West of the western roundabout on Sancrox Road, the speed limit increases to 80 km/hr. East of the eastern roundabout on Fernbank Creek Road, the speed limit is not signposted, but is assumed to be 60 km/hr.

Pacific Highway

The confluence of Sancrox Road and Fernbank Creek Road with the Pacific Highway is at grade. Only left in and left out movements are provided at the confluence of Sancrox and Fernbank Creek Road with the Pacific Highway, respectively (GHD, 2010). The Pacific Highway in this location is dual carriageway. The speed limit on the Pacific Highway at the merge points is 110 km/hr. This section of the Pacific Highway upgrade was completed in 2017, constructed to the most recent quality and safety requirements for Motorway Standard roadways (Class M) as specified by the NSW Roads and Maritime Services (RMS).

An interchange roundabout from the Pacific Highway onto the Oxley Highway is located approximately 2.5 km from the southbound exit of the Sancrox Interchange. The Oxley Highway Interchange allows for truck movements to the east and west. The eastern exit allows delivery of product to the southern portion of Port Macquarie and coastal townships to the south, while the west exit allows product delivery to Wauchope and surrounds.

12.2.2 *Accident History*

Review of the Transport for NSW Crash and Casualty statistics for the Port Macquarie Local Government Area (for the 2012 to 2016 reporting period) detailed the accident statistics in the Project locality, as shown in *Figure 12.3* and detailed in *Table 12.1*.

Figure 12.3 Location of Accidents in vicinity of the Project Site

These statistics cover a 5 year reporting period from 2012 to 2016 and show there were 14 accidents reported. No fatal accidents occurred in the vicinity of the Project site. Approximately 60% of the accidents occurred in darkness. Approximately 36% of the accidents were at intersections (three at intersection of Sancrox Road with Pacific Highway and one at Bushland Drive and Sancrox Road to the west of the quarry). No crashes occurred at the intersection of the Sancrox Road and Quarry Road Access during the five year reporting period.

Table 12.1 Accident Statistics in the Vicinity of the Project Site

Date	Crash ID	Degree of Crash	Description	Type of Location	Light Conditions	Long.	Lat.	# injured
2016	1099889	Moderate Injury	Out of control on bend	2-way undivided	Daylight	152.80	-31.44	1
	1102572	Moderate Injury	Off road right	2-way undivided	Darkness	152.79	-31.44	1
2015	1064144	Non-casualty (towaway)	Object on road	2-way undivided	Darkness	152.82	-31.43	-
	1072335	Non-casualty (towaway)	Other opposing	X-intersection (Pacific Highway)	Daylight	152.82	-31.44	-
	1084328	Serious Injury	Off road to right	2-way undivided	Daylight	152.78	-31.44	1
	1093081	Non-casualty (towaway)	Other same direction	X-intersection (Pacific Highway)	Daylight	152.82	-31.44	-
2014	1003787	Moderate Injury	Rear end	2-way undivided	Daylight	152.82	-31.44	2
	1006981	Moderate Injury	Off right/left bend	2-way undivided	Daylight	152.78	-31.44	1
	1024413	Non-casualty (towaway)	Off left/left bend	2-way undivided	Darkness	152.82	-31.43	-
	1031606	Non-casualty (towaway)	Cross traffic	X-intersection (Pacific Highway)	Darkness	152.82	-31.44	-
2013	828422	Serious Injury	Off road right	T-junction (Sancrox Road and Bushland Drive)	Daylight	152.81	-31.44	1
	835574	Non-casualty (towaway)	Struck animal	X-intersection (Pacific Highway)	Darkness	152.82	-31.44	-
2012	796407	Serious Injury	Off road to left	2-way undivided	Darkness	152.81	-31.44	2
	805488	Non-casualty (towaway)	Off road right	2-way undivided	Darkness	152.82	-31.43	-

1. Source: (http://roadsafety.transport.nsw.gov.au/statistics/interactivecrashstats/lga_stats.html?tablga=4)

12.2.3 Existing Truck Traffic Generated by the Quarry

The Environmental Protection Licence (EPL 5289) and PMHC development consent approved annual extraction limit that currently applies to the quarry is 450,000 tpa.

During the period between 1 September 2016 and 31 August 2017, the Proponent counted the number of quarry truck trips to understand the traffic generated by the site. The number of trucks/day was counted by the weighbridge on-site. Trucks do not cross the weighbridge on ingress to the site, only upon egress from the site. Hence, the number of trucks counted by the weighbridge is representative of a 'trip' (i.e. a two way movement) comprising the ingress and egress of a truck from site. Over the course of this 12 month period, a total of 10,650 trips were counted, containing a total of 245,930 tonnes of product. These trips occurred over a total of 256 sales days.

Table 12.2 provides the maximum, average and median daily truck trips during the counted year.

Table 12.2 Daily Truck Count

Data type	Daily Truck Count
Average	42
Maximum	130
Median	38

1. Truck count data provided by Hanson. Extracted from weighbridge data.

The truck count data also included hourly breakdowns as shown in *Table 12.3*. The type of vehicle making these movements is outlined in *Table 12.4*. The entire years count data and a graph demonstrating daily truck count is provided in *Annex H*.

Table 12.3 Hourly Breakdown of Daily Truck Count

Ticketed time	Count	% of daily count
6am - 7am	161	1.5
7am - 8am	1,310	12.3
8am - 9am	1,228	11.5
9am - 10am	968	9.1
10am - 11am	1,395	13.1
11am - 12pm	1,404	13.2
12pm - 1pm	1,042	9.8
1pm - 2pm	1,107	10.4
2pm - 3pm	1,211	11.4
3pm - 4pm	691	6.5
4pm - 5pm	120	1.1
5pm - 6pm	11	0.1
Misc.	2	0.0
	10,650	**100**

1. Truck count data provided by Hanson. Extracted from weighbridge data.

Table 12.4 Truck Type

Total trucks over bridge by size	Count	% of deliveries
Cars or car and trailer for weighing service	120	1
Small truck 2 axle (> 6 tonne)	384	4
Rigid tri axle or smaller	3,023	28
Truck and tri axle or quad axle dog or semi-trailer	7,123	67
Total	**10,650**	**100**

1. Truck count data provided by Hanson. Extracted from weighbridge data.

The daily truck count breakdown demonstrates that the peak in movements from the quarry occurs from 10am to midday. This is outside the peak hour for non-Project related vehicles on Sancrox Road that occurs in the morning between 8 and 9am and in the afternoon between 4:30pm and 5:30pm.

The predominant vehicle types associated with the movements from the quarry are truck and dogs/semi-trailer (67%), followed by trucks with no trailers (28%).

12.2.4 Current Road Use Statistics

ERM contacted PMHC to enquire about traffic count data on Sancrox Road. PMHC indicated that no traffic counts have been undertaken in the past ten years and that count data has not been collected since the opening of the Sancrox Interchange. The upgrade of the Oxley Highway to Kundabung section of the Pacific Highway had been under construction since 2015 and was not fully operational until 2018. As such, previous traffic data collected by TTM for the quarry expansion approved in 2013 has been extrapolated to provide background traffic data for this assessment. Given the limited change in the surrounding residential and industrial areas since the completion of the TTM assessment, the data is considered valid.

TTM undertook a traffic impact assessment which included peak hour counts during late 2012 for a quarry modification submitted in the following year. The count was undertaken at the old intersection of the Quarry Access Road with Sancrox Road, prior to the upgrade of the Sancrox Interchange where the north western roundabout is now present. At the time of the count, the intersection was a T-intersection with Sancrox Road at 90° and to the south of the intersection was the heavy duty access track for Expressway Spares. This demonstrated in *Figure 12.4* below.

Figure 12.4 ***Previous intersection arrangement of Quarry Access Road and Sancrox Road (Sourced from Google Earth Pro – Historic Imagery from 25 March 2013)***

The morning hourly peak at the Quarry Access Road and Sancrox Road intersection was between 8 and 9am. Movements on Sancrox Road were predominately eastbound and with a total count of 80 vehicles (composed of one heavy vehicle and 79 light vehicles). One of the light vehicles accessed the quarry from the eastbound traffic on Sancrox Road. There were 24 movements that were westbound on Sancrox Road (composed of two heavy vehicles and 22 light vehicles). One of the heavy vehicles turned into the quarry from westbound Sancrox Road. Two heavy vehicles and one light vehicle exited the quarry and all travelled east on Sancrox Road. One heavy vehicle accessed the heavy vehicle access into Expressway Spares from the west, and no vehicles left this access during the peak.

The afternoon peak is between 4.30pm and 5.30pm with traffic predominately travelling westbound. The traffic volumes are very similar to the morning data, with traffic travelling in the reverse direction (representing the return movement of the vehicle (i.e. the completion of the trip)). The traffic count data from this period is provided in *Table 12.5*.

Development of the residential area within the Sancrox locality has not significantly increased following the completion of the TTM assessment in 2013. Hence a highly conservative annual increase of 3 vehicles per year has been applied to the TTM data to provide for potential increase in background traffic volumes. This equates to an approximate 3-4% annual increase in background traffic volumes. This extrapolation is provided in *Table 12.5*.

The quarry expansion in 2013 indicated that the maximum hourly traffic count from the quarry due to increased operations would be 10 trucks per hour. As a conservative approach, this additional truck volume was added to both the morning and afternoon peak hours. For simplicity, it was assumed that all additional truck movements associated with the proposed 2013 expansion would head east (and hence have been added to the extrapolated eastbound morning and westbound afternoon peak Sancrox traffic volumes).

Table 12.5 Extrapolated Traffic Count Data on Sancrox Road (to provide current background estimated traffic volumes)

Traffic Direction	TTM 2012 Data		Extrapolated TTM 2012 data[2] for 2018 estimated volumes.	
	Morning peak hour	Afternoon peak hour	Morning peak hour	Afternoon peak hour
Eastbound on Sancrox	80 vehicles	29 vehicles	108 vehicles	47 vehicles
Westbound on Sancrox	24 vehicles	81 vehicles	42 vehicles	109 vehicles
Exit from quarry Road	3 vehicles	0 vehicles	13 vehicles	10 vehicles

1. Modified from TTM (2013) Hanson Quarry Expansion Traffic Impact Assessment
2. Extrapolated data includes peak truck volumes associated with approved expansion in 2013.

12.2.5 Intersection Sight Distances

Safe Intersection Sight Distance

Safe Intersection Sight Distance (SISD) is the minimum sight distance which should be available from vehicles on legs of an intersection which have priority to vehicles which could emerge from non-signalised legs (Austroads, 2005).

Desirable SISD ('desirable' is based on providing two seconds reaction time) for the intersections of the quarry with Sancrox Road and Wambuyn Road with Fernbank Creek Road (where the speed limit is 60km/hr) is 123m (for a level roadway) (Austroads, 2005).

Quarry Access Road and Sancrox Road Intersection

The Quarry Access Road joins Sancrox Road at the single lane (north western) roundabout of the Interchange. Sight distance to the east is greater than 250m, allowing for traffic entering from the northbound Pacific Highway auxiliary lane to be observed from the confluence point of the roundabout. The topography to the east of the quarry access track is flat; there is limited vegetation or other potential view obstructions, so business access points between the Pacific Highway auxiliary lane and the Quarry Access Road can be observed. To the west of the Quarry Access Road along Sancrox Road, the road is straight and flat with an available sight distance of approximately 125m.

Wambuyn Road and Fernbank Creek Intersection

The intersection of Wambuyn and Fernbank Creek Road is the north eastern roundabout of the Sancrox interchange with sight distance to the west all the way to the Pacific Highway (approximately 115 m to the west). Traffic can be seen on the Pacific Highway for the required sight distance from the entrance to the roundabout, and interactions with traffic to the west will be limited to the use of the roundabout for U-turns. To the east, Fernbank Creek has a moderate rise and a minor bend, though provides an available sight distance of approximately 135 m.

Sight distances on Winery Drive are expected to be of sufficient standard as the road was designed and constructed under the Pacific Highway upgrade project, as managed by Roads and Maritime Services.

Pacific Highway Access

The recent upgrade of the Pacific Highway provides acceleration and deceleration lanes for both ingress and egress movements to/from the Sancrox Interchange. The lanes provide greater than 500m sight distance along the Pacific Highway.

12.3 ASSESSMENT

12.3.1 Traffic Generated during Construction

Construction activities will include:

- heavy vehicle floating of plant for vegetation clearing and mulching;
- trucks removing mulch from site;
- the import of the processing plant, asphalt production and cement batch plant infrastructure by heavy vehicles; and
- light vehicles to deliver personnel to site to operate clearing/construction equipment and build the new infrastructure.

Clearing Activities

Clearing activities are expected to require heavy vehicles to float standard clearing plant such as a bulldozer, one to two excavators and a mulcher. Should clearing be undertaken to match the proposed quarry stages, it is expected that each stage would take three to four weeks to clear and mulch. The floating in of equipment would occur at the start and completion of the works (unless mechanical failure required the export of plant for repair).

Removal of mulch would occur in the last two weeks of the activity, if the mulch could not be beneficially reused on-site. The mulch removal activities would be a low priority activity and unlikely to be time constrained, so would likely involve a low volume of trucks (two to three) on a loop throughout the day to deliver the mulch to the approved location.

A maximum of four light vehicles would travel to and from site each day over the course of the activity to deliver personnel to operate the clearing equipment.

Import and Construction of New Ancillary Infrastructure

The construction of the new ancillary infrastructure is assumed to take approximately 12 weeks for each plant. The delivery of all the infrastructure for site would be delivered in approximately 40 heavy vehicle movements importing items to site over these 12 weeks. During this time, personnel will be transported to site via light vehicles (approximately 10 trips per day during construction).

Construction Impact

It is likely that the clearing for the first stage and the establishment of one or potentially both of the plants will occur simultaneously. Truck trips associated with the delivery of quarry product will also continue during these activities. The establishment of the plants and the clearing activities represents construction traffic at its maximum.

The design capacity, intersection types and standard of the recently completed Sancrox Interchange and Pacific Highway (as described in *Section 12.3.4*) is sufficient to accommodate existing traffic on Sancrox Road (including quarry product delivery trucks that will continue during construction) and the short-term increase in:

- light vehicles delivering construction staff to site; and
- heavy vehicles delivering infrastructure and floating clearing plant.

12.3.2 Traffic Generated during Operation

Traffic volumes, particularly heavy vehicles such as truck and dog, and concrete agitator vehicles, will increase due to the Project. The operational traffic volume increase, including truck type, has been estimated for each Project activity.

The typical daily traffic movements would include:

- light vehicle trips transporting staff to and from site concentrated at the start and end times of shifts;
- truck trips delivering quarried product and asphalt;
- concrete agitator trips to deliver concrete to construction sites;

- import of concrete constituents (sand and cement); and
- truck trips delivering waste concrete to site for recycling.

The Project activities will result in additional employees causing a minor increase in light vehicle movements for staff entering and exiting the site during their shifts.

The Project has proposed truck movements and equipment loading 24 hours/day for 365 days a year. Should approval be granted, it will allow for operational traffic to utilise the road network during periods outside of daytime periods. Thus reducing the cumulative impact on traffic during higher volume periods.

The location of the market for concrete and asphalt is considered to be similar for quarry products, so the trip distribution described in *Section 12.3.3* is applicable to all new products generated by the Project.

Quarried Product Delivery Trucks

The proposed increased extraction rate is 750,000 tpa. Comparison of the proposed extraction rate and the actual extraction rate that generated the 2016/17 truck count data demonstrates that the Project will generate approximately 3.05 times more truck trips than the counted year. As such, a linear multiplication by 3.05 has been applied to the count data to provide an estimate of additional trips generated by the proposed expansion.

Table 12.6 provides the estimated daily truck volume increase from the 2106/17 count data when applying the 3.05 multiplication factor.

Table 12.6 Proposed Daily Quarried Product Delivery Truck Trip Increase Generated by Project

Data type	2016/17 Daily Truck Trips	Proposed increase in Daily Truck Trips
Average	42	127
Maximum	130	396
Median	38	116

1. Truck movement data provided by Hanson. Extracted from weighbridge data.

It is noted that the proposed increase above assumes an increase in the same truck type, with the 2016/17 count data demonstrating an approximate split of 30% rigid and small trucks and 70% truck and dogs or larger.

Table 12.7 provides the proposed hourly truck count increases on an annual basis from the 2106/17 count data when applying the 3.05 multiplication factor.

Table 12.7 Proposed Hourly Quarried Product Delivery Truck Count Increase Generated by Project

Ticketed time	Total Annual Count	Estimated Increase in Total Annual Count
6am - 7am	161	491
7am - 8am	1,310	3,995
8am - 9am	1,228	3,745
9am - 10am	968	2,952
10am - 11am	1,395	4,254
11am - 12pm	1,404	4,282
12pm - 1pm	1,042	3,178
1pm - 2pm	1,107	3,376
2pm - 3pm	1,211	3,693
3pm - 4pm	691	2,107
4pm - 5pm	120	366
5pm - 6pm	11	34
Misc.	2	0
Total	**10,650**	**32,473**

1. Truck movement data provided by Hanson. Extracted from weighbridge data.

The data within *Table* 12.7 assumes that despite the Project having 24 hour operations, the majority of product deliveries will be to markets/sites that operate within standard hours of operation/typical construction hours. This assumption is the worst-case traffic scenario, as it is likely that the Project operational traffic would be able to be spread outside these hours, should approval for 24 operations be granted.

The noise assessment included conservative calculations to determine additional permissible quarry truck trips per hour during the strictest night time road traffic noise criteria, beyond the typical operations outlined above. With consideration to public traffic and the typical quarry trucks during night time hours outlined above, it was estimated that an additional six quarry truck trips per hour could operate on Sancrox Road (classed as a local road) during the night time period and not exceed Leq 1 hour criteria and an additional 12 truck trips could occur during the entire night time period (10pm – 7am) and not exceed the Leq, 9 hour criteria.

The total number of truck trips permissible on a local road during the night time period is 18 truck trips (36 movements). The total number of trips permissible within any hour during the night time period is 12 trips/ hour (24 movements/hour), noting that the truck trip limit for the total night time period cannot be exceeded.

The estimated allowable hourly night truck movements, based on road traffic noise criteria, is well in excess of the anticipated typical quarry vehicle trips used in the modelling on typical operating hours.

Extrapolated traffic data to represent current volumes on Sancrox Road (*Table 12.5*) indicates that the morning peak occurred at 8 to 9am, comprising 108 eastbound vehicles and 42 westbound vehicles. The afternoon peak hour on Sancrox Road occurred between 4.30 and 5.30pm and generated 47 eastbound vehicles and 109 westbound vehicles. The quarry traffic peaks occurred outside of the Sancrox Road peak hour traffic, occurring between 10am and midday. The worst-case scenario of assuming the predicted average increase in trucks due to the Project happened to coincide the morning and afternoon peak hour on Sancrox Road, with all trucks utilising Sancrox Road only, would generate a maximum total volume of traffic of 235 eastbound vehicles during the morning peak hour and 236 westbound vehicles during the afternoon peak.

Agitator Trucks

The following assumptions have been made with regard to agitator movements:

- the density of wet concrete is 2400 kg/m^3;
- the annual volume of concrete permitted to be produced at the site is 20,833 m^3 (50,000tpa);
- the capacity of the agitators delivering the materials is 6.5 m^3 (Maxi Agitator capacity as taken from Hanson (2017)); and
- the deliveries will occur over approximately 300 work days.

Based on the aforementioned assumptions, the introduction of the concrete batching plant is estimated to generate an average of approximately 11 agitator trips/day. As previously described, five concrete agitator truck drivers will be employed.

Asphalt Trucks

The following assumptions have been made with regard to the transport of asphalt:

- only rigid trucks (no dogs) will transport asphalt to sites (to allow for loading into paver);
- the load capacity of these trucks is eight tonne; and
- that deliveries will be made over 300 days throughout the year.

Utilising these assumptions, equates to 6,250 truck trips per annum and 21 truck trips per day.

Waste Concrete

The following assumptions have been made with regard to the delivery of waste concrete to site:

- only trucks will be used to transport the waste concrete (assumed that waste concrete collection sites will have limited space available and would not accommodate truck and dog);
- the capacity of these trucks is eight tonne; and
- the trips to collect the waste concrete will occur over 300 days.

Concrete waste recycling will employ two drivers to transport the unused concrete from Hanson concrete plants to Sancrox Quarry for stockpiling while waiting to be crushed. It is assumed that 8 truck trips/day will occur for concrete waste collection for recycling. There is the potential for waste concrete to be collected as a backload as trucks return from product deliveries, however this is expected to have minimal impact on reducing the total truck trips/day.

Import of concrete constituents

Sand and cement will need to occasionally be imported to supply the concrete batching process. This has been conservatively estimated as three truck trips per week.

Cumulative Daily Traffic Volume Increase due to Project Operation

The daily increase in traffic due to the additional activities associated with the Project operations are provided in *Table* 12.8.

Table 12.8 Cumulative Daily Traffic Volume Increase due to Project Operation

	Quarried Product	**Asphalt delivery**	**Concrete delivery**	**Collection of Waste Concrete**	**Import of concrete constituents**	**Operational Workforce**
Vehicle Type	Truck and Dog (mostly)	Truck	Agitator	Truck	Truck	Light vehicle
Average number of trips / day	127	12	11	8	1 (rounded up as assumed at 3 truck trips/ week)	25

The Project will generate approximately 158 additional heavy vehicle trips/day on Sancrox Road. The site currently generates an average of 42 heavy vehicle trips/day. Upon project operation the average number of truck trips will be approximately 200 truck trips per day.

The increase in light vehicle trips due to employees, will be concentrated around start and finish times of shifts and will have negligible impact due to being a minor input on the overall traffic volume. Light vehicle trips associated with the Project will likely coincide with peak times on Sancrox Road, however will be in the opposite direction of flow to that of other light vehicles utilising the Sancrox Road.

The design capacity, intersection types and standard of the recently completed Sancrox Interchange and Pacific Highway (as described further in Section *12.3.4*) are considered sufficient to accommodate this increase in light and heavy vehicle traffic volume.

12.3.3 Trip Distribution and Haulage Route

The main markets which the quarry will service are located east of the Pacific Highway, including Port Macquarie and other smaller coastal towns to the north and south. To the west there is considered to be less of a market demand, with the primary location to the west being the township of Wauchope (with a population of approximately 7,400 (Id.community (2016)) and smaller surrounding towns similarly generating little demand.

Access to the Pacific Highway for north and south market locations is provided by the Sancrox Interchange. The northern portion of Port Macquarie can also be accessed by Winery Drive off the north eastern roundabout of the Sancrox Interchange that links to Hastings River Drive. Access is provided to the Oxley Highway for east/west movements by the Oxley Highway Interchange to the south.

It is predicted that greater than 99% of the product trucks and agitators leaving the Quarry Access Road will travel either south or east at the north western roundabout of the Sancrox Interchange to gain access to these market locations. Trips to the west of the Quarry Access Road on Sancrox Road/Rawdon Island Road are not required due to the more suitable access options provided by the Interchanges and service roads described above. Hence western movements on the Sancrox Road from the Quarry Access Road would be strictly limited to supplying markets within the Sancrox locality, considered to be less than 1% of the total annual truck trips.

Movements on Fernbank Creek Road, east of the north eastern roundabout will be avoided given that the road is narrow and likely of limited structural capacity to receive regular fully loaded truck and dog movements. Similar to Sancrox Road, movements on this road would be strictly limited to local residents requiring product.

12.3.4 Adequacy of Key Current Haul Roads

The Sancrox Interchange opened to the public on the 30 November 2015. It was constructed to modern RMS road design standards and the design incorporated an understanding of future use of the road (GHD Highway Access Strategy, 2007) and cumulative impacts comprising:

- *the development of the Sancrox Employment Precinct adjacent to Sancrox Road;*
- *further development of the Cassegrains Vineyard property, including special events held on the grounds;*
- *expansion of the Sancrox Quarry;*
- *relocation of the Hanson asphalt production plant to land near Sancrox Road; and*
- *proposed relocation of Pearsons Transport to the north west of Sancrox Road intersection with the Highway.*

In light of these cumulative impacts, in addition to the Project's impacts outlined in this EIS, the Sancrox Road Interchange is considered to be of sufficient design and capacity to service the Project in its current state. No alterations to the current road and interchange layout are proposed. The Pacific Highway upgrade joining the Sancrox Interchange was completed in 2017, constructed to the most recent quality and safety requirements for Motorway Standard roadways (Class M) as specified by the RMS. Hence, no alterations are proposed due to the Project.

The Oxley Highway Interchange will provide for eastern and western trucks movements, allowing for delivery of product to Port Macquarie and Wauchope. Utilisation of the Oxley Highway Interchange eliminates the need for truck travel on Sancrox Road/Rawdon Island Road that ultimately joins to the Oxley Highway in the west. Truck movements on Sancrox Road and Rawdon Island Road will be avoided, except for rare delivery of product to sites within the Sancrox locality. Such a restriction would allow for truck movements to be entirely on major arterial/motorway class roads within the vicinity of the quarry and prevent truck and dogs from entering the Oxley Highway at the confluence with Rawdon Island Road, which has insufficient sight distances and is at higher speed than the Oxley Highway Interchange.

Winery Drive, exiting from the Sancrox Interchange north eastern roundabout is a recently constructed road, designed and constructed to modern standards. This will connect to the old Pacific Highway and Hastings River Drive. The old Pacific Highway will remain of sufficient standard to convey heavy vehicles, and will experience significantly lower traffic volumes due to the new Pacific Highway. Hastings River Drive is a connector road that will be sufficient to convey the heavy vehicles associated with the Project.

Austroads (2015) details the following with a regards to roundabouts. Roundabouts are the intersection controls on three of the Sancrox Interchange intersections prior to accessing the Pacific Highway from the quarry:

> 'a well-designed roundabout is the safest form of intersection control. Numerous 'before and after' type studies have shown that, in general, fewer motor vehicle crashes resulting in casualty crashes occur at roundabouts than at intersections containing traffic signals, stop, or give-way signs'.

Forecast Traffic Volumes

SLR (2016) provides forecast traffic data for the Sancrox Interchange in an Operational Noise Management Plan that was prepared for Roads and Maritime Services. The data includes projected 2016 data and 2026, a ten year forecast from the planned opening of the upgrade. The projected traffic volumes are provided in *Table 12.9*.

Table 12.9 Projected Traffic Volumes Forecast.

Location	2016 Projected Traffic (vehicles per day)		2026 Projected Traffic (vehicles per day)	
	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles
Northbound on-ramp	510	190	2080	900
Northbound off ramp	2160	370	3660	590
Southbound on ramp	530	400	2110	1040
Southbound off ramp	1790	250	3590	510
Sancrox Overbridge	3600	230	9590	1880

1. Source : SLR (2016) Pacific Highway Upgrade – Oxley Highway to Kundabung Operational Noise Management

To demonstrate that the roundabout network will be sufficient based on the projected traffic volume, ERM have extrapolated a highly conservative design hour vehicle volume to compare with Austroads identified typical capacity limit for a one lane roundabout (Table 5.5 of Austroads 2005).

Austroads (2017) states that where peak hour percentages are not available, that design hour volume equals 11% to 16% of the AADT for rural situations. For the purpose of comparison, the projected daily traffic data has been utilised as AADT. Both light vehicles and heavy vehicle volumes have been added to provide total daily traffic volume. Design hour volume has been conservatively assumed as 16%. Applying 16% to the total daily vehicle volume of traffic on the Sancrox overbridge (at least one roundabout must be utilised to get to the overbridge), generates a highly conservative, worst case design hour vehicle volume of 1835 vehicles/hour.

Comparison of this extrapolated data with Austroads (2005) one lane roundabout typical limit of capacity of 2600 vehicles per hour, it is demonstrated that there is sufficient remaining capacity on all roundabouts providing access to the Pacific Highway. Hence, no further infrastructure upgrades are required.

12.3.5 Other Road Users

Pedestrians

No footpath is present for pedestrians along the Sancrox Interchange (except on the bridge and directly adjacent to the roundabouts), nor along Sancrox Road to the west or Fernbank Creek Road to the east of the Interchange. Sancrox is a rural residential/industrial area that would be unlikely to generate noteworthy volumes of pedestrian foot traffic.

Cyclists

The Sancrox Interchange has wide verges with sufficient space for bicycles, although Fernbank Creek Road is narrow east of the north eastern roundabout and Sancrox Road narrows west of the north western roundabout. The wide verges of the Sancrox Interchange provide sufficient space for bicycles to share the road reserve. Quarry trucks will very rarely utilise Fernbank Creek Road or Sancrox Road beyond the Interchange, so negligible impacts will be generated on other road users in these locations.

The Sancrox Quarry access roundabout caters for pedestrians and cyclists, with a cycling lane in most directions from the roundabout, excluding east along Sancrox Road. The road to the east continues for approximately 100m towards the Pacific Highway, which is a 'left-in/left-out' intersection.

Buses

Local school bus number 81 utilises Sancrox Road to the west of Bushland Drive (and the quarry) during school terms. The bus enters the Sancrox area via Rawdon Island Road and exits via Bushland Drive during the morning pick-up. The reverse trip is undertaken during the return leg in the afternoon. The mitigation measure of no truck movements to the west of the Sancrox Interchange (except for Sancrox only deliveries) will prevent the interaction of quarry trucks with school buses.

The regular town bus route does not service the Sancrox area.

It is considered that the quarry access and transport route has been constructed to ensure safe movement of pedestrians, bicycles and other vehicles through the roundabout, which was constructed to allow for heavy vehicle movements from the quarry, as well as the other industrial developments in the area.

12.3.6 Car Parking

Existing car parking is provided to the south of the workshop area. Car parking will remain in this locality, with ample area being available in the ancillary infrastructure area to allow for additional parking spaces to accommodate for the proposed increase in staff. No off-site parking will be required. Access to existing car parks and proposed future car parking will limit the interaction of quarry plant and staff vehicles that are not to quarry safety specifications.

12.3.7 SEPP Mining, Petroleum Production and Extractive Industries 2007 – Clause 16 Consideration

Consideration of SEPP Mining, Petroleum Production and Extractive Industries 2007 is provided in *Table 12.10*.

Table 12.10 SEPP Mining, Petroleum Production and Extractive Industries 2007 – Clause 16 Consideration

SEPP Mining, Petroleum Production and Extractive Industries 2007 – Clause 16 Consideration	Discussion
Require that some or all of the transport of materials in connection with the development is not to be by public road	The transport of materials to and from the quarry will be provided by the Sancrox Interchange. The Sancrox Interchange provides direct, motorway class access to the Pacific Highway. The Sancrox interchange was designed to service the industrial estate to the east and south of the quarry.
Limit or preclude truck movements, in connection with the development, that occur on roads in residential areas or on roads near to schools,	The mitigation measure of limiting movements west of the Sancrox Interchange and east of the north eastern roundabout of the interchange along Fernbank Creek Road, excluding local deliveries, will reduce movements through adjacent rural residential areas and school bus routes. No schools are present on the Sancrox Interchange that conveys quarry vehicles to the Pacific Highway.
Require the preparation and implementation, in relation to the development, of a code of conduct relating to the transport of materials on public roads.	A code of conduct is provided in *Section 12.4.1*.

12.4 MITIGATION MEASURES

The following mitigation measures are proposed to minimise impacts to road users and infrastructure:

- movements to the west of the Quarry Access Road on Sancrox Road will be strictly limited to supplying markets in the Sancrox area only. Access to Wauchope and other locations to the west will be provided by utilising the Oxley Highway Interchange. Sancrox Road to the west of the quarry will not be used as a regular product transport route;
- movements to the east of the Sancrox Interchange along Fernbank Creek Road will be strictly limited to supplying local residents/markets in the area. The road will not be used as a regular product transport route.
- limit compression braking;
- avoid bunching of quarry vehicles along product transport routes;

- cover loads entering and leaving the site;
- induct all drivers to the Hanson code of conduct and carry out regular tool box talks discussing road safety issues (see below for further details); and
- all loaded vehicles leaving the site are to be cleaned of materials on tail guards and body edges that may fall on the road.

12.4.1 Vehicle Operator Code of Conduct

A vehicle operator code of conduct has been developed by Hanson to set driver behaviour controls to minimise impacts on road users and the condition of the product transport route infrastructure. The code of conduct states that vehicles operators must:

- obey all the laws and regulations;
- ensure their vehicle complies with relevant State legislation in relation to roadworthiness and modifications;
- undergo regular vehicle checks and maintenance;
- ensure their vehicles have correctly fitted mufflers to minimise noise disturbance;
- not drive whilst under the influence of alcohol, drugs, nor any medication which may affect their ability to drive;
- be medically fit to drive at all times and must inform site co-ordinators if they have any medical condition which may affect their ability to drive;
- drive in a considerate manner at all times and respect the rights of others to use and share the road space;
- follow the haulage route and main roads near the Project site to minimise impact to local roadways;
- report all vehicle defects to their employer. Serious defects must be corrected immediately or an alternative vehicle supplied;
- report any vehicle accident resulting in injury/or damage to property must be reported to the police;
- report any near misses;
- securely fasten and cover loads, as appropriate; and
- keep their vehicle clean and in good mechanical condition to reduce the environmental impact.

The Operation and Construction Environment Management Plan will include the following with relation to this code of conduct:

- process of induction of vehicles operators, detailing the code of conduct to be followed;
- process for regular toolbox talks/meetings discussing driver safety/traffic management;
- a complaint resolution and disciplinary procedure;
- community consultation measures for peak haulage periods; and
- a map of primary haulage routes including critical locations.

REFERENCES

Austroads (2005) *Guide to Traffic Engineering Practice – Part 5: Intersections at Grade*.

Austroads (2015) Guide to Road Design Part 4B: Roundabouts

GHD (2010) *Oxley Highway to Kempsey Upgrading the Pacific Highway – Environmental Assessment*, Roads and Traffic Management Authority of NSW.

Id.community (2016) *Port Macquarie Hastings Council Community Profile* accessed on January 23 2018 from http://profile.id.com.au/port-macquarie-hastings/population?WebID=240.

SLR (2016) Operational Noise Management – IFC Design Documentation, Pacific Highway Upgrade Oxley Highway to Kundabung. Prepared for Lendlease.

RMS (2018) *Map- Oxley Highway to Kundabung*, Oxley Highway to Kundabung Project website. NSW Roads and Maritime Services. Accessed on January 30 2018 from http://www.rms.nsw.gov.au/images/projects/northern-nsw/oxley-highway-to-kempsey/oxley-kundabung-map-900.jpg

TTM (2013) *Hanson Quarry Expansion Traffic Impact Assessment*

13 VISUAL AMENITY

A Visual Impact Assessment has been undertaken to assess the potential for the Project to impact the visual amenity of private landowners in the vicinity of the development and key viewpoints in the public domain. The Project is unlikely to have visual amenity impacts due to the landform and topography and/or vegetation obscuring/screening views from most directions. Therefore a qualitative assessment based on desktop analysis and supporting photographic evidence was considered a suitable approach to assess the potential impacts and satisfy the SEARs.

13.1 METHODOLOGY

The analysis was undertaken by observation, description of existing conditions, and interpretation of changes to the landscape associated with the Project. The four main elements of landscape character which affect the extent to which the Project will impact on the landscape include:

1. topography;
2. vegetation cover;
3. degree of modification to the 'natural' landscape and dominance of built elements; and
4. distance.

The assessment approach involved describing the existing conditions and likely changes to the landscape associated with the Project, including:

- proposed Project layout and its visual components;
- project view shed based on the location of identified viewpoints;
- sensitivities of the land uses within the view shed;
- visual impacts of the key Project elements; and
- mitigation measures to minimise impacts.

ERM has prepared a theoretical, worst case visibility scenario model in ArcGIS. The model demonstrates the visibility of quarry features, modelled solely using topography and height of proposed new infrastructure. The model demonstrates the theoretical visibility of the current quarry and the theoretical visibility of the quarry and ancillary operations at the proposed Stage 5 conditions. This worst-case visibility scenario excludes screening provided by vegetation, bunding and other noise control features and existing or proposed buildings. The analysis utilised the five-metre Digital Elevation Model (DEM) available from Geoscience Australia in conjunction with the contours and infrastructure locations/heights provided by Hanson for the final Stage 5 conditions.

The model allows for the comparison of theoretical visibility of current and final proposed staging to determine the footprint of modelled impacts. With an understanding of site features based on the site inspection, the discussion around site screening features and their amelioration of modelled impacts can be provided.

13.1.1 Site Inspection

ERM undertook a site inspection of the Sancrox Quarry on 16 November 2017, which involved visiting surrounding residential properties, industrial and commercial areas and public roads to identify viewpoints and the potential for impacts to existing visual amenity as a result of the Project. Photographs were taken looking towards the Project site, and factors such as a lack of existing screening (vegetative or other) and contouring of the land between the receptors and the Project site were noted.

13.1.2 Authors

This assessment was prepared by ERM Environmental Scientists with experience in the preparation of qualitative Visual Impact Assessment for quarrying and industrial developments.

13.2 EXISTING ENVIRONMENT

13.2.1 Topography and Vegetation Cover

The topography of the area surrounding the Project site is characterised by floodplains and low lying hills up to approximately 60 mAHD (refer to *Figure 13.1* below). The eastern portion of the Project site has been disturbed by active quarrying activities, while the west and northwest portions are largely undisturbed and predominantly covered with remnant native open forest vegetation and some smaller sections of ground covering pasture. Lot 2 DP 574308 to the north of the quarry is the proposed biodiversity offset area and comprises of Tallowwood-small fruited grey gum dry grassy open forest closest to the quarry and Paperbark swamp forest of the coastal lowlands further from the quarry (SLR, 2019).

Remnant forest vegetation surrounds the north, west and south of the Project site. The land to the east and north of the Project site is being progressively cleared and filled to create a level ground for the development of an industrial area. Narrow strips of vegetation are still currently present along the northern and eastern boundaries of the Project site but will be cleared soon to allow for the construction of industrial development (refer to *Photograph 1*).

13.2.2 Project View Shed

Several rural residential properties are located to the north, south and west of the Project site. As noted above, the landform and vegetation obscure and screen views of the Project site from these residential properties (refer to *Figure 1* for the location of these properties).

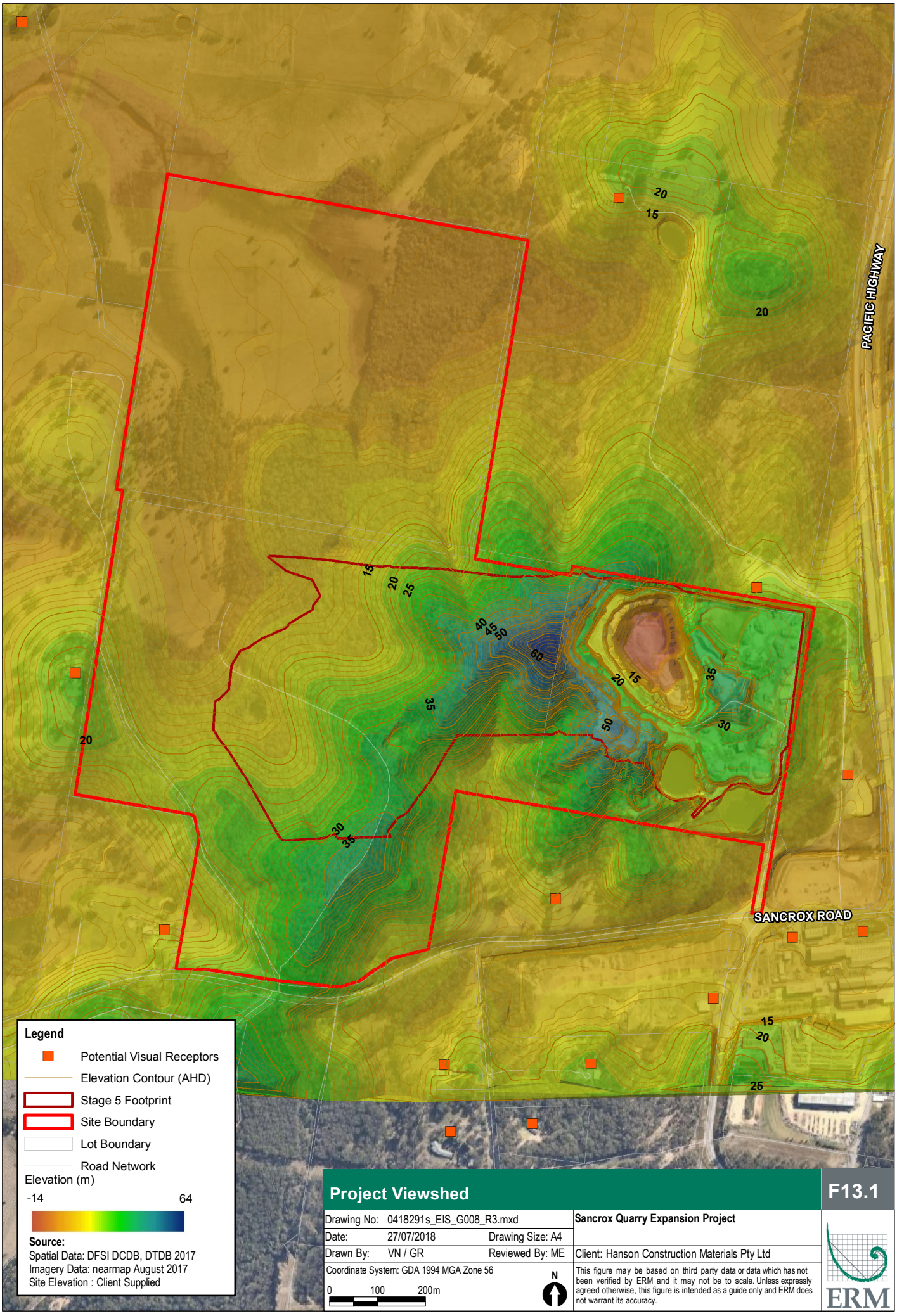
The Pacific Highway and the Cassegrain Winery are located approximately 175 m and 210 m to the east, respectively. Sancrox Road is located approximately 230 m to the south of the site, with a suite of industrial facilities beyond.

Photographs 2 to *6* show the obstructed views towards the Project site from some of these residential properties, the Pacific Highway and Cassegrain Winery.

The western receptor (residential property) exists approximately 1 km west of the existing quarry. The land between the receptor and the Project site is relatively flat, and views from parts of the residential property towards the quarry are currently screened by the forest (refer to *Photograph 7*).

13.2.3 Current Lighting

The Site is currently floodlit via high mast high-pressure sodium luminaires. Operation of the lighting systems is on an as-needed basis and is currently not operational during all nights.


PACIFIC HIGHWAY
SANCROX ROAD
20
15
20
15
20
25
40
45
50
60
35
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15
35
30
50
20
30
35
15
20
25
Legend
Potential Visual Receptors
Elevation Contour (AHD)
Stage 5 Footprint
Site Boundary
Lot Boundary
Road Network
Elevation (m)
-14
64
Source:
Spatial Data: DFSI DCDB, DTDB 2017
Imagery Data: nearmap August 2017
Site Elevation : Client Supplied
Project Viewshed
F13.1
Drawing No: 0418291s_EIS_G008_R3.mxd
Date: 27/07/2018
Drawing Size: A4
Drawn By: VN / GR
Reviewed By: ME
Coordinate System: GDA 1994 MGA Zone 56
0
100
200m
N
Sancrox Quarry Expansion Project
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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Photograph 1 Narrow strips of vegetation currently present along the northern and eastern site boundaries.

Photograph 2 View looking north towards the Project site from Bushland Drive (residential area to the south).

Photograph 3 View looking north towards the Project site from Sancrox Road (residential property to the south).

Photograph 4 View looking north east towards the Project site from Sancrox Road (residential property to the south west).

Photograph 5 View looking southeast from the Project site at vegetative buffer obscuring vision of Pacific Highway.

Photograph 6 View from Cassegrain Winery looking west towards the Project site across the Pacific Highway.

Photograph 7 View looking east towards the Project site from private land north-east of western most residential property.

13.3 ASSESSMENT

13.3.1 Theoretical Visibility Model – (excluding consideration of screening features)

The theoretical visibility model is provided in *Figure 13.2* and demonstrates the theoretical visibility of the current quarry, and the theoretical visibility of the quarry/ancillary operations at the proposed Stage 5 conditions. It can be determined from the theoretical model that the footprint of theoretical visibility for the current quarry remains unchanged at proposed Stage 5 Conditions. However, the degree of impacts within the footprint does vary.

Current Quarry Footprint and Elevations

FREEMANS ROAD
GLEN EWAN ROAD
PACIFIC HIGHWAY
VERDUN DRIVE
SANCROX ROAD
BUSHLAND DRIVE

Legend

- Potential Visual Receptors
- Current Footprint (17 ha)
- Site Boundary
- Stage 5 Footprint - 5km Buffer

Approx. Area of Current Quarry Footprint Visible

- < 3 ha Visible
- > 3 - 5 ha Visible
- >5 - 8 ha Visible
- > 8 - 10 ha Visible
- > 10 ha

Stage 5 Quarry Footprint and Elevations

FREEMANS ROAD
GLEN EWAN ROAD
PACIFIC HIGHWAY
VERDUN DRIVE
SANCROX ROAD
BUSHLAND DRIVE

Legend

- Infrastructure (Crushers, Batching Plant etc)
- Potential Visual Receptors
- Stage 5 Footprint - 5km Buffer
- Site Boundary
- Stage 5 Footprint

Approx. Area of Stage 5 Quarry Footprint Visible

- < 3 ha
- > 3 - 5 ha
- > 5 - 8 ha
- > 8 - 10 ha
- 10 - 13 ha
- > 13 ha
- On-site Infrastructure Visible (Additional to Stage 5 Quarry)

Source:
Spatial Data: DFSI DCDB, DTDB 2017
Imagery: ESRI World Imagery
Site Elevation : Client Supplied

Comparison of Theortetical Visibility of Current Quarry and the Proposed Stage 5 Quarry

F13.2

Drawing No:	0418291s_VIA_G003_R0.mxd		**Sancrox Quarry Expansion Project**
Date:	27/02/2019	Drawing Size: A4	
Drawn By:	GR	Reviewed By: TH	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 1 2km

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Variations in the degree of theoretical visibility in each quadrant demonstrated in the Stage 5 model include;

- the quarry facing hill slopes that would theoretically be able to view the Stage 5 infrastructure in all directions;
- in the northeastern quadrant, the approximate area of the stage 5 quarry visible footprint decreases, with the area of 8-10ha visibility no longer appearing and the proportion of 5-8ha visibility decreasing in the North, North East.
- in the southeastern quadrant, the approximate visible area in the range of 8-10 hectares no longer appears in the modelling;
- in the southwestern quadrant there is a minor increase in theoretical visibility along Sancrox Road, and the approximate visible area in the 5-8 hectare range no longer appearing in the model outside of the site boundary.
- in the northwestern quadrant, there is an increase in the 3-5 hectare visibility range.

This worst-case visibility scenario excludes screening provided by vegetation, bunding and other noise control features and existing or proposed buildings.

13.3.2 Consideration of Screening Features

The model allows for the comparison of theoretical visibility of current and final proposed staging. With an understanding of site features based on the site inspection, the discussion around site screening features and their amelioration of the modelled impacts can be provided.

North Western Quadrant

Actual impacts in the northwestern quadrant are unlikely as Lot 2 DP 574308 to the north of the quarry is the proposed biodiversity offset area. The offset area will be protected by conservation agreement and will not be cleared. The area comprises of Tallowwood and small-fruited grey gum in the upper storey vegetation closest to the quarry, both of which can grow up to 40m high (PlantNET, n.d.) and provide sufficient screening.

South Western Quadrant

The Tallowwood and small-fruited grey gum vegetation type is present to the west and south of the proposed future stages of the quarry within the site boundary. The vegetation stands are a minimum of 40m wide from the edge of the quarry to current cleared pastoral land. The presence of this vegetation is considered a sufficient screen to receptors in these directions. A noise attenuation bund/wall or combination of both is proposed to the west of the quarry. This bund will be vegetated to blend with the existing landscape and should use of noise attenuating fencing also be used in combination; it will be suitably matched to the landscape/setting.

Confirmation that the nearest receptor (and rest of this property) to the west would likely not be impacted was undertaken during the site inspection. The western receptor is located on a hill of approximately 23mAHD. The western extent of the quarry footprint ranges from 30-35mAHD in the south to approximately 10mAHD in the north-west. Despite the receptor height, the maintenance of a vegetative buffer around the quarry (and particularly adjacent to the lowest elevation areas of disturbance) will screen the quarry. It is noted that the vegetation around the residence will also provide screening. Photograph 8 demonstrates the view from the land from the residence, with the circled area demonstrating the vegetation that will remain and will shield the quarry activities in the lowest elevation areas.

Photograph 8 View looking east towards the Project site from private land north-east of western receptor and the circled vegetative buffer.

South Eastern Quadrant

Along the southern edge of the proposed ancillary facility area, vegetation is present in the adjoining lot to the south. The vegetation stand in this locality is a minimum of 60m wide. This vegetation provides a sufficient visual screen to current operations and will provide sufficient screen for the proposed future activities for receptors to the south. A noise attenuation bund/wall or combination of both is proposed to the west of the quarry and the south of the quarry. This bund will be vegetated to blend with the existing landscape and should use of noise attenuating fencing also be used in combination; it will be suitably matched to the landscape/setting.

Vegetation is present around the eastern edge of the water holding dam in the south eastern portion of the site. The width of this vegetation stand within the site boundary is narrow at 20m, however, will provide screening of the ancillary infrastructure for receptors in the east.

North Eastern Quadrant

Commercial and industrial areas with potential to be affected by the Project are located to the north and east of the quarry. The proposed industrial estate adjacent to the quarry is shown in *Figure 13.3*.

To the north a vegetative buffer of approximately 10m wide will remain in the site boundary to provide limited screening. The future development of industrial lots adjoining the quarry lot boundary will face east and north, with the buildings themselves to provide a visual buffer to the quarry.

The removal of the vegetative buffer to the east of the Project site to accommodate the proposed industrial development will result in greater exposure of the existing quarry and accordingly the Project site to the industrial estate, passing traffic along the Pacific Highway, and the Cassegrain Winery.

While the quarry and ancillary facilities will be more exposed to the industrial estate – the facades of the infrastructure on adjoining lots will face the east towards a proposed new access, away from the quarry. Lots on the opposite side of the proposed access track will be screened from the quarry and ancillary facilities by the infrastructure on the opposite side of the proposed access road.

The following screening and influencing factors are expected to limit the visibility of the quarry and ancillary facilities and negate any impacts to passing members of the public on the Pacific Highway:

- a portion of the highway in the vicinity of the quarry is a cut with vegetated batter slopes that would obstruct views of the quarry and ancillary facilities;
- the speed of the traffic passing in this location of 110 km/hr;
- the existing industrial setting of the locality; and
- the future industrial setting of the locality directly to the east of the quarry, and the screening effect to be provided by the industrial buildings.

The infrastructure at Cassegrain Winery faces the east south-east with the rear of buildings facing the quarry and the Pacific Highway. Hence impacts to the winery are considered to be negligible.

It is considered that due to the location of the quarry amongst extensive existing vegetation, surrounding topography, and the proposed long-term rehabilitation and revegetation activities, the visual impacts associated with the Project are negligible, under the assumption that the proposed mitigation measure outlined in *Section 13.4* are implemented.

Source:

"Exhibit 4 - Proposed Subdivision", Sancrox Employment Precinct, Drawing No. 4802RMS Section Plan/01/F, King & Campbell, November 2011.

Adjacent Industrial Area Undergoing Development			F 13.3
Drawing No: 0418291s_EIS_C002_R0.cdr			Sancrox Quarry Expansion Project
Date: 04/03/2019		Drawing size: A4	
Drawn by: GC		Reviewed by: TH	Client: Hanson Construction Materials Pty Ltd
			This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

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13.3.3 Proposed Lighting Requirements

The area requiring lighting for the 24 hour operation of the development is provided in *Figure 13.4*. The lighting performance requirements and recommended lighting technical parameters are:

- visitor and employee car parking bays to contain AS/NZS 1158.3 technical lighting parameter of category P11b;
- heavy vehicle circulation space to contain AS/NZS 1680.5 lighting technical parameters of general storage – pedestrian access with through traffic average illuminance (Eav) of 20lx, minimum illuminance (Emin) of 2.5lx, uniformity of illuminance (U_0) of 7, Glare Rating maximum (GRmax) of 50; and
- pedestrian circulation spaces around the building perimeter are to be covered by AS/NZS 1158.3 lighting technical parameter of category P4.

Luminaires located within the covered areas of the Site are considered shielded from external view, however these would also comprise of full cut-off luminaires.

All external lighting systems applied to the Site are to be assessed against AS 4282 Control of the obtrusive effects of outdoor lighting. The proposed lighting system is to fall below the recommended maximum values of light technical parameters for the control of obtrusive, as outlined within the Standard.

All external lighting systems applied to the Site are to be assessed against AS/NZS 1158.3 Classification of luminaires and associated criteria for control of glare and upward waste light. The proposed lighting system is to fall below the recommended Maximum Upward Waste Light Ratio (UWLR) percentage.

13.3.4 Lighting Impacts and Light Spill

Light spill due to 24 hour operations is unlikely to alter local light pollution levels, which are already influenced by the street lighting from the Pacific Highway to the east. The landform, vegetation and noise attenuation bunds/fencing (on the southern and western perimeters) will obscure and screen light spill at residential properties and the adjacent roadways located to the north, south and west of the Project site. Negligible light spill impacts are likely for users of the Pacific Highway due to the screening factors outlined in *Section 13.3.2* and the incorporation of proposed mitigation measures. It is noted that the level of lighting in the area to the east of the quarry will be increased with the establishment of the industrial estate.

In regards to luminaire specifications for light spill minimisation, numerous mitigating measures shall be adopted to reduce the possibility of obtrusive spill light beyond the Site boundaries and upward waste light. These mitigation measures are outlined in *Section 13.4*.

Legend

Lighting Area

Source:
Client provided June 2019.

Site Lighting Plan

F13.4

Drawing No:	0418291s_EIS_C003_R0.cdr		**Sancrox Quarry Expansion Project**
Date:	19/06/2019	Drawing size: A4	
Drawn by:	GC	Reviewed by: TH	Client: Hanson Construction Materials Pty Ltd

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13.4 MITIGATION MEASURES

The following mitigation measures are recommended to minimise visual amenity impacts:

- retain the vegetative buffer along the northwestern edge of the quarry pit to screen views from nearby private land;
- any combination of noise amelioration bunding/fencing is to be vegetated/match the landscape;
- the light spill will be minimised through detailed design and standard measures to contain lighting and include the following specific measures:
    - LED lens technology which allows for the precise aiming of light onto a designated location reducing spill light outside the Site boundaries. Luminaires are to be aimed within the confines of the Site. This includes stationary/fixed lighting to direct light away from the surrounding vegetation and all lighting within the processing and stockpiling area positioned in locations/elevations that would maximise the illumination of the operational area yet minimises the amount of reflected light and light directed off site;
    - luminaires comprising of full cut-off asymmetric lens optics shall be used throughout the Site. Luminaires to incorporate a flat glass visor, in order to minimise upward waste light;
    - luminaires mounted between 6m – 12m with a zero degree upward tilt;
    - the use of visors and physical obstructions;
    - consideration given to locating carpark pole mounted luminaires against the Site perimeter with the main light distribution directed within the Site;
    - direct stationary / fixed lighting downwards with the height of the light source minimised. Where appropriate, full cut-off fittings would be provided to ensure only localised areas are illuminated; and
    - light generation minimised through the selection of bulbs generating yellow light rather than blue/white light. The selection would be guided largely by safety considerations.

REFERENCES

PlantNET (The NSW Plant Information Network System) (n.d.). Royal Botanic Gardens and Domain Trust, Sydney. http://plantnet.rbgsyd.nsw.gov.au. Accessed 3 March 2019)

14 SOCIAL & ECONOMIC ASSESSMENT

This Chapter of the report has been prepared to describe the potential social and economic impacts associated with the Project, and the steps which will be followed to ensure that any risk is mitigated where possible.

14.1 METHODOLOGY

The SEAR's stipulate that the EIS must include:

- a detailed assessment of the likely social impacts of the development on the local and regional community by the (NSW DPE, 2017) *Social impact assessment guideline for State significant mining, petroleum production and extractive industry development*; and
- a detailed assessment of the likely economic impacts of the development, paying particular attention to:
- the significance of the resource;
- the costs and benefits of the project, identifying whether the development as a whole would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates; and
- the demand for the provision of local infrastructure and services.

The above requirements are addressed in the Social and Economic Impact Assessment prepared by Ethos Urban (2019) in accordance with NSW DPE. This report is summarised below and provided in Annex K. Ethos Urban (2019) characterised the Study Area for the social and economic assessment into Primary and Secondary Study Areas as shown in *Figure 1*.

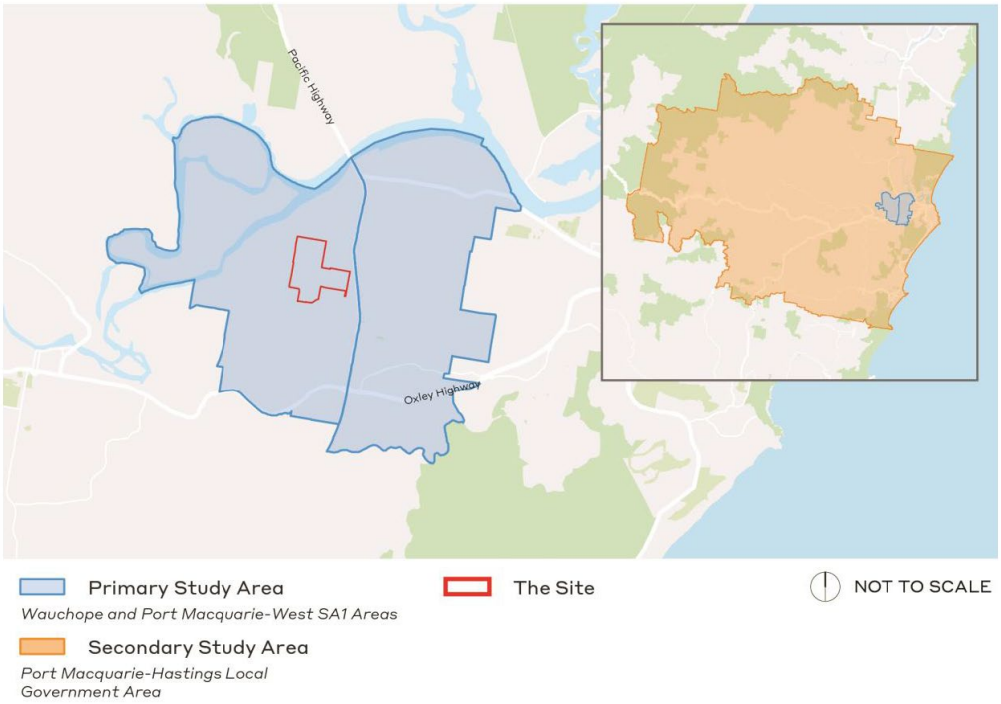

Figure 1 ***Social and Economic Study Area (Ethos Urban (2019))***

14.2 ASSESSMENT

14.2.1 Social Considerations

Context

The environment surrounding the site includes remnant woodland vegetation immediately adjacent to the north, west and south. A narrow strip of vegetation is present along the eastern boundary, with partially cleared land located 100m to the east. The closest residence to the site is located approximately 200m to the south-west, along Sancrox Road. A number of rural residential residences are also located along Bushland Drive to the south-west of the site, the closest being approximately 650m to the southwest. A further rural residence is located approximately 1km to the west. The Pacific Highway and Cassegrain Winery are located approximately 175m and 210m to the east, respectively. Sancrox Road is located approximately 230m to the south of the site, with a variety of industrial uses beyond.

The road infrastructure directly adjacent to the Sancrox Quarry has recently undergone redevelopment and improvement. The Sancrox Interchange connects to the Pacific Highway which services northern, southern and eastern movements from the quarry and was opened to the public on 30 November 2015. The Interchange was designed to cater for the existing industry and businesses in the area, as well as servicing the area which is planned for development as an industrial precinct.

The Pacific Highway in the vicinity of the quarry has recently been upgraded, as part of the Oxley Highway to Kempsey Pacific Highway Upgrade Project. The Highway is a dual carriageway, 110km/hr Motorway class road.

To the east of the quarry, construction has commenced on the development of an estate zoned for light industry. The Greater Sancrox Structure Plan 2014-2034 outlines future development options including rural residential development opportunities to the west of the quarry and south of Sancrox Road.

The typical social impacts associated with activities as proposed by the Project include land use conflicts, noise and vibration, air quality, traffic and transport, soil and water and visual. These are discussed below.

Land Use Conflicts

Ethos Urban (2019) assessed whether the proposed development may have potential social impacts with relation to personal and property rights, including affectation of economic livelihoods, and personal disadvantage or affectation of civil liberties. This may be the result of the following:

- Potential environmental impacts related to water quality, noise and vibration and air quality that could affect surrounding landowners.

- Potential impacts on surrounding businesses and residents associated with increased congestion and traffic movements due to expanded operations.

Ethos Urban (2019) determined that potential impacts will be minimal as the quarry site is remote and rural with no social infrastructure within walking distance of the site that would be affected by the expansion of quarry operations. The site is located near major road; however, as expected for a rural quarry site, there is limited public and active transport accessible to the site. The mitigation measures provided throughout the relevant technical assessment within this EIS will ensure that any potential impacts to neighbouring lands are mitigated to the full extent possible, where practicable.

Noise and Vibration Impacts

A detailed noise assessment was undertaken as part of this EIS. Potential impacts associated with construction road traffic and ground-borne noise and impacts associated with construction and operational vibration were qualitatively assessed.

Potential negative social impacts can be associated with increased operational and construction noise. Increased noise and vibration has the potential to create annoyance, interfere with daily activities, interfere with concentration and memory particularly with regard to children's school performance and business activity that depends on quiet surroundings, disrupt sleep and rest patterns and create or exacerbate health concerns such as hearing impairments and cardiovascular health (elevated blood pressure).

Construction and operational noise levels have the potential to exceed the applicable criteria, limits and thresholds if not suitably mitigated. Construction noise impacts may not be reduced to imperceptible or negligible levels for all receptors during all construction activities. However, the recommendations presented in *Chapter 10.5* will minimise residual construction noise impacts. Operational noise levels are predicted to exceed the applicable INP operational noise criteria and limits. Therefore, noise reduction and mitigation measures have been established to assist in achieving compliance with relevant guidelines. These measures are outlined in *Chapter 10.5*.

The assessment also identified the blasting overpressure, and vibration levels have only a limited potential to exceed the applicable AS2187 criteria and thresholds, as long as normal blast design planning and consideration for potential environmental impacts occurs.

Mitigation measures considered suitable to the magnitude and extent of the predicted construction and operational impacts are designed to reduce noise levels and minimise impacts as far as is commonly feasible and reasonable to do so and practical to implement. The details of the assessment and the recommended mitigation measures are provided in *Chapter 10* and *Annex G*).

Air Quality Impacts

An Air Quality and Greenhouse Gas Assessment have been prepared to support this EIS, which considers all reasonable and feasible mitigation measures to minimise the emissions from the proposed activities at the site, including a range of mitigation measures identified in *Chapter 11*. This assessment identified that impacts were below applicable criteria, except for cumulative (background plus Site contributions) PM10 24-hour average predicted concentrations. It is however noted that the exceedance was below particulate matter mitigation criteria from the Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments and consequently under this guidance, the level of impact to surrounding land use is considered to be acceptable.

The assessment considered all reasonable and feasible mitigation measures to minimise the emissions from the proposed activities at the site and provided recommendations for ambient monitoring to ensure compliance with legislation (refer to *Chapter 11* and *Annex H*).

Traffic and Transport Impacts

A Traffic and Transport Impact Assessment was undertaken as part of this EIS which concluded that the Project will not significantly impact on local traffic or transport networks. This conclusion was drawn due to the optimum, modern standard of design and construction of the recently upgraded Sancrox Interchange and Pacific Highway directly adjacent to the site (refer *Chapter 12* and *Annex I*).

The site currently generates an average of 42 heavy vehicle trips per day. The expanded quarry operations will increase average truck volumes to approximately 200 truck trips per day (a 'trip' is two movements – in and out of the site). This is an increase of approximately 158 additional heavy vehicle trips per day on Sancrox Road.

. During operation, typical daily traffic movements are likely to include:

- Light vehicle trips transporting staff to and from site concentrated at the start and end times of shifts;
- Truck trips delivering quarried product and asphalt;
- Concrete agitator trips to deliver concrete to construction sites;
- Import of concrete constituents (sand and cement); and
- Truck trips delivering waste concrete to site for recycling.

The mitigation measures provided throughout the traffic assessment are to be implemented during construction and operation of the Project to further ensure that driver behaviours and administrative controls, beyond the recently installed, high-quality infrastructure in place, minimise likelihood for impacts.

Soil and Water Impacts

Detailed soil and water assessment was undertaken as part of this EIS. These assessments concluded that soil and water management impacts could be effectively managed through the implementation of mitigation measures.

A surface water monitoring program has been prepared, and the site EPL will need to be varied to incorporate the proposed revision to current water monitoring. The program outlines the proposed surface water monitoring regime for the sediment basins that will be installed as the staged expansion progresses. With the implementation of sediment basins, the utilisation of mitigation measures and the development of an SWMP and PESCPs, the potential soil and water impacts of the Project can be effectively managed so that there is no significant, negative impact to the environment..

For soil-related mitigation measures, refer to *Chapter 9*. For water-related mitigation measures, refer to *Chapter 7* and *8*, and *Annex E* and *F* (Surface Water and Groundwater, respectively).

Visual Impacts

It is considered that due to the location of the quarry adjacent to areas of dense vegetation, surrounding topography, the proposed long-term rehabilitation/revegetation activities and lighting management measures that the visual impacts of the development are minimal (refer to *Chapter 13*).

14.3 ECONOMIC CONSIDERATIONS

14.3.1 Demand

The Mid North Coast Regional Strategy (Department of Planning, 2009) estimated a population increase throughout the Mid North Coast region that is among the highest in regional NSW. Ethos Urban (2019) detailed that the Primary Study Area (PSA) is forecast to undergo significant growth to 2036, generally associated with new development in the locality of Thrumster, close to the site. Between 2016 to 2036, the population of the PSA is forecast to increase by around 9,000 persons to 13,300 persons by 2036 (Ethos Urban, 2019). This implies an average annual growth rate of 5.9%, this projected growth rate is much higher than Port Macquarie-Hastings, which is forecast to be 1.3% over this same period (Ethos Urban, 2019). Most of this population growth is forecast to occur within the locality of Thrumster, which is directly south-east of the site (Ethos Urban, 2019).

In the PSA, the number of dwellings is projected to increase by around 720, to around 1,100 by 2036. The number of households are expected to increase by 700 (Ethos Urban, 2019). The average household size of the PSA is forecast to increase slightly to 2.84 by 2036, while the average expected household size of the LGA is expected to be 2.61 (Ethos Urban, 2019). The increase in average household size is driven by an increase in family households occurring in new developments within the PSA (Ethos Urban, 2019).

Between 2016 to 2036, the number of households in the Port Macquarie-Hastings LGA is forecast to increase from 34,100 households to 44,800 households (at a growth rate of greater than1.3% per annum), while the average household size is forecast to remain at 2.31 persons per household over the period (Ethos Urban, 2019).

The number of dwellings in the Port Macquarie-Hastings LGA is forecast to increase from 37,020 dwellings in 2016 to 47,500 dwellings in 2036, representing a dwelling growth rate of 1.3% per annum over the period (Ethos Urban, 2019). The dwelling occupancy rate over the 20 years is expected to remain constant at 92%, with 10,480 new dwellings required between 2016 to 2036 to meet population growth demand (Ethos Urban, 2019).

Between 2011 and 2016, the population increased by around 450 residents within the PSA, at an average annual growth rate of 16.2%. This was much greater than the average annual growth rate of Port Macquarie-Hastings LGA at 2.6%. This suggests that the area has transformed in recent years, coinciding with the development of rural areas to residential (Ethos Urban, 2019).

CCAA (2015) states that in Australia each year, Australia use the equivalent of 7 tonnes of aggregate per person. Furthermore, the construction of a new house requires approximately 110 tonnes of construction aggregates and 53m^3 of concrete. With this requirement, and the increased population and associated housing requirements in the region, a demonstrable demand is present and will continue to expand.

These resources will be important in supporting strong urban and infrastructure growth forecast in the Port-Macquarie-Hastings LGA and broader region over the coming decades (Ethos Urban, 2019). The role of Sancrox Quarry in supporting major projects is highlighted by the product provided for the now completed Sancrox Interchange and Oxley Highway to Kempsey Pacific Highway Upgrade projects (Ethos Urban, 2019).

Resource demand will be driven by increased sub-divisions for residential and industrial developments across the Mid-North Coast region, and major infrastructure projects (e.g. roads) (Ethos Urban, 2019). This will include concrete aggregate supply to Port Macquarie and Taree Concrete plants for construction, as well as road base and fill material (Ethos Urban, 2019)..

Ethos Urban (2019) provided current and potential development within the region, as follows:

- Port Macquarie: Ascot Park, Thrumster, Sovereign Hills, Ocean Drive upgrade, Port Macquarie Ring Road, Lake Cathie, Bonny Hills, Rainbow Beach development, Lakewood;
- Sancrox: Expressway, Spares industrial development, Le Clos and Freeman residential developments; and
- Wauchope: Crosslands and Beechwood residential developments, road developments to Walcha.

Additional production capability will provide improved efficiencies and allow Sancrox Quarry to support developments beyond Taree and Kempsey, with an estimated range of 100km (Ethos Urban, 2019).

14.3.2 Key Markets

Ethos Urban (2019) outlined that products from Sancrox Quarry are extensively used by public and private customers, especially for State/major projects and for commercial development projects. Combined, these two key markets accounted for approximately 70% of product sales in 2018.

Table 14-1 Sancrox Quarry - Key Markets (by share) 2017 and 2018

Customer	2017	2018
Private developers	30%	35%
State/major projects	31%	33%
Concrete aggregates	15%	15%
Port Macquarie- Hastings LGA	14%	8%
Wholesale/retail	10%	8%
Total	100%	100%

14.3.3 Benefits

The increased quarry production along with the proposed batching and recycling operations will result in considerable economic benefits at both the local and regional level. The principal economic benefits of the Project are related primarily to the local provision of:

- hard rock aggregates to regional projects;
- an additional option for the recycling of concrete for beneficial reuse;
- concrete for development projects throughout the region;
- asphalt for regional road construction projects;
- employment growth at the quarry and in the broader community – which also brings potential social benefits to the community associated with increased business expenditures and expanded employment opportunities;
- efficient and cost-effective delivery of the product to customers/end users; and
- environmental benefits through the diversion of used concrete from landfill.

The Project will provide surety of supply of construction materials to assist in meeting the urban growth resource needs, stimulated by ongoing population expansion and the proposed pipeline of major State Government infrastructure investment projects of the Mid North Coast region.

Sancrox Quarry is in a strong position to provide quality construction materials for the provision of vital road network infrastructure in the form of hard rock aggregate, fill materials and asphalt. The ongoing supply of these materials to the Mid North Coast market is critical in ensuring increased demand for construction materials is met, thus contributing to the affordability and overall capability of state and locally funded infrastructure projects.

Ethos Urban (2019) identified that the proposed development would have the following potential positive social impacts in relation to the way of life in the PSA and broader locality:

- increased employment opportunities associated with expanded operations at the quarry. The strategic policy context has identified that it is a state and local government priority to develop vibrant economies and enhance employment opportunities within the local area, and over a third of resident workers within the Port Macquarie-Hastings LGA are employed in construction-related employment; and

- increased diversity of employment opportunities. Currently, the economic profile of the area indicates that the largest sectors of industry employment for residents in the area construction, agriculture, fishing and forestry. This proposal is likely to generate new employment opportunities in the mining and resource extraction industry.

Employment generation will occur during both the construction and operational phases of the project, which is estimated as follows:

- Construction employment of 80 direct Full-Time Equivalent (FTE) jobs over the development phase. This is based on allocating 50% of investment on labour and applying an average of $80,000 per FTE construction job (ABS Average Weekly Earnings, Australia Nov 2018). In addition to direct employment, 130 further FTE jobs will be supported in the wider economy through the employment multiplier effect (based on the ABS multiplier for 'other construction' of 2.6). In total 210 FTE jobs will be generated through the construction phase of the project on a direct and indirect basis. Operational employment of greater than 10 new FTE jobs (compared to the existing situation); and

- In addition to direct employment, 35 further FTE jobs (rounded) will be supported in the wider economy through the employment multiplier effect (based on the ABS multiplier for 'other mining' of 4.3). It total 45 FTE jobs will be generated through the operational phase of the project on a direct and indirect basis.

An estimated $2.1 million pa in quarry operational expenditure is retained in the Port Macquarie-Hastings LGA economy through local wages and on costs ($1.0 million), and suppliers and services ($1.1 million). These figures relate to year ending 2018.

The expansion of Sancrox Quarry, as per the proposed project, will increase resource supply considerably at the facility over the coming years. While actual annual production levels will be subject to market conditions, Hanson estimate gross market value of available resource is estimated at approximately $24 million pa (2019 dollars), based on annual production of 750,000 tonnes.

14.3.4 Project Investment

Ethos Urban (2019) detail that project investment of $12.5 million will be required to complete the expansion of Sancrox Quarry, with this investment likely to benefit the regional economy in terms of employment, business contracts and supply chain impacts. This is evidenced by the strong construction-related business and workforce base available in Port Macquarie-Hastings LGA to service the project (Ethos Urban, 2019).

Based on similar projects undertaken by Hanson, the project has the potential to be 70%-90% locally sourced (90% represents a local company securing the contract to build and design the plant, using domestic steel) (Ethos Urban, 2019).

14.3.5 Macro-economic Considerations

As with all commodities, macro-economic factors such as economic growth, changes in market prices and movements in interest rates can affect demand for product. With regard to the types of product to be sourced from the expanded Sancrox Quarry, it is unlikely demand for these products will be impacted significantly by such macro-economic factors, with Ethos Urban (2019) providing the following reasons:

- products from the expanded quarry will be focused entirely on the domestic market (principally local/regional markets); therefore, output will not be subject to the type of volatility often associated with export-focused commodities (e.g. metals, coal);

- population and dwelling growth forecasts remain strong at a local and regional level, underpinning significant demand for quarry resources into the future – which includes infrastructure projects which support urban growth;

NSW economic growth remains strong, with the 2018-19 NSW Budget noting:

- "The New South Wales economy has been exceptionally strong over the last few years with the outlook for growth to remain above trend this year and for the next two years". The more recent 2018/19 NSW Budget Half-Yearly Review, forecasts employment to increase at between1.25% to 1.50% pa to 2021/22, while unemployment is expected to remain at approximately 4.5%. Gross State Product (GSP) is projected to remain steady (and above long-term trends) at 2.50% between 2018/19 and2021/22. The Half-Yearly Review also notes the State Government's infrastructure investment pipeline is $89.7billion over the next four years, which represents an upward revision of $2.5 billion since the Budget; and

- Interest rates have been at historical lows and stable for some time, with the Reserve Bank of Australia's official cash rate is 1.0% at July 2019. The RBA's outlook indicates further stability, with only minor movements in the base rate (up or down) likely in the short-medium term.

14.3.6 *Local Spending Stimulus*

The additional employment generation associated with the operations of the expanded quarry, represents a 75% uplift in labour (from 13 jobs to 23 jobs) which will have a flow on stimulus impact to the Port Macquarie-Hastings economy (assuming these new employees are resident workers) (Ethos Urban, 2019). Additionally, increased local purchases of goods and services are likely to occur due to the expanded operations.

Based on existing wage/purchase stimulus of $2.1 million pa and applying a 75% uplift, an additional $1.6 million pa (2019 dollars) will be generated in local stimulus through the operational phase of the project (Ethos Urban, 2019).

14.3.7 *Concrete Recycling*

The expansion of Sancrox Quarry will include the development of a recycled concrete processing plant which can produce up to 20,000 tonnes of concrete pa. The concrete recycling facility will, therefore, contribute to positive environmental benefits by diverting concrete waste product from landfill (Ethos Urban, 2019).

Providing such resources to road infrastructure projects provide benefits to communities and individuals at a local, state and national level by improving road conditions and reducing time spent travelling, which in turn has potential to reduce costs associated with travel and transport of materials and positively improving productivity.

14.4 MITIGATION MEASURES

The construction and operation of the Project are anticipated to have minimal negative socio-economic impacts. Individual technical assessment contained throughout this EIS that can potentially negatively impact on the local community (such as traffic, noise and vibration, air and water quality) include mitigation measures that must be implemented.

Community and stakeholder engagement has been outlined in *Chapter 4*, providing the local community with access to project information and the opportunity to raise any concerns with regard to the Project.

Ethos Urban (2019) outlined the following mitigation measures with regard to social and economic factors:

- maximise positive social impacts of increased employment opportunities within the PSA through practices that encourage the employment of local residents within the PSA, such as training programs to ensure that local residents have the skills required to take advantage of new employment opportunities;

- maintain the existing complaints register to continue to monitor issues raised by the community related to community composition, cohesion, character, how it functions and sense of place;

- plan community engagement to specifically address sense of place within the local community, to assist in defining sense of place to be reflected in future planning stages. For example, a community survey, or specific discussion of sense of place with the Community Consultative Committee established for the project;

- confirm ongoing operation of the Community Consultative Committee as a conduit between the broader community and Hanson; and

- Undertake consultation with the CCC and broader community regarding options for the potential future rehabilitation of the site when operations have ceased, to maximise the positive social benefits to the local community.

14.5 CONCLUSION

The Project is not expected to result in any significant negative economic or social impacts for the local and wider communities upon the implementation of the mitigation measures proposed. The Project will facilitate numerous construction projects within the region, which, in addition to the jobs created by the project, will result in economic benefits for the community. Given the expected population increase in the future, construction materials proposed for production at the Sancrox Quarry will be vital for the sustainable expansion and growth of the area. The proposed concrete waste recycling will generate beneficial reuse of this waste stream and lessen the burden on limited landfill volume in the region.

REFERENCES

CCAA (2015) Stone, Gravel and Sand – The key to Australia's infrastructure. Cement Concrete and Aggregates Australia

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NSW Department of Planning and Environment (2017). **Preparing an Environmental Impact Assessment.** Draft Environmental Impact Assessment Guidance Series.

NSW Department of Planning and Environment (2017). Social impact assessment guideline. State significant mining, petroleum production and extractive industry development

15 HAZARDS AND RISK ASSSESSMENT

This chapter provides an assessment of environmental hazards and risks that could arise during the operation of the Project, and management strategies to address these hazards and risks.

A hazard analysis and risk screening assessment has been undertaken for the Project, which evaluates the likely risks to public safety, focusing on the transport, handling and use of hazardous materials and bushfire risk. The assessment also determines whether the Project should be considered a hazardous or potentially hazardous industry under *State Environmental Planning Policy 33 – Hazardous and Offensive Development* (SEPP 33).

15.1 ASSESSMENT METHODOLOGY

A desktop assessment was carried out to identify environmental hazards and risks that could arise during the construction and operation of the Project, as well as mitigation measures to address such issues.

The assessment focused on those hazards and risks with the potential to adversely affect the quality of the surrounding environment, land uses and communities, with consideration of the following relevant policies and guidelines:

- *State Environmental Planning Policy 33 – Hazardous and Offensive Development* (SEPP 33);
- *Hazardous and Offensive Development Application Guidelines: Applying SEPP 33* (Department of Planning, 2011);
- *International Standard (ISO / IEC 31010) Risk Management – Risk Assessment Technique;*
- *Australian Code for the Transport of Dangerous Goods by Road and Rail (7th edition)* (National Transport Commission, 2007);
- *Storage and Handling of Dangerous Goods Code of Practice* (WorkCover, 2005);
- The aims and objectives outlined throughout *Planning for Bushfire Protection 2006* (NSW RFS); and
- Bushfire prone land mapping developed and published by PMHC.

There may be additional health and safety hazards that are not specifically considered in this EIS and would be addressed by the construction contractor.

15.2 APPLICATION OF SEPP 33

Definitions

Industries or projects determined by a risk screening process to be hazardous or potentially hazardous would require the preparation of a Preliminary Hazard Analysis (PHA) in accordance with Clause 12 of SEPP 33. No further assessment under SEPP 33 is required for projects not considered potentially hazardous or offensive.

Definitions of 'potentially hazardous industry' and 'potentially offensive industry' are provided in SEPP 33:

'potentially hazardous industry' means a development for the purposes of any industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would pose a significant risk in relation to the locality:

a. to human health, life or property, or

b. to the biophysical environment, and includes a hazardous industry and a hazardous storage establishment.

'potentially offensive industry' means a development for the purposes of an industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would emit a polluting discharge (including for example, noise) in a manner which would have a significant adverse impact in the locality or on the existing or likely future development on other land, and includes an offensive industry and an offensive storage establishment.

15.3 ASSESSMENT

15.3.1 Hazard Analysis

In assessing the proposed Project, the emphasis is on preventing hazardous incidents on-site, such as fire and explosion, or the release of significant quantities of toxic or biologically harmful chemicals that could result in substantial off-site effects.

The assessment of the suitability of the Project site to accommodate existing or proposed development of a potentially hazardous nature is based on consideration of:

- the nature and quantities of hazardous materials stored and processed on the site;
- the type of plant and equipment in use;
- the adequacy of proposed technical, operational and organisational safeguards;
- the surrounding land uses or likely future land uses; and
- the interactions of these factors.

This information is incorporated into the Project's hazard analysis. The objective of hazard analysis is to develop a comprehensive understanding of the hazards and risks associated with the existing and proposed quarry operations and of the adequacy of safeguards.

15.3.2 Potential impacts during Construction and Operation

Potential hazards and risks during construction and operation include (but are not limited to):

- the on-site storage, use and transport of dangerous goods and hazardous substances;
- risk of damage to existing building basements and ground support structures due to ground movement and geotechnical uncertainty; and
- bushfire risks.

These hazards and risks are described further in the following sections. It is noted that bitumen that will feed the asphalt production process is a Class 9 dangerous good. Applying SEPP 33 states that this class poses little threat to people or property and are excluded from risk screening. As bitumen and bitumen emulsions will be present in volumes greater than 10,000kg, SafeworkNSW are to be notified and manifests and emergency plans developed.

Storage, Use and Transport of Dangerous Goods and Hazardous Materials

Hazardous materials are defined within *Hazardous and Offensive Development Application Guidelines: Applying SEPP 33* as substances falling within the classification of the Australian Code for Transportation of Dangerous Goods by Road and Rail (Dangerous Goods Code). As detailed in *Table 15.1* the hazardous materials that are currently stored or proposed to be stored on site are not subject to the provisions of SEPP 33.

An indicative list of the types of potentially hazardous materials anticipated to be used, stored and transported during construction and operation of the Project is provided in *Table 15.1* along with the relevant storage and transport thresholds established under Applying SEPP 33.

The thresholds in Applying SEPP 33 represent the maximum quantities of hazardous materials that can be stored or transported without causing a significant off-site risk.

In most instances, low volumes of potentially hazardous materials would be stored on site. The volume required to be stored on site would largely depend on the anticipated rates of consumption, with deliveries of dangerous goods coordinated to match consumption rates.

Construction site planning would ensure hazardous materials are stored appropriately and at the required distance from sensitive receptors, in accordance with the thresholds established under Applying SEPP 33. Should the minimum buffers be unable to be maintained, either due to space constraints, the close proximity of receptors, or a requirement to store volumes of hazardous materials in excess of storage thresholds, a risk management strategy would be developed on a case‐by-case basis. Typical storage facility layouts are demonstrated in *Photographs 15.1 – 15.4*.

Environmental hazards and risks associated with the on-site storage, use and transport of chemicals, fuels and materials would be managed through standard mitigation measures to be developed as part of the construction environmental management documentation. These measures would include the storage and management of all hazardous substances in accordance with the *Work Health and Safety Act 2011*, the *Storage and Handling of Dangerous Goods Code of Practice* (WorkCover NSW, 2005) and Applying SEPP 33.

Table 15.1 Proposed Hazardous Material Storage at Sancrox Quarry (Construction and Operation)

Material	Australian Dangerous Goods Class	Storage Location	Storage Method	Storage Quantity	Applying SEPP 33 Thresholds		
					Storage Volume	Minimum storage distance from sensitive receptors	Transport
Diesel Fuel	Class C1[1]; or 3 PG III[2]	Above ground tank, located near Workshop Area	20 Litre drums / carry cans, self bunded tank	50,000 L	Greater than 5 tonnes, if stored with other Class 3 flammable liquids.	5 metres	Fortnightly transport of 35,000 L. Not applicable if not transported with Class 3 dangerous goods
Lubricating and hydraulic oils and grease	Class C2[1] or 3 PG III[2]	Workshop Area	20 litre drums	10,000 kg	N/A	N/A	Monthly Transport of 2000 L. Not applicable, if not transported with Class 3 dangerous goods
Precoat Supa 30 (bitumen emulsions)	Not classified under the ADG but is GHS classed as flammable liquid Cat 4 so to be stored as combustible liquid - Class C1[1] or 3 PG III[2]	On ground tanks, located near Workshop Area	Above ground storage tank (AST)	50,000 L	greater than 2 tonnes	N/A if not stored with other flammable items or ignition sources (will not be stored near the workshop, will be stored near the Asphalt production plant or in the new stockpile area). To be stored in accordance with AS 1940:2017 (The storage and handling of flammable and combustible liquids) which considers the separation and segregation issues to insure there is no fire escalation to be outlined in management plan).	Monthly transport of 27,000 L. Not applicable if not transported with Class 3 dangerous goods

Material	Australian Dangerous Goods Class	Storage Location	Storage Method	Storage Quantity	Applying SEPP 33 Thresholds		
					Storage Volume	**Minimum storage distance from sensitive receptors**	**Transport**
Industrial grade oxygen	Class 2.2	Workshop Area - G & E size cylinders	Cylinders (up to 55 kg) in rack	70 m^3	N/A	N/A	Not subject to Applying SEPP 33 transport thresholds
Industrial grade acetylene	Class 2.1	Workshop Area - G & E size cylinders	Cylinders (up to 55 kg) in rack	50 m^3	Greater than 0.1 tonnes (100kg)	N/A	Monthly transport of 4 X G size heavy duty gas cylinders, which falls below the minimum threshold and does not trigger SEPP 33.
LPG	Class 2.1	Workshop Area	50kg cylinder	50 kg	10 tonne or 16m^3	N/A	6 monthly transport of 50 kg. Below the minimum transport threshold and such does not trigger SEPP 33.
Unleaded Petrol	C1[1]; 3 PG III[2]	Workshop Area	20 litre drums	40 L	Greater than 5 tonnes, if stored with other Class 3 flammable liquids	5 metres	Not applicable if not transported with Class 3 dangerous goods.
Hydrochloric Acid	Class 8, PG II	Workshop Area	20 litre drums	60L	25 tonne (packing group II	Ensure segregation from incompatibles (AS3780 recommends 5m where storage is open)	Deliveries will likely be annually. Not subject to Applying SEPP 33 transport thresholds

1. Classified as C1 if not stored with other Class 3 flammable liquids.
2. Classified as 3PGIII if stored with other Class 3 flammable liquids.

Photograph 15-1 Typical Acetylene and Oxygen storage.

Photograph 15-2 Typical Self-bunded Diesel storage.

Photograph 15-3 Typical Lubricant and hydraulic oil storage standard used by Hanson.

Photograph 15-4 Typical Precoat Supa storage at Sancrox Quarry.

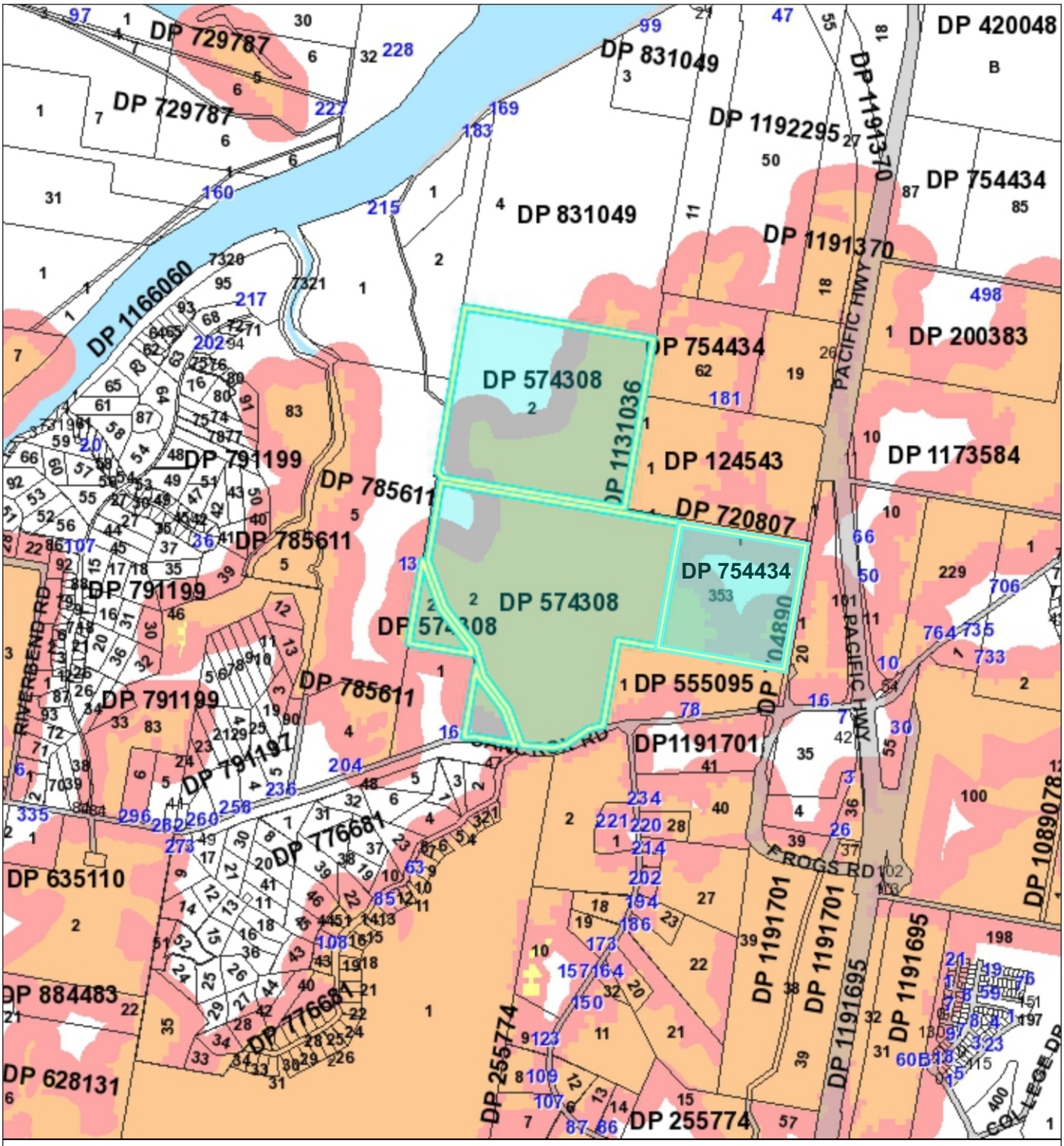
The risk screening process for the storage of hazardous materials at the Project site and the transportation of hazardous materials to/from the site demonstrates that in all cases, types and quantities would be below the Applying SEPP 33 thresholds. For storage, this demonstrates that operational inventories would not pose a significant risk of harm beyond the site boundary. For transportation, this also demonstrates that risks are unlikely to be significant.

It can be concluded that the risks associated with storage and transportation of hazardous materials are unlikely to be significant or pose a risk to public safety. Given that Applying SEPP 33 thresholds are not exceeded, the Project is not considered to be a hazardous or potentially hazardous industry under SEPP 33. Therefore a PHA is not required to be undertaken for the Project.

Bushfire Risk

A search of the NSW Rural Fire Service online bush fire prone land tool (NSW RFS, 2017) has indicated that the Project site exists within a designated bush fire prone area (refer to *Figure 15.1*). All development on bush fire prone land must satisfy the aim and objectives of *Planning for Bush Fire Protection 2009*. The aim is to provide for the protection of human life and minimise impacts on property from the threat of bush fire, while having due regard to development potential, site characteristics and protection of the environment.

The nature of the proposed Project activities will not increase the potential for or severity of bushfires in the locality, however the risk that a fire may start in the surrounding area and threaten the quarry will be addressed within the overall Emergency Response Plan. The existing site layout already provides an area of defendable space around all administration and workshop buildings, and the proposed clearing of land mapped as Vegetation Category 1, will result in further reduction of bushfire fuel loads. Nevertheless, due to the existence of the Project site within a bushfire prone area, associated bushfire prevention and mitigation measures are provided in *Section 15.4.2* below to minimise bushfire risks should they occur within and/or adjacent to the Project site.



LOT: 2	DP: 574308
LOT: 353	DP: 754434

BUSH FIRE NOTE:

Category 1, Category 2 and Buffer areas are defined as Bush Fire Prone Land

Mapping data certified by RFS on 6th July, 2010. Further enquiries can be made to Council's Duty Planner Monday to Thursday between the hours of 8.30am to 1pm

Legend

- Category 1
- Category 2
- Buffer

Source:

Port Macquarie-Hastings Council, 01/03/2018.

Bushfire Prone Land Map

F.15.1

Drawing No:	0418291s_HR_B_C001_R0.cdr		Sancrox Quarry Expansion Project
Date:	02/03/2018	Drawing size: A4	
Drawn by:	GC	Reviewed by: TB	Client: Hanson Construction Materials Pty Ltd

Drawing Not to Scale

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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

15.3.3 Potentially Offensive Assessment

The assessment of the suitability of the Project site to accommodate existing or proposed development of a potentially offensive nature is based on consideration of:

- the nature and quantities of materials stored and processed on the site;
- the type of plant and equipment in use;
- the adequacy of proposed technical, operational and organisational safeguards;
- the surrounding land uses or likely future land uses; and
- the interactions of these factors.

The potential polluting discharges a development of this type that could generate that would be deemed offensive and cause adverse impacts if unmitigated are outlined in *Table 15.2*. Discussion of where these issues are addressed in the EIS and hence why they are considered to be mitigated is also outlined.

Table 15.2 Potentially Offensive Assessment

Potential Impacts	Discussion
Odour	Assessed in Chapter 11, and Annex H. Odour will be managed to prevent it from being offensive. A vapour balancing system will be installed for the delivery of bitumen on-site and vapour recovery system will be employed for transfer of asphalt to trucks to minimise odour and dust emissions. Moreover, the asphalt plant will be totally enclosed and particulate matter emissions will be mitigated using one fabric filter associated with the natural-gas fired dryer.
Noise	Assessed in Chapter 10 and Annex G. With the implementation of mitigation measures such as noise attenuation bunds and enclosures, noise has been modelled to be compliant with criteria and thus is considered unlikely to be offensive.
Air Emissions	Assessed in Chapter 11 and Annex H. With the implementation of mitigation measures, air emissions such as dust suppression and bag filters are not considered to be offensive.
Water Discharge/Runoff	Water discharges are assessed and discussed in Chapter 7 and Annex E. Mitigation measures in accordance with Landcom 2004 and DECC 2008 including sediment basins and progressive rehabilitation will manage potential impacts such that the water discharges can be deemed inoffensive.
Ground Contamination	Chapter 7 identifies a low likelihood of contamination exists in the proposed quarry expansion area. Chemical management and spill response measures are proposed to prevent future contamination and thus the proposed development is considered inoffensive with regards to ground contamination.

15.4 MITIGATION MEASURES

The mitigation measures to be implemented to address potential hazards and risks are provided below.

15.4.1 Hazardous Materials Storage and Transportation

Storage

The following mitigation measures will be implemented for the storage of hazardous materials to ensure compliance with the application of SEPP 33, including but not limited to:

- all hazardous substances that may be required for construction and operation would be stored and managed in accordance with the Storage and Handling of Dangerous Goods Code of Practice (WorkCover NSW, 2005) and Hazardous and Offensive Development Application Guidelines: Applying SEPP 33 (Department of Planning, 2011), including but not limited to the following:
  - diesel will not be stored with Class 3 materials;
  - lubricating and hydraulic oils and grease will not be stored with Class 3 materials; and
  - maximum stored inventories (250 kg) will be located more than 25 metres (m) away from the nearest site boundary, so as to not trigger the Applying SEPP 33 thresholds if considered in aggregate.

As bitumen and bitumen emulsions will be present in volumes greater than 10,000kg, SafeworkNSW are to be notified and manifests and emergency plans developed.

Transportation

Mitigation measures relating to the transport of potentially hazardous materials include:

- the method for delivery of explosives would be developed prior to the commencement of blasting in consultation with the DPI&E and be timed to avoid the need for on-site storage. No explosive storage on site is proposed.
- transportation routes outlined in the Traffic and Access Assessment (refer to *Chapter 12*) will be followed to ensure impacts to road systems will be minimised where practicable.

15.4.2 Bushfire Prevention and Control

Prevention

This section has been prepared to address the aims and objectives of *Planning for Bushfire Protection (2006)* as requested by the NSW Rural Fire Service.

For a bushfire to occur there are three factors which must be present, namely oxygen, fuel and an ignition source, along with several other factors which affect the probability and intensity of a bushfire. While exclusion of oxygen is not feasible, each of the remaining issues will be managed as follows.

- fuel loads within the Site will be managed through:
    - the maintenance of Asset Protection Zones (APZ) in accordance with the *Planning for Bushfire Protection Guidelines* (RFS, 2006) will be established and maintained around all administration buildings and the workshop areas, as outlined in *Figure 15*.2 below.
    - trees and shrubs will be maintained to prevent the spread of a fire towards the buildings, taking into account the requirement for an effective visual screen.
- company-controlled ignition sources and the associated management measures that will be implemented include the following:
    - all Project-related activities will be undertaken, where practicable, in cleared areas;
    - all mobile equipment will be maintained in good working order with appropriate exhaust and fire suppression systems;
    - all mobile equipment working in vegetated areas will be inspected to ensure that they do not pose a risk of starting a bushfire. This will include inspection of exhaust and electrical systems, including, in the case of vehicles using unleaded petrol, catalytic converters; and
    - mobile equipment working in vegetated areas will not be left unattended with the engine running.
- personnel, contractors and their employees will undergo site-specific training incorporating bush fire management awareness as part of the Project's induction program ensuring the following is outlined:
    - obligations toward prevention and notification;
    - all mobile equipment will be equipped with appropriate communication equipment, including two-way radios and/or mobile telephones;

- restriction of activities during periods of very high (or higher) bushfire danger rating;
- emergency response procedures;
- locations of fire-fighting equipment;
- adopt appropriate controls during re-fuelling; and
- ensure fire extinguishers are fitted to all site vehicles.
- welding or other hot works activities will, as far as practicable, be conducted and confined to the main workshop area

- fuel loads within the Project site will be managed in conjunction with Hanson's obligations in relation to rehabilitation of the Project site and biodiversity offset requirements.

Pit Floor

Dam

Concrete Batching Plant
& Recycling Facility

Old Processing Plant
(to be relocated)

Vegetation
(to be cleared)

New
Processing
Plant

New Asphalt
Production Plant

New
Stockpile
Area

Dam

Existing Site Office,
Weightbridge & Workshop

Dam

Legend

- Existing Property Ownership
- Haul roads
- Lot Boundary
- Road Network
- Asset Protection Zones
- Infrastructure

Source:
Spatial Data: DFSI DCDB, DTDB 2017
Imagery Data: nearmap August 2017

Notes:
Asset Protection Zone for the site is 85m. This based on:
1. The site is in bush fire prone area
2. The site is surrounded by open forest (Dry sclerophyll forests)
3. The buildings are located in 5º-10º slope
A Guide for Councils, Planner, Fire Authorities and Developers - Planning for bushfire protection, NSW rural fire service 2006

Asset Protection Zones

F15.2

Drawing No:	0418291s_EIS_G0017_R0.mxd		Sancrox Quarry Expansion Project
Date:	12/03/2018	Drawing Size: A4	
Drawn By:	VN	Reviewed By: ME	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 25 50m

N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

Control

The ability to control a bushfire depends upon available fuel, control of ignition sources and good access and water supplies. The following fire management procedures will be adopted to assist with the control of any bushfire on or adjacent to the Project site:

- provision of access to strategic areas on the site;
- a static water supply is provided for firefighting purposes in areas where reticulated water is not available, this includes all weather access to the sedimentation dams;
- stockpiling of cleared vegetation with a minimum 10m cleared buffer zone; and
- creating suitable all weather access tracks (with suitable signage and turning circles if not a through road) and if required during a bushfire event, strategically located fire breaks.

Hanson will also incorporate bushfire management procedures in the overall Emergency Response Plan for the Project. A copy of the procedures, including a map of all fire-fighting equipment, access roads, communications protocol, emergency evacuation plans and any locked gates will be provided to the local RFS.

REFERENCES

Department of Planning (2011). Hazardous and Offensive Development Application Guidelines: Applying SEPP 33.

Hanson (2017a). *Brandy Hill Quarry Environmental Impact Statement – Hazard Impact Assessment*.

International Organisation for Standardisation and The International Electrotechnical Commission (2009). *Risk Management – Risk Assessment Technique* (ISO / IEC 31010:2009).

National Transport Commission (2007). *Australian Code for the Transport of Dangerous Goods by Road and Rail* (7th edition).

NSW Government (1992). *State Environmental Planning Policy 33 – Hazardous and Offensive Development* (SEPP 33);

NSW RFS (2018). Bush Fire Prone Land Mapping Tool. https://www.rfs.nsw.gov.au/plan-and-prepare/building-in-a-bush-fire-area/planning-for-bush-fire-protection/bush-fire-prone-land/check-bfpl

Port Macquarie – Hastings Council (2018). *Bushfire Prone Land Map* for the Sancrox Area.

WorkCover (2005). *Storage and Handling of Dangerous Goods Code of Practice*.

16 WASTE MANAGEMENT

16.1 *METHODOLOGY*

This waste assessment has been prepared to provide guidance on the classification and removal of wastes generated as a result of the construction and operation of the Project.

Hanson provided an estimation of waste types and volumes based on the understanding of waste generated by current operations on the site. Where such information was unavailable for the site, Hanson provided waste volumes based on waste generation estimates for the proposed Brandy Hill Quarry, which has a similar extraction rate to this Project. An understanding of the process of operating a concrete batching and recycling facility and an asphalt production plant were utilised to generate likely waste streams.

Regulatory guidelines referred to in the preparation of this assessment include:

- *Waste Classification Guidelines* (EPA 2014); and
- Resource Recovery Orders and Exemptions prepared by the New South Wales Environment Protection Agency (NSW EPA).

This assessment was prepared by ERM Environmental Scientists with experience in the preparation of waste impact assessments and management strategies for quarrying and industrial developments.

16.2 *BACKGROUND*

The requirements of the following legislation will be adhered to during construction and operation of the Project, to ensure the effective management of wastes on-site:

- *Protection of the Environment Operations Act 1997* (POEO Act)
- *Protection of the Environment Operations (Waste) Regulations 2005*
- *Waste Avoidance and Resource Recovery Act 2001*

The SEARs specify that waste management must be addressed in the EIS and include estimates of the quantity and nature of the waste streams that would be generated or received by the development and any measures that would be implemented to minimise, manage or dispose of these waste streams.

16.2.1 Management of Wastes

The NSW EPA is the state government agency responsible for initiating waste avoidance and resource recovery strategies as a method of ensuring ecological sustainability. These strategies will be implemented where possible for the construction and operation of the Project. The objectives of these strategies are to:

- minimise the consumption of natural resources;
- encourage resource recovery, including reuse, recycling and energy recovery;
- provide for continual reduction in waste generation; and
- minimise the final disposal of waste.

The Waste Management Hierarchy will be incorporated into the waste reduction and resource recovery strategies for the construction and operation of the Project. The principles of the hierarchy in order of priority are:

1. avoid;
2. reuse;
3. recycle/reprocess; and
4. dispose.

Hanson prioritizes waste avoidance and strives for best practice with extraction and processing of materials. This ensures the most efficient use of the available resource with minimal waste generation.

The guiding principle of the waste concrete recycling facility is the beneficial reuse of a resource in accordance with the Resource Recovery Order under Part 9, Clause 93 of the *Protection of the Environment Operations (Waste) Regulation 2014 – The recovered aggregate order 2014*.

Additionally, waste is to be managed in accordance with the requirements outlined throughout the POEO Act 1997, including the correct transportation of waste to a licenced facility (Section 143) and the disposal of waste in a manner that will not induce harm to the environment (Section 115).

16.2.2 Identified Waste Streams

Waste is classified in groups that pose similar risks to human health and the environment. This allows for correct management of these waste types and their disposal. The Waste Classification Guidelines (EPA 2014) identify six waste classes, including:

1. Special waste;
2. Liquid waste;
3. Hazardous waste;
4. Restricted solid waste;
5. General solid waste (putrescible); and
6. General solid waste (non-putrescible).

The anticipated waste types generated by the Project have been categorised into these waste streams, and provided in *Table 16.1.*

Table 16.1 Waste Streams generated by the Project

Waste Type	Classification
Employee generated waste	General solid waste (putrescible)
Sewage	General solid waste (putrescible)
Sediment	General solid waste (non-putrescible)
Overburden	General solid waste (non-putrescible)
Construction waste	General solid waste (non-putrescible)
Processing waste	General solid waste (non-putrescible)
Tyres	Special
Metal	General solid waste (non-putrescible)
Batteries	Hazardous Waste
Waste Concrete	General solid waste (non-putrescible). The Recovered Aggregate Resource Recovery Order (EPA 2014) applies.
Excess Asphalt	General solid waste (non-putrescible). The Reclaimed Asphalt Pavement Resource Recovery Order (EPA 2014)
Mulch	General solid waste (non-putrescible). The Mulch Resource Recovery Order (EPA 2016) applies.
Sediment entrained water	Liquid Waste
High alkalinity water	Liquid Waste
Oil and grease	Liquid Waste

16.3 *WASTE GENERATED AT SANCROX QUARRY*

16.3.1 Employee Generated Waste

Employee generated waste is classified as *General Solid Waste (putrescibles)* in accordance with EPA guidelines (EPA 2014). The waste is composed of everyday waste items such as food scraps, paper, aluminium cans, plastics, packaging and other materials generated by on-site staff. Collection bins are provided for recyclable materials (including paper and cardboard, glass bottles and aluminium cans). General domestic and recyclable waste generated by on-site staff will be appropriately managed and disposed of at an appropriately licenced landfill.

16.3.2 Sewage

Effluent from on-site staff amenities will be managed via the current, council approved on-site septic system.

16.3.3 Sediment

Sediment basins within the Project site require de-silting to ensure they have sufficient capacity to capture water during heavy rain events. The basins will have measuring guides installed to allow for measurement of sediment levels. De-silting occurs as needed and is often dependant on the volume of rainfall received. This waste material will be used for site revegetation.

16.3.4 Overburden

Overburden will be reused on-site. If required to be removed from site, it is considered a 'virgin excavated natural material' as classified by *Waste Classification Guidelines, Part 1: Classifying Waste* (EPA 2014). Overburden stripped during quarry operations will be used for earth bunds and water diversions on the perimeter of the quarry. Final reuse of the overburden will be for rehabilitation both progressively as quarrying is completed and towards the end of its life.

16.3.5 Construction Waste

The construction of the new quarry processing plant, concrete batching plant and other ancillary facilities proposed as part of the Project is expected to generate non-putrescible construction waste temporarily over the construction period. It is difficult to quantify the extent of the anticipated construction waste due to the unknown nature of how suppliers will package products. However a similar project undertaken by Hanson at Brandy Hills Quarry assumed 40m^3 of waste associated with construction activities of a concrete batch plant, concrete recycling facility and pre-coat plant. Skip bins will be used over the course of the construction period to manage this stream. The construction waste will be managed in accordance with the legislative requirements outlined above and where possible, construction waste materials will be recycled (e.g. pallets sent back to supplier or reused on-site).

16.3.6 Mulch

Vegetation clearing is required to allow for the expansion of the quarry footprint. This vegetation will be mulched. Where possible, any valuable timber will be harvested for alternative use prior to mulching. Mulch is suitable, when used appropriately, for sediment controls at the quarry site. Mulch is also suitable for off-site, beneficial reuse in accordance with the Resource Recovery Order under Part 9, Clause 93 of the *Protection of the Environment Operations (Waste) Regulation 2014 – The Mulch order 2016*.

Where mulch cannot be reused on-site, it will be taken to off-site locations that meet the exemption and order requirements for beneficial reuse, including the preparation of a risk management protocol. The volume of mulch likely to be produced has not been estimated, though all mulch produced by the Project is planned for beneficial reuse either on-site or in accordance with the resource recovery exemption.

16.3.7 Product Processing Waste

The majority of solid products from quarry processing are intended for construction projects, including the fines (fine materials/aggregates often with limited commercial value, such as clay and fine sand/fine aggregates) that have been traditionally regarded as waste. Fines will be blended with other extracted materials to produce a usable product where possible, or will be reused on-site.

The quantity of product processing waste is variable depending on the type of materials being generated (smaller size rock will produce more fines), and the fact that washing will not be required for all materials generated by the quarry. Ultimately, this waste stream can be beneficially reused or incorporated into product sold to market.

16.3.8 Tyres

Tyres are classified as special waste in accordance with the EPA Waste Guidelines (EPA 2014). Hanson currently operates Brandy Hill Quarry that extracts 700,000 tpa. Depending on tyre wear, this quarry uses between four and eight tyres per annum. Most mobile plant requires new tyres every three years and depending on wear can last much longer. Due to the similar extraction rate, the waste tyre generation rate from Brandy Hill Quarry is considered a suitable estimate for likely waste tyre generation rates from the Project.

The addition of new plant for the proposed concrete and asphalt operations will further add to the annual waste tyre generation rate. These operations are conservatively estimated to generate 1-2 tyres per annum.

Tyres are recycled onsite and used as barriers, however should tyres be taken off-site for disposal, the waste tracking requirements under *Protection of the Environment Operations (Waste) Regulation 2014* will be met. The trigger for load tracking of waste tyres is greater than 20 tyres or 200kgs within NSW.

16.3.9 Metal

Scrap metal is stored in a scrap metal bin on-site until a quantity sufficient for on-sale to a metal recycler is accumulated. The price available for scrap metal also determines the quantity accumulated on-site prior to selling.

The scrap metal is generated by routine maintenance activities to the site plant.

Brandy Hill Quarry generates approximately 26 m^3 of scrap metal per annum. This is removed from the site approximately every six weeks. With the additional plant required for concrete and asphalt operations, which will require maintenance and potentially generate scrap metal, a conservative estimate of double the likely scrap metal generation rate (52 m^3 of scrap metal per annum) has been predicted.

Where suitable, scrap metal is also currently reused on-site. This practice will continue with ongoing operations.

16.3.10 Batteries

Batteries are classified as hazardous waste. Spent batteries that have been removed from plant during maintenance activities are stored on-site within a bunded, covered area until they can be taken to an appropriate licenced disposal location. Batteries are very minor contribution to the overall waste stream generated at the Sancrox Quarry.

Based on waste battery generation rates at Brandy Hill Quarry, the increased quarrying activities are likely to generate approximately six batteries per annum. The additional concrete and asphalt operations may contribute 1-2 batteries per annum.

Employees are aware that transporting in excess of 200 kg of lead acid batteries is illegal without a licence to do so.

16.3.11 Waste Concrete

The Project includes the development of a concrete recycling facility. The facility is proposed to receive 20,000 tpa of waste concrete. Waste concrete is suitable for beneficial reuse in accordance with the Resource Recovery Order under Part 9, Clause 93 of the *Protection of the Environment Operations (Waste) Regulation 2014 – The recovered aggregate order 2014*. The waste concrete will be suitable for reuse following conformance with the testing to confirm the absence of potential contaminants as outlined in the Recovered Aggregate Order 2014. Small quantities of waste concrete may be generated by the concrete agitator washout bay and surplus from the batching process but will be recycled on-site.

16.3.12 Excess Asphalt

Excess asphalt generated by the production process will be reused on site where practicable. Should offsite disposal be required, the resource recovery exemptions will be implemented to ensure beneficial reuse rather than disposal to landfill.

16.3.13 Liquid Wastes

Sediment Laden Water

The water supply at Sancrox Quarry for operational purposes is planned to be self-sufficient and maximise water recycling practices within quarry operations. Measures will be implemented to ensure that all water demands are met, thereby limiting discharge to local receiving waters. The use of internally sourced water will be a method of managing stored volumes on-site and thus will likely limit the volume and regularity with which sediment basins on-site may have otherwise discharged.

All sediment basins will be licenced to discharge, with appropriate criteria relating to water quality and basin design size, to limit the impacts to receiving waters. The proposed design of the sediment basins means they will typically overflow at a frequency of six to eight times per year, which is in accordance with *Managing Urban Stormwater: Soils and Construction, Volume 2E Mines and Quarries* (DECC 2008).

Highly Alkaline Water

Highly alkaline water will be generated by concrete truck washout and the concrete batching activities. A first flush system will be developed to drop out any entrained sediment and the water will be recycled through the concrete batching operations.

Oil and Grease

Grease and lubricants are classified as Liquid Waste in accordance with the *Waste Classification Guidelines* (EPA 2014). Small quantities of these wastes may be generated by construction activities and plant maintenance during operation. To protect against any environmental harm, these wastes will be stored in designated drums for recycling at an appropriate off-site recycling facility. The waste oil will be collected by the licenced waste oil recycling contractor.

Waste oils arising from the maintenance of heavy machinery will be disposed of by maintenance contractors under their own licensing agreement. Contractors will be required to have spill protection protocols in place when working on the site. Spill response equipment will be stored on the site, in case of unforeseen spills.

Brandy Hill Quarry generates approximately 18,000 litres of oil per year that is sent off-site for recycling. The concrete and asphalt batching operations are estimated to contribute approximately 3,000 litres of oil per annum.

Oil filters will be sent off-site for recycling. Enclosed storage bins for filters will be provided by waste oil contractors.

16.4 *ESTIMATED WASTE GENERATION*

An estimate of the quantity and nature of the waste streams to be generated by the Project are provided in *Table 16.2* below.

Table 16.2 Estimated Waste Generation by the Project

Waste	Estimated Quantity
Employee generated waste	Similar project undertaken by Hanson at Brandy Hills Quarry assumed 405m³ per year (site office, weighbridge and workshop) for a similar sized number of employees. This is considered a suitable, conservative estimate for the Project
Sewage / Effluent	Approximately 365,000L per year, based on 40L/day generated by proposed total of 25 operational employees
Sediment	Removed when required on-site, highly variable depending on final dam sizing and rainfall received
Overburden	Approximately 1.4 million bank cubic metres. It is noted that overburden may be used as commercial product for road base, general fill etc., where not kept on-site for later rehabilitation
Construction waste	Similar project undertaken by Hanson at Brandy Hills Quarry assumed 40m³ of waste associated with construction activities
Processing waste	Variable depending on numerous factors
Tyres	5-10 per year
Metal	52 m³ per year
Batteries	7-8 batteries per year
Waste Concrete	Any waste generated on-site by agitator washout and surplus from the batching process will be recycled within the concrete recycling facility (capacity for 20,000 tonnes per year)
Excess asphalt	To be reused in the process where practicable or implement a resource recovery exemption to ensure beneficial reuse rather than disposal to landfill
Mulch	Unknown. Resource recovery exemption to be implemented to ensure beneficial reuse
Sediment entrained water	Variable dependent on rainfall
High alkalinity water	Variable dependant on production and rainfall
Oil and Grease	21,000 litres per year

1. Data provided by Hanson

16.5 *MITIGATION MEASURES*

Mitigation measures to be implemented to minimise wastes generated by the Project include:

- separation of recyclable and non-recyclable materials will take place where possible and be stored in designated receptacles;
- waste receptacles will be collected on a regular basis by licensed contractors or Council collection service and transported for off-site disposal at an appropriately licensed landfill or recycling facility;
- beneficial reuse of suitable resources will be undertaken where practicable, in accordance with relevant requirements of the relevant resource recovery order and exemption;
- all waste disposal will be in accordance with the POEO Act and *Waste Classification Guidelines* (EPA 2014);
- waste tracking will occur for any types and quantities of waste that trigger the requirement for tracking; and
- waste management measures will be incorporated into the site Construction and Operation Environment Management Plan (or form its own separate sub-plan if requested by the DP&E) which will outline measures to avoid waste generation and promote reuse, recycling and reprocessing of waste where possible.

Hanson 2017b. **Brandy Hill Expansion Project Environmental Impact Statement – Appendix 14A – Waste Impact Assessment**.

NSW Environmental Protection Authority 2014. **Waste Classification Guidelines Parts 1-4**.

NSW Department of Planning and Environment (2017). **Guidelines for preparing an Environmental Impact Statement.**

17 QUARRY CLOSURE AND REHABILITATION

This chapter outlines the anticipated closure and rehabilitation activities proposed to be undertaken post-quarry operations.

17.1 CLOSURE AND REHABILITATION FRAMEWORK AND METHODOLOGY

The effective closure and rehabilitation of the quarry site will incorporate key principles outlined in the following guidelines:

- *Mine Rehabilitation Handbook* (Commonwealth Department of Industry Tourism and Resources [CDITR], 2006);
- *Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry* (Commonwealth Department of Industry, Innovation and Science [CDIIS], 2016a);
- *Mine Closure– Leading Practice Sustainable Development Program for the Mining Industry* (CDIIS, 2016b); and
- *Strategic Framework for Mine Closure* (Australian and New Zealand Minerals and Energy Council [ANZMEC] and Minerals Council of Australia [MCA] (ANZMEC/MCA, 2000).

The SEARs includes the following specific requirements relating to the rehabilitation of the quarry site:

- the proposed rehabilitation strategy for the site having regard to the key principles in the *Strategic Framework for Mine Closure*, including:
    - rehabilitation objectives, progressive rehabilitation commitments, methodology, monitoring programs, performance standards and proposed completion criteria;
    - nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and
    - the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.

These rehabilitation requirements have been addressed in this chapter of the EIS.

This chapter has been prepared by ERM Environmental Scientists with previous experience in the preparation of rehabilitation strategies for quarry projects.

17.2 FINAL LAND USE OPTIONS

The 30 year life of the proposed quarry operations expose the project and its final land use to potential changes in stakeholder expectations, requirements and preference for the final land use options at the quarry. There is also the possibility for updated guidelines from government that outline rehabilitation requirements and methodologies. Hanson commit to regular consultation with community and relative government agencies to ensure the final land use/rehabilitation of the quarry is acceptable. The current conceptual rehabilitation and final land use options are outlined below, with rehabilitation of the site with native endemic plant species, and inundation of the void over time by surface and groundwater being considered a suitable Conceptual Closure Plan for use during feasibility, development and detailed design.

17.2.1 Rehabilitation with Native Endemic Plant Species

The industry standard approach to rehabilitation could be applied to the site, aiming to rehabilitate it to a self-sustaining, stable condition which is revegetated with native endemic plant species. Once established, this approach would provide habitat for native plants and create a vegetative corridor connecting habitat suitable for use by native fauna.

Such an approach would be consistent with the *Port Macquarie Hastings Biodiversity Strategy (2017 – 2030),* as discussed further in *Section 17.4*.

Final Landform

The final landform includes benched quarry walls and a quarry floor at RL –40m AHD. The benches above the inundated void (the void will naturally accumulate surface water and groundwater) will be topsoiled and revegetated with suitable native, endemic species. The benches will be constructed to drain and outlet to stabilised areas, or to the quarry void as determined by topography.

Diversions will be established, as the quarry stages progress, that divert clean water from undisturbed upslope catchments from entering the quarry and these will remain in place upon the completion of quarrying. The topography of the site and the depth of the quarry void will be such that it will accumulate surface and groundwater.

Unauthorised access will continue to be prevented by the maintenance of fencing established during the early phases of the Project. Prominent signage for warning against entry and informing of rehabilitation activities will be provided.

Infrastructure will be decommissioned and removed from site. This will allow for revegetation to commence, or the ongoing use of these pad sites for future proposed activities, depending on the final rehabilitation option that is chosen.

17.2.2 Treated Effluent Storage within the Quarry Void for Beneficial Reuse

A previously considered end use of the final quarry void is as a storage for treated effluent from PMHC's sewage treatment plants. The non-potable water source would be available for beneficial reuse for either agricultural, construction or wildlife purposes. The current EMP (ERM, 2014) outlines this treated effluent water storage as a rehabilitation strategy to be implemented.

The end use for the existing processing areas, stockpile areas and the additional cleared, flat site that will be created for the establishment of the asphalt plant, is yet to be determined. It is anticipated that these cleared, flat areas will be suitable for a wide range of industrial or transport uses, inclusive of infrastructure to assist in managing the beneficial reuse of the treated effluent (likely pumping station, potentially pipeline infrastructure, site sheds, etc.). The end use of these areas situated above the quarry void will be determined in consultation with relevant stakeholders during the progression of the quarry, with rehabilitation measures to be designed to suit this final end use.

The final landform will include benching that will be revegetated, where it is above the proposed treated effluent inundation levels within the void. This revegetation will occur as outlined in *Section 17.2.1*.

The proposed storage of treated effluent would require further assessment closer to the time of closure to consider the proposed expansion and revised final quarry void (volume, depth, groundwater interaction) to ensure that such an option remains viable. The quarry life has also been extended, meaning that the quarry cannot be used as storage for 30 years from any potential approval date, thus potentially affecting the viability of this option.

Implementation of this rehabilitation option would align with the *Hastings Effluent Management Strategy,* as discussed further in *Section 17.42*.

17.2.3 Rehabilitation Objectives

General rehabilitation objectives as outlined in CDIIS (2016a) are dependent on which rehabilitation option is chosen:

- rehabilitation to a new landform, land capability or final land use. This general rehabilitation objective will be applied should the option to use the quarry void for the storage of treated effluent be chosen; and

- restoration or reclamation of the area so that the pre-mining conditions are replicated (75% of mines in Australia use native plant species because the establishment of native ecosystems gives the greatest chance of self-sustainability). This general objective will be applied should the option to revegetate the site with native, endemic species be chosen.

In either case, the final rehabilitated site will meet the following criteria typically required by Australian regulatory agencies (CDIIS, 2016a):

- stable;
- incorporate native vegetation;
- non-polluting; and
- safe/secure to prevent negative impacts to humans and wild/domesticated fauna.

Beneath the overarching general rehabilitation objective are more specific temporal social and financial objectives requiring consideration. These specific objectives are outlined in the *Strategic Framework for Mine Closure* (ANZMEC/MCA, 2000) and include to:

- enable all stakeholders to have their interests considered during the closure process;
- ensure the closure process occurs in an orderly, cost-effective and timely manner;
- ensure the cost of closure is adequately represented in company accounts and that the community is not left with a liability;
- ensure there is clear accountability, and adequate resources, for the implementation of the closure plan;
- establish a set of indicators which will demonstrate the successful completion of the closure process; and
- reach a point where the company has met agreed completion criteria to the satisfaction of the responsible authority.

These objectives will form the basis of the Quarry Closure and Rehabilitation Plan to be prepared post-approval. The Plan will be prepared to the preferred option of rehabilitation with native endemic plant species and inundation over time by surface and groundwater.

The site's rehabilitation outcomes associated with these objectives are separated into short and long-term outcomes. Short-term outcomes concentrate on the opportunistic, progressive stabilisation as quarrying activities within each stage are completed. Long-term outcomes focus on the effective decommissioning and rehabilitation of the site to comply with environmental and legal requirements, along with satisfying the expectations of the local community and stakeholders.

Measuring success against rehabilitation outcomes will be assessed through the inclusion of specific performance indicators and monitoring strategies. The Quarry Closure and Rehabilitation Plan will be regularly reviewed to ensure that outcomes and performance indicators are being met, and whether the need exists to modify the plan to better suit the current environment. The proposed rehabilitation outcomes are provided in *Table 17.1* below.

Table 17.1 Rehabilitation Outcomes

Outcome	Completion Criteria	Performance Indicator	Management Monitoring Strategy
Short Term			
Safety - Ensuring quarry pit benches are stable.	The stabilised benches don't pose a security or safety risk.	The final quarry pit and associated infrastructure area is geotechnically stable.	Conduct periodic geotechnical assessments based on a risk assessment approach. Develop and undertake action plan based on findings and recommendations from geotechnical assessment. Geotechnical assessment of terminal benches on closure of quarry.
Conservation of soil resources, particularly topsoil during quarrying activities.	Rehabilitated areas are to have adequate soil depth and quality to support revegetation.	Topsoil has adequate nutrient levels to support revegetation.	Topsoil from stripping will be stockpiled separately and securely. The location is to be recorded by GPS and noted in the Quarry Clouse and Rehabilitation Plan to be prepared. Soil testing will be undertaken to determine requirement for ameliorants, to ensure suitable growth medium is provided to enhance likelihood of revegetation success.
Progressive stabilisation of areas where quarrying is complete, as soon as is reasonably practicable.	Stabilisation in accordance with (Landcom 2004) achieved such that erosion and subsequent sediment entrained run-off/fugitive dust are mitigated	Compliance with operational air quality criteria. No off-site sedimentation issues associated with revegetated areas.	Operational Air Quality Management Plan criteria, controls, and monitoring commitments to be implemented Operational erosion controls are outlined in Chapter 7 of the EIS. Management measures will be detailed in the Operational Erosion and Sediment Control Plan and in Progressive Erosion and Sediment Control Plans developed as opportunities arise for progressive rehabilitation.

Outcome	Completion Criteria	Performance Indicator	Management Monitoring Strategy
Long Term			
Legal requirements and standards	Relevant stakeholders to develop and propose standards that are both acceptable and achievable. Agreed standards are to be adopted into the Quarry Closure and Rehabilitation Plan.	Compliance with the Quarry Closure and Rehabilitation Plan.	Rehabilitation will be regularly reported on in the Project's Annual Review.
Environmental management requirements	Rehabilitated quarry will not present an ongoing environmental liability.	Rehabilitated quarry is consistent with the final landform approved in the project's Quarry Closure and Rehabilitation Plan. Successful achievement of the quarry rehabilitation will result in the NSW EPA allowing the relinquishment of the EPL.	Rehabilitation will be regularly reported on in the Project's Annual Review.
Decommissioning of plant, buildings and infrastructure	Demolition/removal of buildings no longer in use in accordance with Australian code of practice applicable at the time of quarry end of life.	Completed to the satisfaction of the regulating body (i.e. Port Macquarie Hastings Council and/or DPI&E).	Responsibility of the approved demolition contractor in conjunction with the relevant approval authorities.
	Maximise the recycling of building materials.	Buildings, plant, and structure materials are recycled and not disposed of in landfill.	Quarry Closure and Rehabilitation Plan to detail how building materials will be recycled.
	Identification of contaminated sites for remediation.	Remediation of any contaminated land.	Clearance certificates and validation reports. Records of off-site disposal of wastes.

Outcome	Completion Criteria	Performance Indicator	Management Monitoring Strategy
	All internal roads, car parks, office structures, auxiliary structures, the processing plant and concrete batching plant are removed should this be required to meet the desired final use.	Survey of infrastructure to be removed at the time of quarry closure.	Site assessment by a suitably qualified person.
Stakeholder involvement	Stakeholder identification, consultation, involvement and communication with the long-term rehabilitation process and final landform.	Compliance with the Quarry Closure and Rehabilitation Plan.	Included in the Community Consultative Committee meeting agenda. Maintenance of community consultation register.
Final landform planning	Quarry Closure and Rehabilitation Plan for use during feasibility, development and detailed design.	Closure planning is required to ensure that closure is technically, economically and socially feasible.	Quarry Closure and Rehabilitation Plan will be prepared to the preferred option of rehabilitation with native endemic plant species and inundation over time by surface and groundwater. The Plan will be modified as a result of any operational change, new regulations or new technology, and will be comprehensively reviewed on a regular and pre-determined cycle (e.g. every 3 to 5 years). The Plan will be flexible enough to cope with unexpected events, and will include the management of social and financial issues associated with rehabilitation, as well as environmental issues.
Financial costing and provisioning	A cost estimate for closure will be developed from the Quarry Closure and Rehabilitation Plan.	The relevance of closure costs for financial stewardship reporting purposes is recognised by the accounting profession.	Closure cost estimates will be reviewed regularly to reflect changing circumstances. Progressive rehabilitation will be undertaken to lessen the cost burden at the end of the Project when income from quarry activities has ceased.
	Adequate securities will protect the community from closure liabilities.	Financial surety instruments.	Financial securities accounted for and reconciled annually through the Project's Annual Review.

17.3 REHABILITATION STRATEGY

17.3.1 Existing Rehabilitation

Rehabilitation measures have already been undertaken at the Project site and have included planting of endemic species along the northern bank of the existing earth mound on the northern boundary adjacent to the stockpiles and the northern part of the active quarry area. These revegetated areas act as a visual screen to adjacent properties. Revegetation activities took place in 2001 and 2002 using the following endemic species:

- Callistemon (4 species);
- Eucalypt (3 species); and
- Acacia (4 species).

Rehabilitation of the northern face of the dam wall adjacent to the crushing plant occurred in 2009, which included the planting of endemic grasses and tree species to prevent erosion of topsoil and to effectively promote native revegetation opportunities throughout the site.

17.3.2 Progressive Rehabilitation

Sancrox Quarry currently practices progressive rehabilitation on site. Hanson's opportunistic and progressive rehabilitation would continue throughout the Project life, as part of a planned program of activities to achieve an acceptable final landform. Rehabilitation will be carried out progressively following each stage of extractive operations to ensure a stable landform and to control soil erosion.

The progressive approach helps minimise the liability falling on the operator by rehabilitating the quarry during the operation rather than undertaking the larger task of rehabilitating the quarry following the closure of the quarry, when there is no direct income from quarrying activities (CDITR 2006).

The progressive approach will allow for rehabilitation methods to be tested and consequently improved to ensure rehabilitation methods are effective (CDITR 2006).

The progressive approach will be beneficial to the overall structure of the ecosystem following the conclusion of quarrying activities. The diversity of the ecosystem will be enhanced by the stands of vegetation of differing ages, heights and depths from the staggered timing of the revegetation activities.

17.3.3 Future Rehabilitation Requirements

Quarry Faces

Batter slopes rehabilitation works are only required on those benches located above the final water level that will inundate the void (either if the void naturally accumulates surface water and groundwater or is used as storage of treated effluent).

The benches will be excavated with a cross fall towards the upper batter, forming a table drain at the foot of that batter. The benches will be constructed to drain to stable vegetated areas or the water filled void. Suitable sediment control and velocity impediments (hay bales, geofabric filter fences and/or rock weirs) will be employed to minimise potential for scouring of the table drain within the bench and subsequent sediment transportation. A clean water diversion drain will be constructed at the top of the batter/quarry footprint, where there is the potential for in-flow of upslope run-off.

The benches will be revegetated as follows:

- the benches are to be ripped and spread with topsoil (consisting of previously stockpiled topsoil, sediment collected from silt retention dams and crushing works). The bench will be planted in clumps with endemic species (e.g. species of Eucalypt, Acacia and Callistemon) or those as considered appropriated with the *Port Macquarie Hastings Biodiversity Strategy (2017-2030)* along its length;

- topsoil will be spread over the upper part of the batter and clump planted with endemic species; and

- native groundcovers will be introduced at 1.5 m intervals along the top and bottom of the un-vegetated sector of the batters.

Production, Processing and Stockpile Areas

Rehabilitation of the production, processing and stockpile areas will commence at the completion of extraction and removal of all stockpile products and infrastructure. The rehabilitation of these areas will involve re-grading the main processing and stockpile floor to even grades, where not already flat.

Topsoil is to be spread to a depth of 150 mm (using the sediment collected from silt retention dams and the processing works) over the stockpile floor and revegetating in a manner suitable to its determined end-use.

If an industrial/transport end-use is chosen, then the stockpile floor will be seeded with native grasses, outside of the footprint of any proposed infrastructure. If no such end-use has been determined, the stockpile floor will be clump planted with endemic species including Eucalypt, Acacia and Callistemon, or endemic species that align with the objectives of the *Port Macquarie Hastings Biodiversity Strategy (2017-2030).*

Funding for Rehabilitation Activities

Hanson is committed to the ongoing allocation of funds for the progressive rehabilitation of the quarry in determination of its operational budgets. The allocation of funds will be tied to demand and the output of the quarry. The allocated money will be accumulated pending the availability of areas to be rehabilitated. The budget allocation may also be increased over the lifetime of the quarry to reflect inflationary changes and rehabilitation needs as necessary.

Maintenance of Rehabilitated Areas

Rehabilitated areas are to be maintained as follows:

- following planting, plants will be watered daily for the first week and once a week for the following three months;
- preceding this establishment stage, watering will be undertaken on an as needed basis, with increased watering in dry periods;
- weed control measures will be implemented on a three monthly basis for the first two years following planting; and
- erosion control devices will be regularly inspected (monthly) and particularly after heavy rainfall to ensure proper operation.

Monitoring Rehabilitation Performance

Regular monitoring of the revegetated areas will be required during the initial vegetation establishment period and beyond to demonstrate that the objectives of the rehabilitation strategy are being achieved and that a sustainable, stable landform has been provided. The adjacent remaining vegetation would provide a suitable reference site for comparison.

Monitoring will be conducted periodically by independent, suitably skilled and qualified persons at locations which will be representative of the range of conditions on the rehabilitating areas. Annual reviews will be conducted of monitoring data to assess trends and monitoring program effectiveness. The outcome of these reviews will be included in Project's Annual Review.

17.4 INTEGRATION WITH EXISTING STRATEGIES

17.4.1 Port Macquarie Hastings Biodiversity Strategy (2017-2030)

The SEARs require the EIS to outline the potential for integration of this rehabilitation strategy with other existing rehabilitation/offset strategies within the PMHC region. PMHC has recently prepared a *Biodiversity Strategy (2017-2030)* which aims to guide and enable strategic growth and development while conserving biodiversity values throughout the region.

Rehabilitation of the Sancrox Quarry will be undertaken with due regard to the findings and information provided throughout the *Biodiversity Strategy (2017-2030)*, as it contains critical information in regards to the ecological value across the region. Such information will be used in conjunction with the rehabilitation strategies and objectives outlined throughout this plan to ensure effective rehabilitation of the landscape.

In the event that additional relevant strategies are prepared during the Project's lifetime, then effort will be made to align the operations being undertaken at Sancrox Quarry with the relevant guidelines identified throughout the relevant strategy.

17.4.2 Hastings Effluent Management Strategy

In 2006, PMHC confirmed that investigation into potential future use of Sancrox Quarry as a non-potable water source would occur. The proposal included possible use of the final quarry void as a storage for treated effluent from the Port Macquarie and Wauchope Sewage Treatment Plants. This storage would allow for the beneficial reuse of the treated effluent.

The treated effluent to be stored in the final void was for either agricultural, construction or wildlife purposes. Utilisation of the quarry for such a purpose aligns with the strategic planning of the PMHC.

REFERENCES

ERM (2014). *Sancrox Quarry Environmental Management Plan*. Prepared for Hanson Construction Materials Pty Ltd.

Commonwealth Department of Industry Tourism and Resources (CDITR) (2006) *Mine Rehabilitation Handbook.*

Commonwealth Department of Industry, Innovation and Science (CDIIS) (2016a). *Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry.*

Commonwealth Department of Industry, Innovation and Science (CDIIS) (2016b). *Mine Closure – Leading Practice Sustainable Development Program for the Mining Industry* (Commonwealth).

Australian and New Zealand Minerals and Energy Council (ANZMEC) and Minerals Council of Australia (MCA) (ANZMEC/MCA, 2000). *Strategic Framework for Mine Closure*.

18 MITIGATION MEASURES

The SEAR's prepared for the proposed development require the preparation of:

- *a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS;*

This chapters collates the mitigation measures identified throughout the impact assessment process and wider EIS prepared for the proposed development.

The mitigation measures are consolidated in *Table 18.1*.

Table 18.1 Summary of Mitigation Measures

Overarching Environmental Aspect	Specific Environmental Issue/timing	Mitigation Measure
Biodiversity	Pre-construction	Fauna residing within or occupying the expansion area are safely and ethically salvaged and relocated. Delineate quarry expansion limit (to ensure no native vegetation outside expansion area is cleared). Install and maintain erosion and sediment control measures in accordance with the requirements of the 'Blue Book' (Landcom 2004).
	During construction	Supervision of tree felling to rescue and recover any fauna (as necessary). • Vehicle wash-down • Site weed control program • Prepare weed control plan Rubbish (such as food scraps and building waste) are to be properly managed during construction and must not be stockpiled on areas of native vegetation. Revegetation – re-use topsoil and seeding of pasture grasses and legumes (or as directed in relevant revegetation guidelines or management plans). • Speed limits of 40 km/hr (or less if lower speed limit imposed in other environmental assessments) to be imposed within site, reducing the likelihood of animal strikes. • Educate workers on possibility of animal strike through construction management program. Design and implement a planting plan for corridor of native vegetation east and west of proposed quarry pit, to maintain north-south corridor link of canopy trees, as per sub-regional corridor in Greater Sancrox Structure Plan (PMHC 2015).
	Post-construction	Speed limits of 40 km/hr (or less if lower speed limit imposed in other environmental assessments) are proposed, reducing the likelihood of animal strikes. Limit spread of weeds in accordance to the methods provided throughout the landscape maintenance program and weed control plan. Each luminaire will be aimed downwards and only switched on during loading-unloading and servicing activities outside of daylight hours and during heavy fog.

Overarching Environmental Aspect	Specific Environmental Issue/timing	Mitigation Measure
		Appropriate systems will be implemented to ensure that each waste stream generated by the development is effectively managed and/or disposed of off-site (see *Chapter 16*). There will not be any on-site stockpiling or disposal of waste materials. Maintain and monitor plantings within proposed native vegetation corridors east and west of quarry pit. An engineered surface water drainage and management strategy is to be prepared and implemented. Techniques currently proposed to manage stormwater include bunding walls, swales, underground water capture systems and dams (see *Chapter 7*).
Heritage	Historic Heritage	In the unlikely event that historic heritage items are found during works, the following Unexpected Finds Protocol will be followed. • where a potential historic heritage item is found during works, all works within the vicinity of the item, or with the potential to impact the item will cease and a temporary exclusion zone established; • an appropriately qualified heritage consultant will examine the item to assess its significance and further archaeological potential; and • where a relic is found, the NSW Heritage Council will be notified and approval will likely be required prior to the continuation of works. Other archaeological deposits will be recorded and assessed for significance and potential salvage by an appropriately qualified heritage consultant.
	Aboriginal Heritage	The potential scarred tree is located within the western extent of the proposed extraction area and is likely to be impacted as a direct result of extraction. It is recommended that BLALC is afforded the opportunity to retain the scar for educational and interpretive purposes (if requested). The ceremonial site, although now completely destroyed, is considered to have high cultural significance and recognition of its location within the Sancrox area could be considered for display in the quarry site office. The development of any cultural information will be undertaken in consultation with the BLALC. The Unexpected Finds Protocol provided throughout the Heritage Assessment (Annex D) will be followed if further Aboriginal heritage sites, or suspected human skeletal remains are encountered during works. Cultural Awareness Training In order to comply with best practice principles, all employees and subcontractors will undergo environmental awareness training as part of the site induction to ensure they understand their obligations and responsibilities.

Overarching Environmental Aspect	Specific Environmental Issue/timing	Mitigation Measure
Surface Water / Hydrology	Stormwater Diversion	• stormwater diversion will be required within both clean and dirty catchments throughout the development of the Project; • diversions in the form of bunds or drains, as fitted to the topography of the specific catchment, will be implemented to allow for the diversion of sediment-laden run-off to sediment basins and in a few circumstances to divert clean run-off from entering the site; • diversions within clean catchments are to be stabilised quickly (through covering of the diversion channel with geofabric or revegetation); and • diversion measures within dirty catchments will incorporate rock check dams to reduce sediment loads within the run-off prior to reaching the basin (to maximise efficiency of the basin and reduce desilting requirements) and where possible have low grade to lower flow velocities.

	Erosion Control	**Mulch**
		• the mulch will be mixed with topsoil and applied to batters and other locations requiring rehabilitation, acting as both an addition of organic matter to boost the soil quality (along with other ameliorants) and act as an erosion control measure;
		• mulch will be used as a replacement to sediment fences, by creating a bund of between 300 and 500 mm high; and
		• mulch can also be applied as a blanket, of approximately 150 mm thick, to cover disturbed areas and prevent erosion.
		Site Stabilisation and Rehabilitation
		• a progressive site rehabilitation approach will be adopted, whereby stabilisation works (either by revegetation, hard armouring or allowing hard rock finishes to remain where no sediment-laden run-off will be generated) is undertaken immediately following the completion of the activity. Key principles of progressive rehabilitation include:
		  • availability of acceptable soil materials;
		  • correct site preparation and replacement of topsoil;
		  • selection of the most suitable establishment technique;
		  • selection of appropriate plant species, fertilisers and ameliorants;
		  • application of sufficient water for germination and to sustain plant growth if rainfall is insufficient;
		  • an adequate maintenance program; and
		  • areas not satisfactorily revegetated will be investigated to determine the reason for failure. Appropriate remedial action will be undertaken, including replacing any lost topsoil and re-sowing the site.

Overarching Environmental Aspect	Specific Environmental Issue/timing	Mitigation Measure
	Sediment Control	**General** • sediment basins are required for the management of disturbed locations. Conceptual locations are shown in Figure 1.3 of the Hydrology Impact Assessment Chapter, preliminary basin sizes are provided in the Hydrology Assessment (ERM, 2018b); • the Proponent must restore the design storage capacity to each basin within five days of the cessation of a rainfall event that causes run-off to occur on the site; • a basin register will be applied to the Environment Protection Licence (EPL 5289) to allow for progressive integration of the basins to the licence as each stage of work commences; and • sediment basins will be established prior to the removal of all vegetation across each stage, where practicable. Essentially, this will require clearing a path to the basin location, removing the vegetation, constructing the basin and then clearing the remainder of the catchment. **Basin Desilting** • all sediment basins will be inspected regularly for accumulated sediment. Graduated markers placed within the basin will assist in measuring sediment depths. Sediment to be removed prior to reaching capacity. **Water Treatment and Flocculation** • water quality testing will determine compliance, and identify if pH modification (through use of products such as lime or hydrochloric acid) or TSS modification (through the use of gypsum) is required.
	Pollution Control	**General** • waste receptacles will be provided for the safe and efficient storage of all construction and miscellaneous wastes, as necessary; • recyclable materials will be separated and recycled where possible. Otherwise, disposable wastes will be removed from site regularly and disposed of by approved means; • spent chemical and hydrocarbon drums will be removed from site immediately to limit the potential for spills of the remnant product; • refuelling within active quarry areas will be carried out using a mobile fuel cart fitted with an electronic fuel pump; and • routine maintenance of all plant and machinery will be carried out in the designated maintenance area adjacent to the site office to minimise the potential of accidental contamination of water.

Overarching Environmental Aspect	Specific Environmental Issue/timing	Mitigation Measure
		Spill Management • spill kits will be provided at active work locations, the workshop area, refuelling areas and adjacent to pump locations. Training of site personnel in their use will ensure that in the event of any spills appropriate action can be taken rapidly to prevent and minimise impacts to surface waters; • Material Safety Data Sheets (MSDS) for all chemicals stored on-site are to be collected and maintained by the quarry manager and made available to site personnel. Site personnel will be informed of their location as a part of the site induction; • an impervious bund will be constructed to contain any spills of more than 110% of the volume of the largest container in the bunded area, should none be present in the workshop area. Any spillage will be immediately contained and absorbed with a suitable absorbent material; • storage and transport of Dangerous Goods, Flammable and Combustible Liquids will comply with AS 1940 1993 The Storage and Handling of Flammable and Combustible Liquids and National Code of Practice for the Storage and Handing of Workplace Dangerous Goods [NOHSC: 2017 (2001)].
	Asphalt Production	• clean water diversions around the asphalt production plant site to limit catchment to smallest footprint possible and prevent clean water run-on; • the proposed sediment basin will be contrasted to capture sediment-laden run-off from the plant catchment area; • a triple interceptor or similar pollution control device will be utilised as a "first flush" for the potential hydrocarbon contaminated areas in the plant site;
	Plant Controls	• all oils, fuels, lubricants, liquids and chemicals will be stored in appropriately bunded areas; • bitumen, diesel and other chemicals handling will be undertaken within a contained (bunded) area. Any spillages will be immediately ameliorated; and • the sediment basin servicing the plant catchment will be fitted with a floating hydrocarbon boom as a precautionary measure to contain any potential loss of hydrocarbons from the plant catchment.

Overarching Environmental Aspect	Specific Environmental Issue/timing	Mitigation Measure
	Concrete Batching Plant Controls	• the footprint of the plant will be limited to the smallest extent practicable to reduce the area from which contaminated stormwater can be generated (EPA Victoria, 1998); • all contaminated stormwater and process wastewater will be collected and recycled at the earliest possible opportunity (EPA Victoria, 1998); • a dedicated, paved and bunded washout area will be established for the following locations: o truck washing and agitator drum washout area; o the concrete batching area; and o any other location that will generate stormwater contaminated with cement dust or residues. • the stormwater from these locations will be directed to a first flush system. The OEH (2015) recommended design criteria for first flush containment systems utilised for concrete batching plants must be able to contain 10 mm of rainfall; • a bypass to the first flush system is to be created to allow for run-off from larger storm events (greater than 20mm) to bypass the collection system for when the first flush collection is full; • dry cement will be stored where it cannot generate fugitive dust or be exposed to water and generate run-off; • the sediment collected in the first flush must be regularly cleaned out; and • whenever wet weather discharges occur from the catchment system within the plant, pH and total suspended solid monitoring will be undertaken (EPA Victoria, 1998). EPA Victoria (1998) also states run-off after heavy rainfall (more than 20 mm over 24 hours) contains very small quantities of wastes and is unlikely to pose a significant threat to the environment.

<table>
<tr><th>Overarching Environmental Aspect</th><th>Specific Environmental Issue/timing</th><th>Mitigation Measure</th></tr>
<tr><td></td><td>Monitoring</td><td>• site inspection of erosion and sediment controls will be undertaken at least monthly and always following rainfall events (greater than 20mm rainfall); and
• the EPL 5289, and the surface water monitoring requirements within remain relevant to the Project, the following parameters for the proposed conceptual basins.
<table>
<tr><th>Pollutant</th><th>Units of Measurement</th><th>100%ile Concentration Limit</th><th>Frequency</th><th>Method</th></tr>
<tr><td>Oil and Grease</td><td>milligrams/ Litre</td><td>10 and/or not visible</td><td><24 hours prior to a controlled/scheduled discharge and daily for any continued controlled/scheduled discharge</td><td>Visual (grab sample to be taken if sheen observed)</td></tr>
<tr><td>Ph</td><td>-</td><td>6.5 – 8.5</td><td><24 hours prior to a controlled/scheduled discharge and daily for any continued controlled/scheduled discharge</td><td>Grab sample / calibrated field probe</td></tr>
<tr><td>Total Suspended Solids</td><td>milligrams/ Litre</td><td>50</td><td><24 hours prior to a controlled/scheduled discharge and daily for any continued controlled/scheduled discharge</td><td>Grab sample</td></tr>
</table></td></tr>
<tr><td>Groundwater</td><td>Licencing Requirements</td><td>The NSW Aquifer Interference Policy specifies that all water taken during an activity must be accounted for, and that a water licence is required irrespective of whether the water is taken for consumptive use or whether water is taken incidentally in the course of undertaking the activity. Hanson currently hold a Water Access Licence (WAL42524) for water supply works undertaken on site. Depending on specifics of licences currently held by Hanson, a new licence may need to be applied for.</td></tr>
<tr><td></td><td>Water Level Drawdown</td><td>Mitigation measures for the potential impacts associated with drawdown on bores GW303749 and GW306269 will vary dependant on the extent of the impact, but would include (if deemed necessary):
• lowering the bore pump in the bore casing;
• drilling a deeper bore; or
• providing an alternative water source as part of “make good” arrangements.</td></tr>
</table>

Overarching Environmental Aspect	Specific Environmental Issue/timing	Mitigation Measure
	Groundwater Monitoring Program	It is recommended that a groundwater monitoring plan be developed that includes specifics of such a monitoring program, including threshold trigger values as well as a contingency strategy if triggers are exceeded. While the development of such a plan falls outside the scope of this assessment, recommendations for monitoring requirements are outlined below. **Water Take** It is recommended that monitoring of inflows be undertaken to the extent feasible as part of water balance activities. This can be done by metering water being pumped from the in-pit sumps. An estimation of rainfall contribution to water being pumped from the in-pit sumps can then be made on an annual basis by factoring in rainfall data and the pit extent after which the groundwater component can be estimated. Groundwater take will be estimated and reported in this manner on an annual basis. If geological/hydrogeological observations during quarry extension vary significantly from that considered for the groundwater flow model the groundwater flow model will be re-evaluated. The model re-evaluation may include running the existing groundwater model for different stages of pit development and including transient analysis in the modelling to evaluate contributions from aquifer storage (which may require additional pumping tests and observations bore installation). **Water Levels** The groundwater monitoring program will include monitoring of water levels at the potentially affected groundwater bores. In order to be able to identify over or under predictions by the modelling in a reasonable way, it is recommended that all bores showing a > 0.5 m of simulated drawdown be included in the monitoring program. This would include bores GW303436, GW303749 and GW306269. As the predicted drawdown is based on steady state drawdown associated with the final stage of pit extension (the maximum drawdown expected over the life of the Project), initial monitoring of water levels can serve as a baseline against which to compare future water level measurements. Monitoring frequency should be adaptable (depending on trends observed and stages of the quarry development) with twice annual monitoring recommended for the first year of monitoring. Water level data will be reported on an annual basis along with the reporting of the water take estimates. **Water Quality** Water quality monitoring is recommended at the in-pit sump(s) and existing monitoring bores while they remain accessible. Parameters monitored will include standard field parameters (pH, EC, temperature, ORP and DO) and laboratory analysis of TDS. Monitoring frequency of these sampling locations should be adaptable (depending on trends observed) with twice annual monitoring recommended for the first year of monitoring. Water quality results will be reported on an annual basis along with the reporting of the water take estimates.

Overarching Environmental Aspect	Specific Environmental Issue/timing	Mitigation Measure
		Monitoring water quality of water discharges from the site will continue as per the conditions specified in the site Environmental Protection Licence (EPL). In addition to the current suite of parameters, it is recommended that consideration be given to including EC and TDS in the EPL related compliance monitoring. ERM (2018c) outlines that pit lake modelling may be required prior to closure of the quarry.
Soil and Land Resource	Soils	The stockpiling of topsoils will ensure that the soils mapped with higher capability (Class 4 and 5 lands) are given preference for storage. These higher capability soils are considered likely to improve the success of rehabilitation. Application of lime is required to address high levels of acidity and aluminium toxicity associated with the Euroka landscape. Amelioratives will be added to other soils to address issues associated with the other landscapes. A soil sampling program will be undertaken prior to topsoil stripping to understand acidity concentrations and receive advice from the laboratory on proposed liming and ameliorative application rates.
	Contamination	No contamination risk is present or will be introduced by the Project that would warrant not undertaking the activity. Chemical and hydrocarbon management, spill prevention and control mitigation measures as outlined in Chapter 7 to be implemented. A site walkover will be undertaken prior to clearing activities taking place to ensure that any refuse is identified and can be removed from site and disposed of at an appropriate licenced location. Should unexpected contamination be identified, works will cease and an appropriately experienced contamination specialist engaged to develop a strategy to manage the contamination.
	Erosion and Sediment Controls	Erosion and sediment controls outlined in Chapter 7 (Surface Water/Hydrology Assessment) will be implemented to prevent loss of soil and impacts to adjacent watercourses.
	Land Slippage	Standard geotechnical controls will be implemented as required to avoid or minimise impact of land slippage including: • Batter slope trimming - The angle of batter slopes will be reduced to the extent considered safe based on localised geology and hazardous blocks of rock removed. • Bunds - installed as necessary at batter bases to control falling rocks • Future bunds and material stockpiles - will be located away from top of benches where they may be subject to instability. • Void progression - will progress along a ridgeline such that any potential inflow of surface water runoff over batter faces will be minimal. Benching will also be implemented during quarry progression.

Overarching Environmental Aspect	Specific Environmental Issue/timing	Mitigation Measure
Noise and Vibration	Construction	To ensure noise emissions associated with construction works and activities are kept to acceptable levels, the following noise mitigation and management measures are recommended: • Noise generating work and activities will be carried out during the ICNG recommended standard hours (i.e. 7am to 6pm Monday to Friday and 8am to 1pm Saturdays), with no work on Sundays or public holidays. Any work that is required outside the recommended standard hours must be suitably managed with a goal of achieving compliant noise levels at all residential receptors or undertaken with agreement from any potentially affected neighbours. • Where unforeseen works will occur in close proximity (<100m) to a receptor and these works are anticipated to generate high levels of noise e.g. >75 dBA, potential respite periods e.g. three hours of work, followed by one hour of respite will be considered. Respite would be implemented if it is the preference of the affected receptors and if it is feasible and reasonable to achieve during the works. In some circumstances, respite may extend the duration of works and inadvertently increase noise impacts, hence due care should be taken when considering this management measure. • During construction planning, choose appropriate machines for each task and adopt efficient work practices to minimise the total construction period and the number of noise sources on the site. Select the quietest item of plant available where options that suit the design permit. • During the works, avoid unnecessary noise due to idling diesel engines and fast engine speeds when lower speeds are sufficient. • During the works, instruct drivers to travel directly to site and avoid any extended periods of engine idling at or near residential areas, especially at night. • During any night works, any activity that has the potential to generate impulsive noise will be avoided. These types of events are particularly annoying; especially at night and have the limited potential to generate sleep disturbance or awakening impacts. Any impulsive or transient noise events expected to exceed the sleep disturbance criteria at residential receptors will be strictly avoided at night. • During the works, ensure all machines used on the site are in good condition, with particular emphasis on exhaust silencers, covers on engines and transmissions and squeaking or rattling components. Excessively noisy machines will be repaired or removed from the site. • During the works, ensure that all plant, equipment and vehicles movements are optimised in a forward direction to avoid triggering motion alarms that are typically required when these items are used in reverse.

Overarching Environmental Aspect	Specific Environmental Issue/timing	Mitigation Measure
		• If any validated noise complaints are received, operator attended noise measurements will be undertaken to measure and compare the site noise level contributions (Leq, 15 minute and Lmax in dBA) to: o the predicted values; and o the NMLs presented in this report. • All site noise levels will be measured in the absence of any influential source not associated with the site. If the measured site noise levels are below the predicted values and comply with the NMLs presented in this report, no further mitigation or management measures are required. If the measured site noise levels are above the predicted noise levels or NML presented in this report, further mitigation and/or management measures will be considered. • Prior to commencement of works, a Construction Noise Management Plan (CNMP) will be prepared and implemented, which will consider all potential acoustical factors identified in this report including those addressed in Chapter 5 and Chapter 6. The CNMP will detail any noise monitoring and take into consideration measures for reducing the source noise levels of construction equipment by construction planning and equipment selection where reasonable and feasible.
	Operation	**Boundary Mitigation:** • Earth Bunding (approximately 25 m in height, 450 m in length and 75 m in width) is required along the southern boundary of the site to provide additional shielding from the processing plant and asphalt production plant. • Earth Bunding (approximately 20 m in height, 250 m in length and 60 m in width) is also required at the western boundary of the pit to provide shielding from in pit activities from Stage 2 of the quarry expansion when in pit activities progress closer to Receptor 20 to the west. **Plant/Equipment Procurement:** • During the operational design, choose appropriate machines for each task and adopt efficient work practices to minimise the total number of noise sources on the site. Select the quietest item of plant available where options that suit the design permit, with consideration to offensive noise characteristics such as tonality, low frequency noise or impulsiveness. • The key items of plant/equipment are presented in Table 2.3 of the NVIA. Operational LW emissions should be at or below those presented in Table 2.3 and Table 7.1 of the NVIA. Where items of procured plant generate offensive noise characteristics, INP penalties will be applied prior to meeting the LW values presented above.

Overarching Environmental Aspect	Specific Environmental Issue/timing	Mitigation Measure
		At Source Mitigation: • Where LW values for plant/equipment outlined in Table 2.3 are not reasonable or feasible, the operational design would incorporate acoustic enclosures / barriers to assist in reducing the noise emission of identified plant/equipment. Design of acoustic enclosures / barriers would also consider offensive noise characteristics as tonality, low frequency noise or impulsiveness. **General Operational Mitigation Measures**: • Avoid unnecessary noise due to idling diesel engines and fast engine speeds when lower speeds are sufficient. • Instruct drivers to travel directly to site and avoid any extended periods of engine idling at or near residential areas, especially at night. • During any night works, any activity that has the potential to generate impulsive noise will be avoided. These types of events are particularly annoying; especially at night and have the limited potential to generate sleep disturbance or awakening impacts. Any impulsive or transient noise events expected to exceed the sleep disturbance criteria at residential receptors will be strictly avoided at night. • Ensure all machines used on the site are in good condition, with particular emphasis on exhaust silencers, covers on engines and transmissions and squeaking or rattling components. Excessively noisy machines will be repaired or removed from the site. • Ensure that all plant, equipment and vehicles movements are optimised in a forward direction to avoid triggering motion alarms that are typically required when these items are used in reverse. • Noisy plant and equipment will be located as far as possible from noise sensitive areas. • The location of activities, plant and equipment would optimise attenuation effects through measures such as topography, natural and purpose built barriers. • If any validated noise complaints are received, operator attended noise measurements will be undertaken to measure and compare the site noise level contributions (Leq, 15 minute and Lmax in dBA) to: o the predicted values; and o the PSNLs presented in this report. • All site noise levels will be measured in the absence of any influential source not associated with the site. If the measured site noise levels are below the predicted values and comply with the PSNLs presented in this report, no further mitigation or management measures are required. If the measured site noise levels are above the predicted noise levels or PSNLs presented in this report, further mitigation and/or management measures will be considered.

Overarching Environmental Aspect	Specific Environmental Issue/timing	Mitigation Measure
		• A Detailed Design Noise Impact Assessment will be undertaken during the final stages of the Project design to ensure that noise emissions from the Processing Plant and Asphalt Production Plant can be effectively reduced to compliant levels through plant / equipment procurement and construction of acoustic enclosures / barriers. An Operational Noise Management Plan (ONMP) will be also prepared based on the detailed design, and will consider all potential acoustical factors identified in this report including those addressed in Chapter 5 and Chapter 7 of the Noise and Vibration Assessment. The ONMP will detail any noise monitoring and take into consideration measures for reducing the source noise levels of operational equipment by equipment selection, management and mitigation where reasonable and feasible.
	Monitoring	**Blast Monitoring** • As outlined in *Section 4.3.2* of the NVIA, monitoring is required for all blast events carried out in or on the premises. Air-blast overpressure and ground vibration levels must be measured at any point within one metre of any affected residential boundary or other noise sensitive location, such as a school or hospital for all blasts carried out in or on the premises. In addition, the licensee must monitor all blasts carried out in or on the premises at or near the nearest residence or noise sensitive location that is likely to be most affected by the blast. **Construction / Operational Noise Monitoring** • Construction and operational noise monitoring will also be undertaken for the Project however, the type and frequency would be adapted according to type of work. Noise monitoring would occur in the form of attended noise measurements and/or unattended real-time noise monitoring. • All monitoring measures will be outlined in the Construction Noise Management Plan and the Operation Noise Management Plan. • Noise measurements would be undertaken at the potentially most affected receptor locations identified in the NVIA. Monitoring would occur at the following receptors at minimum to represent receptors surrounding the site: Receptors 13 and 14 to the south, receptor 20 to the west, receptor 11 to the north and receptor 34 to the east.
Air Quality and Greenhouse Gas	General	The Air Quality and GHG Assessment considered all reasonable and feasible mitigation measures to minimise the emissions from the proposed activities at the site, including: • Roads, which are likely to remain unchanged throughout the Project stages and to be frequently used by machinery, will be sealed using asphalt and swept daily to minimise wheel-generated dust emissions; • Full dust extraction system for drilling; • Utilisation of water sprays during truck rear dumping;

Overarching Environmental Aspect	Specific Environmental Issue/timing	Mitigation Measure
		• The use of mobile sprinkler systems during the operation of FELs; • Dust suppression measures such as water sprays in place at the crushers and screeners; • Water sprays used on all conveyor transfer points; • Level 2 watering (more than 2 litres/m2/hour) applied to unsealed roads to minimise impact from hauling; • Water sprays to be utilised to minimise wind erosion from stockpiles during wind speeds of over 5.4 metres per second; • The dry product delivered to the concrete batching and recycling plant and asphalt plant to be stored in aggregate storage bins enclosed on three sides. The walls to extend one metre above the height of the maximum quantity of raw material, and two metre beyond the front of the stockpile. The aggregate storage bins to be fitted with water sprays to keep the stored material damp at all times; • Cement and cement supplement to be delivered to the concrete batching plant in the agitator trucks and pneumatically fed to the bottom-loaded silos; • Concrete batching loading point to be totally enclosed with all particulate matter emissions generated by the facility captured by one bag filter located above the pan mixer; • Vapour balancing system to be installed for the delivery of bitumen at the asphalt plant; • Asphalt plant loading point will be totally enclosed. All particulate matter emissions generated at the loading point will be captured by one fabric filter associated with the natural-gas fired dryer; and • Vapour recovery system to be employed for transfer of asphalt to trucks.
Traffic and Access	General	The following mitigation measures are proposed to minimise impacts to road users and infrastructure: • movements to the west of the Quarry Access Road on Sancrox Road will be strictly limited to supplying markets in the Sancrox area only. Access to Wauchope and other locations to the west will be provided by utilising the Oxley Highway Interchange. Sancrox Road to the west of the quarry will not be used as a regular product transport route; • movements to the east of the Sancrox Interchange along Fernbank Creek Road will be strictly limited to supplying local residents/markets in the area. The road will not be used as a regular product transport route. • limit compression braking;

Overarching Environmental Aspect	Specific Environmental Issue/timing	Mitigation Measure
		• avoid bunching of quarry vehicles along product transport routes; • cover loads entering and leaving the site; • induct all drivers to the Hanson code of conduct and carry out regular tool box talks discussing road safety issues; and • all loaded vehicles leaving the site are to be cleaned of materials on tail guards and body edges that may fall on the road. • Adhere to Vehicle Operator Code of Conduct outlined in *Section 12.4.1* of the Traffic Assessment.
Visual Amenity	General	The following mitigation measures are recommended to minimise visual amenity impacts: • Retain the vegetative buffer along the north western edge of the quarry pit to screen views from nearby private land. • Light spill will be minimised through detailed design and standard measures to contain lighting.
Socio-economic	General	The construction and operation of the Project is anticipated to have minimal negative socio-economic impacts and as such no additional socio-economic specific mitigation measures have been provided, other than those provided throughout each technical assessment contained throughout this EIS. Community and stakeholder engagement has been outlined in Chapter 4, providing the local community with access to project information and the opportunity to raise any concerns with regard to the Project.
Hazards and Risks	Hazardous Material Storage and Transportation	**Storage** The following mitigation measures will be implemented for the storage of hazardous materials to ensure compliance with the application of SEPP 33, including but not limited to: • all hazardous substances that may be required for construction and operation would be stored and managed in accordance with the Storage and Handling of Dangerous Goods Code of Practice (WorkCover NSW, 2005) and Hazardous and Offensive Development Application Guidelines: Applying SEPP 33 (Department of Planning, 2011), including but not limited to the following: • diesel will not be stored with Class 3 materials; • lubricating and hydraulic oils and grease will not be stored with Class 3 materials; • maximum stored inventories (250 kg) will be located more than 25 metres (m) away from the nearest site boundary, so as to not trigger the Applying SEPP 33 thresholds if considered in aggregate.

Overarching Environmental Aspect	Specific Environmental Issue/timing	Mitigation Measure
		As bitumen and bitumen emulsions will be present in volumes greater than 10,000kg, SafeworkNSW are to be notified and manifests and emergency plans developed. **Transportation** Mitigation measures relating to the transport of potentially hazardous materials include: • the method for delivery of explosives would be developed prior to the commencement of blasting in consultation with the DP&E and be timed to avoid the need for on-site storage. No explosive storage on site is proposed. • transportation routes outlined in the Traffic and Access Assessment (refer to Chapter 12) will be followed to ensure impacts to road systems will be minimised where practicable.
	Bushfire Prevention and Control	**Prevention** For a bushfire to occur there are three factors which must be present, namely oxygen, fuel and an ignition source, along with several other factors which affect the probability and intensity of a bushfire. While exclusion of oxygen is not feasible, each of the remaining issues will be managed as follows. • fuel loads within the Site will be managed through: o the maintenance of Asset Protection Zones (APZ) in accordance with the Planning for Bushfire Protection Guidelines (RFS, 2006) will be established and maintained around all administration buildings and the workshop areas, as outlined in Figure 15.2 o trees and shrubs will be maintained to prevent the spread of a fire towards the buildings, taking into account the requirement for an effective visual screen. • company-controlled ignition sources and the associated management measures that will be implemented include the following: o all Project-related activities will be undertaken, where practicable, in cleared areas; o all mobile equipment will be maintained in good working order with appropriate exhaust and fire suppression systems; o all mobile equipment working in vegetated areas will be inspected to ensure that they do not pose a risk of starting a bushfire. This will include inspection of exhaust and electrical systems, including, in the case of vehicles using unleaded petrol, catalytic converters; and o mobile equipment working in vegetated areas will not be left unattended with the engine running.

Overarching Environmental Aspect	Specific Environmental Issue/timing	Mitigation Measure

- personnel, contractors and their employees will undergo site-specific training incorporating bush fire management awareness as part of the Project's induction program ensuring the following is outlined:
    - obligations toward prevention and notification;
    - all mobile equipment will be equipped with appropriate communication equipment, including two-way radios and/or mobile telephones;
    - restriction of activities during periods of very high (or higher) bushfire danger rating;
    - emergency response procedures;
    - locations of fire-fighting equipment;
    - adopt appropriate controls during re-fuelling; and
    - ensure fire extinguishers are fitted to all site vehicles.
    - welding or other hot works activities will, as far as practicable, be conducted and confined to the main workshop area
- fuel loads within the Project site will be managed in conjunction with Hanson's obligations in relation to rehabilitation of the Project site and biodiversity offset requirements.

Control

The ability to control a bushfire depends upon available fuel, control of ignition sources and good access and water supplies. The following fire management procedures will be adopted to assist with the control of any bushfire on or adjacent to the Project site:

- provision of access to strategic areas on the site;
- a static water supply is provided for firefighting purposes in areas where reticulated water is not available, this includes all weather access to the sedimentation dams;
- stockpiling of cleared vegetation with a minimum 10m cleared buffer zone; and
- creating suitable all weather access tracks (with suitable signage and turning circles if not a through road) and if required during a bushfire event, strategically located fire breaks.

Hanson will also incorporate bushfire management procedures in the overall Emergency Response Plan for the Project. A copy of the procedures, including a map of all fire-fighting equipment, access roads, communications protocol, emergency evacuation plans and any locked gates will be provided to the local RFS.

Overarching Environmental Aspect	Specific Environmental Issue/timing	Mitigation Measure
Waste	General	Mitigation measures to be implemented to minimise wastes generated by the Project include: • separation of recyclable and non-recyclable materials will take place where possible and be stored in designated receptacles; • waste receptacles will be collected on a regular basis by licensed contractors or Council collection service and transported for off-site disposal at an appropriately licensed landfill or recycling facility; • beneficial reuse of suitable resources will be undertaken where practicable, in accordance with relevant requirements of the relevant resource recovery order and exemption; • all waste disposal will be in accordance with the POEO Act and Waste Classification Guidelines (EPA 2014); • waste tracking will occur for any types and quantities of waste that trigger the requirement for tracking; and • waste management measures will be incorporated into the site Construction and Operation Environment Management Plan (or form its own separate sub-plan if requested by the DP&E) which will outline measures to avoid waste generation and promote reuse, recycling and reprocessing of waste where possible.

19 CONCLUSION

This EIS has assessed the potential environmental impacts associated with the proposed expansion and increase in annual extraction rates at Sancrox Quarry alongside the proposed establishment of the concrete batching plant, asphalt production plant, and concrete recycling facility The EIS was prepared having regard to biophysical, economic and social considerations and the principles of ESD. There were no significant environmental impacts identified during the preparation of the EIS that cannot be mitigated by appropriate mitigation measures and management strategies.

The environmental assessment process has been used to drive the development of the site and ensure operations will be sustainable and create minimal disruption to the local community. Proposed operations have been designed to ensure sustainable water use and management, minimise traffic impact on local roads, ensure acceptable noise and dust emissions, effective management of waste and to minimise visibility of the operations. All of the potential environmental impacts of the Project have been considered and mitigation measures developed to minimise any impacts as detailed throughout the EIS.

The Project will provide a viable supply of construction materials to the surrounding region. The Project can be implemented with minimal adverse environmental impacts as demonstrated throughout this assessment and is justified in terms of the overall economic benefits to the local, state and national economies. The construction materials, such as those produced at Sancrox Quarry, will be used to meet a fundamental community need for the construction of roads, other infrastructure and major development projects in the region.

The Project will allow for the sourcing of construction materials to be produced at a site that is already highly disturbed. The construction materials produced will be used throughout the region and will have positive flow on effects throughout the local economy through the creation of jobs in associated industries.

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Annex A

SEARs and Existing Development Consent

Planning Services
Resource Assessments
Contact: Anthony Barnes
Phone: 8289 6709
Email: anthony.barnes@planning.nsw.gov.au

Matt Errington
Principal Environmental Consultant
Environmental Resources Management Australia
Locked Bag 3012 Australia Square
NSW 1215

Dear Mr Errington

Reissue of State Significant Development - Secretary's Requirements
Sancrox Quarry Extension Project (SSD 7293)

I have enclosed updated Secretary's requirements for the preparation of an Environmental Impact Statement (EIS) for the Sancrox Quarry Extension Project which replace the Secretary's requirements issued on 19 October 2015.

These requirements are based on the information you have previously provided, and reflect previous consultation with relevant government agencies.

Your attention is drawn to the environmental planning instruments (EPI), policies and guidelines to be addressed in your EIS (see Attachment 1). Please note that where these EPIs, guidelines and policies have changed or been updated, your EIS will need to address the latest available version.

The agencies' previous comments are attached for your information (see Attachment 2). You must have regard to these comments in the preparation of the EIS.

Please note that the Department may alter these requirements at any time, and that you must consult further with the Department if you do not lodge a development application and EIS for the project within the next two years.

You should establish whether the proposal requires a separate approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as soon as possible. If such an approval is required, please notify the Department immediately, as the Commonwealth approval process is likely to be integrated with the NSW approval process (under the bilateral agreement), and supplementary requirements will need to be issued.

Please contact the Department at least two weeks before you plan to submit the development application and EIS for the project. This will enable the Department to:

- confirm the applicable fee (see Division 1AA, Part 15 of the *Environmental Planning and Assessment Regulation 2000*); and
- determine the required number of copies of the EIS (hard copy and digital).

It is important for you to recognise that the Department will review the EIS for the project carefully before putting it on public exhibition. If it fails to adequately address these requirements, then you will be required to submit an amended EIS.

If you have any enquiries about these requirements, please contact Anthony Barnes on the details listed above.

Yours sincerely

Howard Reed

Howard Reed 18.9.17
Director
Resource Assessments
as the Secretary's delegate

Secretary's Environmental Assessment Requirements

State Significant Development

Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*
Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*

Application Number	SSD 7293
Proposal	The Sancrox Quarry Extension Project, which involves: • extending the approved extraction boundary by approximately 52 hectares, • extending the quarry life by ten years (from 20 to 30 years), • increasing the production limit from 455,000 tonnes per annum (tpa) to 750,000 tpa, • constructing and operating a concrete batching plant producing 20,000m^3 per annum (p/a), • constructing and operating a concrete recycling facility processing 20,000 tonnes p/a, • increasing truck movements and equipment loading from 7am–11pm weekdays, and 7am–1pm weekends and public holidays to 24 hours per day 7 days per week, • increasing quarry operations from 7am–5pm weekdays, and 7am–1pm Saturday to 24 hours per day 7 days per week, • transporting material off-site via public roads; and • Constructing and operating an asphalt plant producing 50,000 tonnes per annum.
Location	Sancrox Road Sancrox, Lot 2 DP 574308 Lot 353 DP 754434 Lot 1 DP 704890 Lot 1 DP 720807
Applicant	Hanson Construction Materials Pty Ltd (Hanson)
Date of Issue	18 September 2017
General Requirements	The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.* In particular, the EIS must include: • a stand-alone executive summary; • a full description of the development, including: – the resource to be extracted, including the amount, type and composition; – the site layout and extraction plan, including cross-sectional plans; – the production process and processing activities, including the in-flow and out-flow of materials and points of discharge to the environment; – surface infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate approvals process); – a waste (overburden, rejects, tailings etc) management strategy; – a water management strategy; – a rehabilitation strategy to apply during, and after completion of, extraction operations, and proposed final use of site; and – the likely interactions between the development and any existing, approved or proposed development in the vicinity of the site; • a strategic justification of the development focusing on site selection and the suitability of the proposed site; • a list of any approvals that must be obtained before the development may

	commence; • an assessment of the likely impacts of the development on the environment, focussing on the key issues identified below, including: – a description of the existing environment likely to be affected by the development, using sufficient baseline data; – an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice; – a description of the measures that would be implemented to avoid, minimise, mitigate and/or offset the likely impacts of the development, and an assessment of: o whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; o the likely effectiveness of these measures; and o whether contingency measures would be necessary to manage any residual risks; and – a description of the measures that would be implemented to monitor and report on the environmental performance of the development; • a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; • consideration of the development against all relevant environmental planning instruments (including Part 3 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007)*; • the reasons why the development should be approved, having regard to: - relevant matters for consideration under the *Environmental Planning and Assessment Act 1979*, including the objects of the Act; - the biophysical, economic and social impacts of the project, including the principles of ecologically sustainable development; - the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses; - feasible alternatives to the development (and its key components), including the consequences of not carrying out the development; • a signed declaration from the author of the EIS, certifying that the information contained within the document is neither false nor misleading. While not exhaustive, Attachment 1 contains a list of some of the environmental planning instruments, guidelines, policies, and plans that may be relevant to the environmental assessment of this development. In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*, the development application must be accompanied by a signed report from a suitably qualified expert that includes an accurate estimate of the capital investment value (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the development, including details of all the assumptions and components from which the capital investment value calculation is derived.
Key Issues	The EIS must address the following key issues: • **Noise & Blasting** – including: - a detailed assessment of the likely construction, operational and off-site transport noise impacts of the development in accordance with the *Interim Construction Noise Guideline*, *NSW Industrial Noise Policy* and the *NSW Road Noise Policy* respectively, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - if a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the *Interim Construction Noise Guideline*; - proposed blasting hours, frequency and methods; - a detailed assessment of the likely blasting impacts of the development (including noise, vibrations, overpressure, visual and odour) on people,

	animals, buildings, infrastructure and significant natural features, having regard to the relevant ANZEC guidelines; - reasonable and feasible mitigation measures to minimise noise emissions; and - monitoring and management measures, in particular real-time and attended noise monitoring; • **Air Quality** – including: - a detailed assessment of potential construction and operational impacts, in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW,* and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - an assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products; - reasonable and feasible mitigation measures to minimise dust and emissions; and - monitoring and management measures, in particular, real-time air quality monitoring; • **Water** – including: - a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures; - identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*; - demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP); - a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo; - an assessment of any likely flooding impacts of the development; - an assessment of the likely impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives; - an assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users; and - a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts; • **Biodiversity** – including: - accurate predictions of any vegetation clearing on site; - a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, and having regard to the *NSW Biodiversity Offsets Policy for Major Projects* and the *Framework for Biodiversity Assessment*; and - a strategy to offset any residual impacts of the development in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*, including evidence that the appropriate type and quantum of offsets will be available; • **Heritage** – including: - an assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including evidence of appropriate consultation with relevant Aboriginal communities/parties and documentation of the views of these stakeholders regarding the likely impact of the development on their cultural heritage; and - identification of historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items, having regard to the relevant policies and guidelines listed in

	Attachment 1; • **Traffic & Transport** – including: - accurate predictions of the road traffic generated by the construction and operation of the development, including a description of the types of vehicles likely to be used for transportation of quarry products; - a detailed assessment of potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road network (as identified above), including a road safety audit; and - a description of the measures that would be implemented to mitigate any impacts, including concept plans of any proposed upgrades, developed in consultation with the relevant road and rail authorities (if required); • **Land Resources** – including a detailed assessment of: - potential impacts on soils and land capability (including potential erosion and land contamination) and the proposed mitigation, management and remedial measures (as appropriate); - potential impacts on landforms (topography), paying particular attention to the long term geotechnical stability of any new landforms (such as overburden dumps, bunds etc); and - the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements in Clause 12 of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries)* 2007, paying particular attention to the agricultural land use in the region; • **Waste –** including estimates of the quantity and nature of the waste streams that would be generated or received by the development and any measures that would be implemented to minimise, manage or dispose of these waste streams; • **Hazards –** including an assessment of the likely risks to public safety, paying particular attention to the transport, handling and use of any hazardous or dangerous goods; • **Visual** – including a detailed assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, paying particular attention to any new landforms, and to minimising the lighting impacts of the development; • **Social & Economic** – including: - a detailed assessment of the likely social impacts of the development on the local and regional community in accordance with the *Social impact assessment guideline for State significant mining, petroleum production and extractive industry development*; and - a detailed assessment of the likely economic impacts of the development, paying particular attention to: o the significance of the resource; o the costs and benefits of the project; identifying whether the development as a whole would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates; and o the demand for the provision of local infrastructure and services; and • **Rehabilitation** – including the proposed rehabilitation strategy for the site having regard to the key principles in the *Strategic Framework for Mine Closure*, including: - rehabilitation objectives, progressive rehabilitation commitments, methodology, monitoring programs, performance standards and proposed completion criteria; - nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and - the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.
Consultation	During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities, service providers, Aboriginal stakeholders, community groups and affected landowners. You must:

	• consult with: - affected landowners; - community groups; - Port Macquarie-Hastings Council; - Office of Environment and Heritage (including the Heritage Branch); - Environment Protection Authority; - Division of Resources and Geoscience within the Department; - Department of Primary Industries (including the DPI Water, NSW Forestry, Agriculture and Fisheries sections and Crown Lands division); - North Coast Local Land Services; - Roads and Maritime Services; - NSW Rural Fire Service; and • establish a Community Consultative Committee for the project in accordance with the *Community Consultative Committee Guidelines for State Significant Projects,* and consult with the committee during the preparation of the EIS.
Further consultation after 2 years	If you do not lodge a development application and EIS for the development within 2 years of the issue date of these requirements, you must consult further with the Secretary in relation to the preparation of the EIS.

ATTACHMENT 1

Environmental Planning Instruments, Policies, Guidelines & Plans

Air	
	Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (DP&E)
	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA)
	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (EPA)
	Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'
	National Greenhouse Accounts Factors (Commonwealth)
Noise & Blasting	
	Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (DP&E)
	NSW Industrial Noise Policy (EPA)
	Interim Construction Noise Guideline (DECC)
	NSW Road Noise Policy (EPA)
	Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC)
Water	
Groundwater	NSW State Groundwater Policy Framework Document (NOW)
	NSW State Groundwater Quality Protection Policy (NOW)
	NSW State Groundwater Quantity Management Policy (NOW)
	NSW Aquifer Interference Policy 2012 (NOW)
	Office of Water Guidelines for Controlled Activities (2012)
	Groundwater Monitoring and Modelling Plans – Information for prospective mining and petroleum exploration activities (NOW)
	Australian Groundwater Modelling Guidelines 2012 (Commonwealth)
	National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
	Guidelines for the Assessment & Management of Groundwater Contamination (EPA)
Surface Water	NSW Government Water Quality and River Flow Objectives (EPA)
	Using the ANZECC Guideline and Water Quality Objectives in NSW (EPA)
	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Effluent Management (ARMCANZ/ANZECC)
	NSW Water Conservation Strategy (2000)
	State Water Management Outcomes Plan
	NSW State Rivers and Estuary Policy (1993)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (EPA)
	Managing Urban Stormwater: Soils & Construction (Landcom) and associated Volume 2E: Mines and Quarries (EPA)
	Managing Urban Stormwater: Treatment Techniques (EPA)
	Managing Urban Stormwater: Source Control (EPA)
	Technical Guidelines: Bunding & Spill Management (EPA)
	Environmental Guidelines: Use of Effluent by Irrigation (EPA)
	A Rehabilitation Manual for Australian Streams (LWRRDC and CRCCH)
	NSW Guidelines for Controlled Activities on Waterfront Land (NOW)

Land	
	Soil and Landscape Issues in Environmental Impact Assessment (NOW)
	Agfact AC.25: Agricultural Land Classification (NSW Agriculture)
	Agricultural Issues for Extractive Industries (NSW Trade and Investment)
	State Environmental Planning Policy No. 55 – Remediation of Land
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC)
Traffic	
	Guide to Traffic Generating Development (RMS)
	Road Design Guide (RMS) & relevant Austroads Standards
Biodiversity	
	Biodiversity Offsets Scheme (OEH)
	Guidelines for Threatened Species Assessment (DP&E)
	NSW State Groundwater Dependent Ecosystem Policy (NOW)
	Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW)
	State Environmental Planning Policy No. 44 – Koala Habitat Protection
Heritage	
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
	Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DP&E)
	Aboriginal Cultural Heritage Consultation Requirements for Proponents (OEH)
	Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (OEH)
	Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH)
	NSW Heritage Manual (OEH)
	Statements of Heritage Impact (OEH)
	Port Macquarie-Hastings Local Environmental Plan 2011
Hazards	
	State Environmental Planning Policy No. 33 – Hazardous and Offensive Development
	Hazardous and Offensive Development Application Guidelines – Applying SEPP 33
	Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis
Waste	
	Waste Classification Guidelines (EPA)
Rehabilitation	
	Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Strategic Framework for Mine Closure (ANZMEC-MCA)
Social & Economic	
	Social impact assessment guideline for State significant mining, petroleum production and extractive industry development (DP&E)
Environmental Planning Instruments - General	
	State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007
	State Environmental Planning Policy (State and Regional Development) 2011
	State Environmental Planning Policy (Infrastructure) 2007
	State Environmental Planning Policy 55 – Remediation of Land
	Port Macquarie-Hastings Local Environmental Plan 2011

ATTACHMENT 2

Agency Correspondence

NSW GOVERNMENT | Department of Primary Industries

OUT17/34142

Ms Genevieve Seed
Resource Assessments
NSW Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

genevieve.seed@planning.nsw.gov.au

Dear Ms Seed

Sancrox Quarry Extension (SSD 7293)
Request to re-issue SEARS

I refer to your email of 17 August 2017 to the Department of Primary Industries (DPI) in respect to the above matter. Comment has been sought from relevant branches of DPI.

Any further referrals to DPI can be sent by email to landuse.enquiries@dpi.nsw.gov.au.

DPI provides the following recommendations for matters to be addressed in the Environmental Impact Statement (EIS) for the proposal with additional comments at **Attachment A**.

Water

- Annual volumes of surface water and groundwater proposed to be taken by the activity (including through inflow and seepage) from each surface and groundwater source as defined by the relevant water sharing plan.
- Assessment of any volumetric water licensing requirements (including those for ongoing water take following completion of the project).
- The identification of an adequate and secure water supply for the life of the project. Confirmation that water can be sourced from an appropriately authorised and reliable supply. This is to include an assessment of the current market depth where water entitlement is required to be purchased.
- A detailed and consolidated site water balance.
- Assessment of impacts on surface and groundwater sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts.
- A detailed assessment against the NSW Aquifer Interference Policy (2012) using DPI Water's assessment framework.
- Full technical details and data of all surface and groundwater modelling, and an independent peer review.
- Proposed management and disposal of produced or incidental water.

- Works are to be in accordance with the "*Guidelines for Controlled Activities on Waterfront Land* (DPI Water 2012)". It is noted a number of first and second order watercourses are mapped within the proposed extension area.
- Details of the final landform of the site, including final void management (where relevant) and rehabilitation measures.
- Proposed surface and groundwater monitoring activities and methodologies.
- Assessment of any potential cumulative impacts on water resources, and any proposed options to manage the cumulative impacts.
- Consideration of relevant policies and guidelines.
- A statement of where each element of the SEARs is addressed in the EIS in the form of a table.

Land

Department of Industry – Lands & Forestry advises that in relation to the Crown road which traverses Lot 2 DP 574308, this proposal cannot be supported or approved whilst this land remains Crown road. To proceed, the adjoining land owner must make application to the Department for road closure and purchase. For further information and the relevant forms, please go to http://www.crownland.nsw.gov.au/crown_lands/roads.

The Crown road closure and purchase process can take a significant amount of time to complete and Lands & Forestry recommends early lodgement of the application. The applicant may request expedition of the application and should provide documentation to support any such request. This request will be assessed but priority cannot be guaranteed.

Yours sincerely

Mitchell Isaacs

Director, Planning Policy & Assessment Advice

1 September 2017

DPI appreciates your help to improve our advice to you. Please complete this three minute survey about the advice we have provided to you, here:

https://goo.gl/o8TXWz

ATTACHMENT A

Sancrox Quarry Extension (SSD 7293)
DPI Water General Assessment Requirements for State Significant Development and State Significant Infrastructure projects

The following detailed assessment requirements are provided to assist in adequately addressing the assessment requirements for State Significant Development (SSD) and State Significant Infrastructure (SSI) projects for Generic projects; Coal Mines and Gas projects; Quarries and Non Coal Mines and Linear projects respectively where relevant.

For further information visit the DPI Water website, www.water.nsw.gov.au

Key Relevant Legislative Instruments

This section provides a basic summary to aid proponents in the development of an Environmental Impact Statement (EIS), and should not be considered a complete list or comprehensive summary of relevant legislative instruments that may apply to the regulation of water resources for a project.

The EIS should take into account the objects and regulatory requirements of the *Water Act 1912* (WA 1912) and *Water Management Act 2000* (*WM Act*), and associated regulations and instruments, as applicable.

Water Management Act 2000 (WM Act)
Key points:

- Volumetric licensing in areas covered by water sharing plans
- Works within 40m of waterfront land
- SSD & SSI projects are exempt from requiring water supply work approvals and controlled activity approvals as a result of the *Environmental Planning & Assessment Act 1979 (EP&A Act)*.
- No exemptions for volumetric licensing apply as a result of the *EP&A Act*.
- Harvestable rights dams
- Aquifer interference activity approval provisions have not yet commenced and are regulated by the *Water Act 1912*
- Flood management work approval provisions have now commenced
- Maximum penalties of $ 2.2 million plus $ 264,000 for each day an offence continues apply under the *WM Act*

Water Act 1912 (WA 1912)
Key points:

- Monitoring bores
- Aquifer interference activities that are not regulated as a water supply work under the *WM Act*.
- No exemptions apply to licences or permits under the *WA 1912* as a result of the *EP&A Act*.
- Regulation of water bore driller licensing.

Water Management (General) Regulation 2011
Key points:

- Provides various exemptions for volumetric licensing and activity approvals
- Provides further detail on requirements for dealings and applications.

Access Licence Dealing Principles Order 2004

Harvestable Rights Orders

Water Sharing Plans these are considered regulations under the *WM Act*

It is important that the proponent understands and describes the ground and surface water sharing plans, water sources, and management zones that apply to the project. The relevant water sharing plans can be determined spatially at www.ourwater.nsw.gov.au. Multiple water sharing plans may apply and these must all be described.

The *Water Act 1912* applies to all water sources not yet covered by a commenced water sharing plan.

The EIS is required to:

- Demonstrate how the proposal is consistent with the relevant rules of the Water Sharing Plan including rules for access licences, distance restrictions for water supply works and rules for the management of local impacts in respect of surface water and groundwater sources, ecosystem protection (including groundwater dependent ecosystems), water quality and surface-groundwater connectivity.
- Provide a description of any site water use (amount of water to be taken from each water source) and management including all sediment dams, clear water diversion structures with detail on the location, design specifications and storage capacities for all the existing and proposed water management structures.
- Provide an analysis of the proposed water supply arrangements against the rules for access licences and other applicable requirements of any relevant WSP, including:
    - Sufficient market depth to acquire the necessary entitlements for each water source.
    - Ability to carry out a “dealing” to transfer the water to relevant location under the rules of the WSP.
    - Daily and long-term access rules.
    - Account management and carryover provisions.
- Provide a detailed and consolidated site water balance.
- Further detail on licensing requirements is provided below.

Relevant Policies and Guidelines

The EIS should take into account the following policies (as applicable):

- NSW Guidelines for Controlled Activities on Waterfront Land (NOW, 2012)
- NSW Aquifer Interference Policy (NOW, 2012)
- Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW, 2012)
- Australian Groundwater Modelling Guidelines (NWC, 2012)
- NSW State Rivers and Estuary Policy (1993)
- NSW Wetlands Policy (2010)
- NSW State Groundwater Policy Framework Document (1997)
- NSW State Groundwater Quality Protection Policy (1998)
- NSW State Groundwater Dependent Ecosystems Policy (2002)
- NSW Water Extraction Monitoring Policy (2007)

DPI Water policies can be accessed at the following links:
http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/default.aspx
http://www.water.nsw.gov.au/Water-licensing/Approvals/Controlled-activities/default.aspx

An assessment framework for the NSW Aquifer Interference Policy can be found online at: http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/Aquifer-interference.

Licensing Considerations

The EIS is required to provide:

- Identification of water requirements for the life of the project in terms of both volume and timing (including predictions of potential ongoing groundwater take following the cessation of operations at the site – such as evaporative loss from open voids or inflows).
- Details of the water supply source(s) for the proposal including any proposed surface water and groundwater extraction from each water source as defined in the relevant Water Sharing Plan/s and all water supply works to take water.
- Explanation of how the required water entitlements will be obtained (i.e. through a new or existing licence/s, trading on the water market, controlled allocations etc.).
- Information on the purpose, location, construction and expected annual extraction volumes including details on all existing and proposed water supply works which take surface water, (pumps, dams, diversions, etc).
- Details on all bores and excavations for the purpose of investigation, extraction, dewatering, testing and monitoring. All predicted groundwater take must be accounted for through adequate licensing.
- Details on existing dams/storages (including the date of construction, location, purpose, size and capacity) and any proposal to change the purpose of existing dams/storages
- Details on the location, purpose, size and capacity of any new proposed dams/storages.
- Applicability of any exemptions under the *Water Management (General) Regulation 2011* to the project.

Water allocation account management rules, total daily extraction limits and rules governing environmental protection and access licence dealings also need to be considered.

The Harvestable Right gives landholders the right to capture and use for any purpose 10% of the average annual runoff from their property if in the Eastern and Central Divisions. The Harvestable Right has been defined in terms of an equivalent dam capacity called the Maximum Harvestable Right Dam Capacity (MHRDC). The MHRDC is determined by the area of the property (in hectares) and a site-specific run-off factor. The MHRDC includes the capacity of all existing dams on the property that do not have a current water licence. Storages capturing up to the harvestable right capacity are not required to be licensed but any capacity of the total of all storages/dams on the property greater than the MHRDC may require a licence.

For more information on Harvestable Right dams, including a calculator, visit:
http://www.water.nsw.gov.au/Water-licensing/Basic-water-rights/Harvesting-runoff/Harvesting-runoff

Dam Safety

Where new or modified dams are proposed, or where new development will occur below an existing dam, the NSW Dams Safety Committee should be consulted in relation to any safety issues that may arise. Conditions of approval may be recommended to ensure safety in relation to any new or existing dams.

See www.damsafety.nsw.gov.au for further information.

Surface Water Assessment

The predictive assessment of the impact of the proposed project on surface water sources should include the following:

- Identification of all surface water features including watercourses, wetlands and floodplains transected by or adjacent to the proposed project.
- Identification of all surface water sources as described by the relevant water sharing plan.
- Detailed description of dependent ecosystems and existing surface water users within the area, including basic landholder rights to water and adjacent/downstream licensed water users.
- Description of all works and surface infrastructure that will intercept, store, convey, or otherwise interact with surface water resources.
- Assessment of predicted impacts on the following:
    - flow of surface water, sediment movement, channel stability, and hydraulic regime,
    - water quality,
    - flood regime,
    - dependent ecosystems,
    - existing surface water users, and
    - planned environmental water and water sharing arrangements prescribed in the relevant water sharing plans.

Groundwater Assessment

To ensure the sustainable and integrated management of groundwater sources, the EIS needs to include adequate details to assess the impact of the project on all groundwater sources.

Where it is considered unlikely that groundwater will be intercepted or impacted (for example by infiltration), a brief site assessment and justification for the minimal impacts may be sufficient, accompanied by suitable contingency measures in place in the event that groundwater is intercepted, and appropriate measures to ensure that groundwater is not contaminated.

Where groundwater is expected to be intercepted or impacted, the following requirements should be used to assist the groundwater assessment for the proposal.

- The known or predicted highest groundwater table at the site.
- Works likely to intercept, connect with or infiltrate the groundwater sources.
- Any proposed groundwater extraction, including purpose, location and construction details of all proposed bores and expected annual extraction volumes.
- Bore construction information is to be supplied to DPI Water by submitting a “Form A” template. DPI Water will supply “GW” registration numbers (and licence/approval numbers if required) which must be used as consistent and unique bore identifiers for all future reporting.

- A description of the watertable and groundwater pressure configuration, flow directions and rates and physical and chemical characteristics of the groundwater source (including connectivity with other groundwater and surface water sources).
- Sufficient baseline monitoring for groundwater quantity and quality for all aquifers and GDEs to establish a baseline incorporating typical temporal and spatial variations.
- The predicted impacts of any final landform on the groundwater regime.
- The existing groundwater users within the area (including the environment), any potential impacts on these users and safeguard measures to mitigate impacts.
- An assessment of groundwater quality, its beneficial use classification and prediction of any impacts on groundwater quality.
- An assessment of the potential for groundwater contamination (considering both the impacts of the proposal on groundwater contamination and the impacts of contamination on the proposal).
- Measures proposed to protect groundwater quality, both in the short and long term.
- Measures for preventing groundwater pollution so that remediation is not required.
- Protective measures for any groundwater dependent ecosystems (GDEs).
- Proposed methods of the disposal of waste water and approval from the relevant authority.
- The results of any models or predictive tools used.

Where potential impact/s are identified the assessment will need to identify limits to the level of impact and contingency measures that would remediate, reduce or manage potential impacts to the existing groundwater resource and any dependent groundwater environment or water users, including information on:

- Any proposed monitoring programs, including water levels and quality data.
- Reporting procedures for any monitoring program including mechanism for transfer of information.
- An assessment of any groundwater source/aquifer that may be sterilised from future use as a water supply as a consequence of the proposal.
- Identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency plans would be initiated (this may entail water level triggers or a beneficial use category).
- Description of the remedial measures or contingency plans proposed.
- Any funding assurances covering the anticipated post development maintenance cost, for example on-going groundwater monitoring for the nominated period.

Groundwater Dependent Ecosystems

The EIS must consider the potential impacts on any Groundwater Dependent Ecosystems (GDEs) at the site and in the vicinity of the site and:

- Identify any potential impacts on GDEs as a result of the proposal including:
    - the effect of the proposal on the recharge to groundwater systems;
    - the potential to adversely affect the water quality of the underlying groundwater system and adjoining groundwater systems in hydraulic connections; and
    - the effect on the function of GDEs (habitat, groundwater levels, connectivity).

- Provide safeguard measures for any GDEs.

Watercourses, Wetlands and Riparian Land

The EIS should address the potential impacts of the project on all watercourses likely to be affected by the project, existing riparian vegetation and the rehabilitation of riparian land. It is recommended the EIS provides details on all watercourses potentially affected by the proposal, including:

- Scaled plans showing the location of:
  - wetlands/swamps, watercourses and top of bank;
  - riparian corridor widths to be established along the creeks;
  - existing riparian vegetation surrounding the watercourses (identify any areas to be protected and any riparian vegetation proposed to be removed);
  - the site boundary, the footprint of the proposal in relation to the watercourses and riparian areas; and
  - proposed location of any asset protection zones.
- Photographs of the watercourses/wetlands and a map showing the point from which the photos were taken.
- A detailed description of all potential impacts on the watercourses/riparian land.
- A detailed description of all potential impacts on the wetlands, including potential impacts to the wetlands hydrologic regime; groundwater recharge; habitat and any species that depend on the wetlands.
- A description of the design features and measures to be incorporated to mitigate potential impacts.
- Geomorphic and hydrological assessment of water courses including details of stream order (Strahler System), river style and energy regimes both in channel and on adjacent floodplains.

Drill Pad, Well and Access Road Construction (applies to Coal Mines and Gas projects and Quarries and Non Coal Mine projects)

- Any construction activity within 40m of a watercourse, should be designed by a suitably qualified person, consistent with the NSW *Guidelines for Controlled Activities on Waterfront Land* (July 2012).
- Construction of all wells must be undertaken in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (3rd edition 2012) by a driller holding a bore drillers' licence valid in New South Wales.
- The length of time that a core hole is maintained as an open hole should be minimised.

Landform rehabilitation

Where significant modification to landform is proposed, the EIS must include:

- Justification of the proposed final landform with regard to its impact on local and regional surface and groundwater systems;
- A detailed description of how the site would be progressively rehabilitated and integrated into the surrounding landscape;
- Outline of proposed construction and restoration of topography and surface drainage features if affected by the project; and

- An outline of the measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation.

Additional Landform Rehabilitation Requirements for Coal mines and Gas projects and Quarries and Non Coal Mines (including final void management)

- Detailed modelling of potential groundwater volume, flow and quality impacts of the presence of an inundated final void (where relevant) on identified receptors specifically considering those environmental systems that are likely to be groundwater dependent;
- The measures that would be established for the long-term protection of local and regional aquifer systems and for the ongoing management of the site following the cessation of the project.

Consultation and general enquiries

Assessment of state significant development enquiries, or requests for review or consultation should be directed to the, Water Regulation Co-ordination Unit, water.referrals@dpi.nsw.gov.au.

A consultation guideline and further information is available online at:
www.water.nsw.gov.au/water-management/law-and-policy/planning-and-assessment

End Attachment A

NSW GOVERNMENT | Department of Primary Industries

OUT17/34142

Ms Genevieve Seed
Resource Assessments
NSW Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

genevieve.seed@planning.nsw.gov.au

Dear Ms Seed

Sancrox Quarry Extension (SSD 7293)
Request to re-issue SEARS

I refer to your email of 17 August 2017 to the Department of Primary Industries (DPI) in respect to the above matter. Comment has been sought from relevant branches of DPI.

Any further referrals to DPI can be sent by email to landuse.enquiries@dpi.nsw.gov.au.

DPI provides the following recommendations for matters to be addressed in the Environmental Impact Statement (EIS) for the proposal with additional comments at **Attachment A**.

Water

- Annual volumes of surface water and groundwater proposed to be taken by the activity (including through inflow and seepage) from each surface and groundwater source as defined by the relevant water sharing plan.
- Assessment of any volumetric water licensing requirements (including those for ongoing water take following completion of the project).
- The identification of an adequate and secure water supply for the life of the project. Confirmation that water can be sourced from an appropriately authorised and reliable supply. This is to include an assessment of the current market depth where water entitlement is required to be purchased.
- A detailed and consolidated site water balance.
- Assessment of impacts on surface and groundwater sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts.
- A detailed assessment against the NSW Aquifer Interference Policy (2012) using DPI Water's assessment framework.
- Full technical details and data of all surface and groundwater modelling, and an independent peer review.
- Proposed management and disposal of produced or incidental water.

- Works are to be in accordance with the "*Guidelines for Controlled Activities on Waterfront Land* (DPI Water 2012)". It is noted a number of first and second order watercourses are mapped within the proposed extension area.
- Details of the final landform of the site, including final void management (where relevant) and rehabilitation measures.
- Proposed surface and groundwater monitoring activities and methodologies.
- Assessment of any potential cumulative impacts on water resources, and any proposed options to manage the cumulative impacts.
- Consideration of relevant policies and guidelines.
- A statement of where each element of the SEARs is addressed in the EIS in the form of a table.

Land

Department of Industry – Lands & Forestry advises that in relation to the Crown road which traverses Lot 2 DP 574308, this proposal cannot be supported or approved whilst this land remains Crown road. To proceed, the adjoining land owner must make application to the Department for road closure and purchase. For further information and the relevant forms, please go to http://www.crownland.nsw.gov.au/crown_lands/roads.

The Crown road closure and purchase process can take a significant amount of time to complete and Lands & Forestry recommends early lodgement of the application. The applicant may request expedition of the application and should provide documentation to support any such request. This request will be assessed but priority cannot be guaranteed.

Yours sincerely

Mitchell Isaacs

Director, Planning Policy & Assessment Advice

1 September 2017

DPI appreciates your help to improve our advice to you. Please complete this three minute survey about the advice we have provided to you, here:

https://goo.gl/o8TXWz

ATTACHMENT A

Sancrox Quarry Extension (SSD 7293)
DPI Water General Assessment Requirements for State Significant Development and State Significant Infrastructure projects

The following detailed assessment requirements are provided to assist in adequately addressing the assessment requirements for State Significant Development (SSD) and State Significant Infrastructure (SSI) projects for Generic projects; Coal Mines and Gas projects; Quarries and Non Coal Mines and Linear projects respectively where relevant.

For further information visit the DPI Water website, www.water.nsw.gov.au

Key Relevant Legislative Instruments

This section provides a basic summary to aid proponents in the development of an Environmental Impact Statement (EIS), and should not be considered a complete list or comprehensive summary of relevant legislative instruments that may apply to the regulation of water resources for a project.

The EIS should take into account the objects and regulatory requirements of the *Water Act 1912* (WA 1912) and *Water Management Act 2000* (*WM Act*), and associated regulations and instruments, as applicable.

Water Management Act 2000 (WM Act)
Key points:

- Volumetric licensing in areas covered by water sharing plans
- Works within 40m of waterfront land
- SSD & SSI projects are exempt from requiring water supply work approvals and controlled activity approvals as a result of the *Environmental Planning & Assessment Act 1979 (EP&A Act)*.
- No exemptions for volumetric licensing apply as a result of the *EP&A Act*.
- Harvestable rights dams
- Aquifer interference activity approval provisions have not yet commenced and are regulated by the *Water Act 1912*
- Flood management work approval provisions have now commenced
- Maximum penalties of $ 2.2 million plus $ 264,000 for each day an offence continues apply under the *WM Act*

Water Act 1912 (WA 1912)
Key points:

- Monitoring bores
- Aquifer interference activities that are not regulated as a water supply work under the *WM Act*.
- No exemptions apply to licences or permits under the *WA 1912* as a result of the *EP&A Act*.
- Regulation of water bore driller licensing.

Water Management (General) Regulation 2011
Key points:

- Provides various exemptions for volumetric licensing and activity approvals
- Provides further detail on requirements for dealings and applications.

Access Licence Dealing Principles Order 2004

Harvestable Rights Orders

Water Sharing Plans these are considered regulations under the *WM Act*

It is important that the proponent understands and describes the ground and surface water sharing plans, water sources, and management zones that apply to the project. The relevant water sharing plans can be determined spatially at www.ourwater.nsw.gov.au. Multiple water sharing plans may apply and these must all be described.

The *Water Act 1912* applies to all water sources not yet covered by a commenced water sharing plan.

The EIS is required to:

- Demonstrate how the proposal is consistent with the relevant rules of the Water Sharing Plan including rules for access licences, distance restrictions for water supply works and rules for the management of local impacts in respect of surface water and groundwater sources, ecosystem protection (including groundwater dependent ecosystems), water quality and surface-groundwater connectivity.
- Provide a description of any site water use (amount of water to be taken from each water source) and management including all sediment dams, clear water diversion structures with detail on the location, design specifications and storage capacities for all the existing and proposed water management structures.
- Provide an analysis of the proposed water supply arrangements against the rules for access licences and other applicable requirements of any relevant WSP, including:
    - Sufficient market depth to acquire the necessary entitlements for each water source.
    - Ability to carry out a “dealing” to transfer the water to relevant location under the rules of the WSP.
    - Daily and long-term access rules.
    - Account management and carryover provisions.
- Provide a detailed and consolidated site water balance.
- Further detail on licensing requirements is provided below.

Relevant Policies and Guidelines

The EIS should take into account the following policies (as applicable):

- NSW Guidelines for Controlled Activities on Waterfront Land (NOW, 2012)
- NSW Aquifer Interference Policy (NOW, 2012)
- Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW, 2012)
- Australian Groundwater Modelling Guidelines (NWC, 2012)
- NSW State Rivers and Estuary Policy (1993)
- NSW Wetlands Policy (2010)
- NSW State Groundwater Policy Framework Document (1997)
- NSW State Groundwater Quality Protection Policy (1998)
- NSW State Groundwater Dependent Ecosystems Policy (2002)
- NSW Water Extraction Monitoring Policy (2007)

DPI Water policies can be accessed at the following links:
http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/default.aspx
http://www.water.nsw.gov.au/Water-licensing/Approvals/Controlled-activities/default.aspx

An assessment framework for the NSW Aquifer Interference Policy can be found online at: http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/Aquifer-interference.

Licensing Considerations

The EIS is required to provide:

- Identification of water requirements for the life of the project in terms of both volume and timing (including predictions of potential ongoing groundwater take following the cessation of operations at the site – such as evaporative loss from open voids or inflows).
- Details of the water supply source(s) for the proposal including any proposed surface water and groundwater extraction from each water source as defined in the relevant Water Sharing Plan/s and all water supply works to take water.
- Explanation of how the required water entitlements will be obtained (i.e. through a new or existing licence/s, trading on the water market, controlled allocations etc.).
- Information on the purpose, location, construction and expected annual extraction volumes including details on all existing and proposed water supply works which take surface water, (pumps, dams, diversions, etc).
- Details on all bores and excavations for the purpose of investigation, extraction, dewatering, testing and monitoring. All predicted groundwater take must be accounted for through adequate licensing.
- Details on existing dams/storages (including the date of construction, location, purpose, size and capacity) and any proposal to change the purpose of existing dams/storages
- Details on the location, purpose, size and capacity of any new proposed dams/storages.
- Applicability of any exemptions under the *Water Management (General) Regulation 2011* to the project.

Water allocation account management rules, total daily extraction limits and rules governing environmental protection and access licence dealings also need to be considered.

The Harvestable Right gives landholders the right to capture and use for any purpose 10% of the average annual runoff from their property if in the Eastern and Central Divisions. The Harvestable Right has been defined in terms of an equivalent dam capacity called the Maximum Harvestable Right Dam Capacity (MHRDC). The MHRDC is determined by the area of the property (in hectares) and a site-specific run-off factor. The MHRDC includes the capacity of all existing dams on the property that do not have a current water licence. Storages capturing up to the harvestable right capacity are not required to be licensed but any capacity of the total of all storages/dams on the property greater than the MHRDC may require a licence.

For more information on Harvestable Right dams, including a calculator, visit:
http://www.water.nsw.gov.au/Water-licensing/Basic-water-rights/Harvesting-runoff/Harvesting-runoff

Dam Safety

Where new or modified dams are proposed, or where new development will occur below an existing dam, the NSW Dams Safety Committee should be consulted in relation to any safety issues that may arise. Conditions of approval may be recommended to ensure safety in relation to any new or existing dams.

See www.damsafety.nsw.gov.au for further information.

Surface Water Assessment

The predictive assessment of the impact of the proposed project on surface water sources should include the following:

- Identification of all surface water features including watercourses, wetlands and floodplains transected by or adjacent to the proposed project.
- Identification of all surface water sources as described by the relevant water sharing plan.
- Detailed description of dependent ecosystems and existing surface water users within the area, including basic landholder rights to water and adjacent/downstream licensed water users.
- Description of all works and surface infrastructure that will intercept, store, convey, or otherwise interact with surface water resources.
- Assessment of predicted impacts on the following:
    - flow of surface water, sediment movement, channel stability, and hydraulic regime,
    - water quality,
    - flood regime,
    - dependent ecosystems,
    - existing surface water users, and
    - planned environmental water and water sharing arrangements prescribed in the relevant water sharing plans.

Groundwater Assessment

To ensure the sustainable and integrated management of groundwater sources, the EIS needs to include adequate details to assess the impact of the project on all groundwater sources.

Where it is considered unlikely that groundwater will be intercepted or impacted (for example by infiltration), a brief site assessment and justification for the minimal impacts may be sufficient, accompanied by suitable contingency measures in place in the event that groundwater is intercepted, and appropriate measures to ensure that groundwater is not contaminated.

Where groundwater is expected to be intercepted or impacted, the following requirements should be used to assist the groundwater assessment for the proposal.

- The known or predicted highest groundwater table at the site.
- Works likely to intercept, connect with or infiltrate the groundwater sources.
- Any proposed groundwater extraction, including purpose, location and construction details of all proposed bores and expected annual extraction volumes.
- Bore construction information is to be supplied to DPI Water by submitting a “Form A” template. DPI Water will supply “GW” registration numbers (and licence/approval numbers if required) which must be used as consistent and unique bore identifiers for all future reporting.

- A description of the watertable and groundwater pressure configuration, flow directions and rates and physical and chemical characteristics of the groundwater source (including connectivity with other groundwater and surface water sources).
- Sufficient baseline monitoring for groundwater quantity and quality for all aquifers and GDEs to establish a baseline incorporating typical temporal and spatial variations.
- The predicted impacts of any final landform on the groundwater regime.
- The existing groundwater users within the area (including the environment), any potential impacts on these users and safeguard measures to mitigate impacts.
- An assessment of groundwater quality, its beneficial use classification and prediction of any impacts on groundwater quality.
- An assessment of the potential for groundwater contamination (considering both the impacts of the proposal on groundwater contamination and the impacts of contamination on the proposal).
- Measures proposed to protect groundwater quality, both in the short and long term.
- Measures for preventing groundwater pollution so that remediation is not required.
- Protective measures for any groundwater dependent ecosystems (GDEs).
- Proposed methods of the disposal of waste water and approval from the relevant authority.
- The results of any models or predictive tools used.

Where potential impact/s are identified the assessment will need to identify limits to the level of impact and contingency measures that would remediate, reduce or manage potential impacts to the existing groundwater resource and any dependent groundwater environment or water users, including information on:

- Any proposed monitoring programs, including water levels and quality data.
- Reporting procedures for any monitoring program including mechanism for transfer of information.
- An assessment of any groundwater source/aquifer that may be sterilised from future use as a water supply as a consequence of the proposal.
- Identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency plans would be initiated (this may entail water level triggers or a beneficial use category).
- Description of the remedial measures or contingency plans proposed.
- Any funding assurances covering the anticipated post development maintenance cost, for example on-going groundwater monitoring for the nominated period.

Groundwater Dependent Ecosystems

The EIS must consider the potential impacts on any Groundwater Dependent Ecosystems (GDEs) at the site and in the vicinity of the site and:

- Identify any potential impacts on GDEs as a result of the proposal including:
    - the effect of the proposal on the recharge to groundwater systems;
    - the potential to adversely affect the water quality of the underlying groundwater system and adjoining groundwater systems in hydraulic connections; and
    - the effect on the function of GDEs (habitat, groundwater levels, connectivity).

- Provide safeguard measures for any GDEs.

Watercourses, Wetlands and Riparian Land

The EIS should address the potential impacts of the project on all watercourses likely to be affected by the project, existing riparian vegetation and the rehabilitation of riparian land. It is recommended the EIS provides details on all watercourses potentially affected by the proposal, including:

- Scaled plans showing the location of:
  - wetlands/swamps, watercourses and top of bank;
  - riparian corridor widths to be established along the creeks;
  - existing riparian vegetation surrounding the watercourses (identify any areas to be protected and any riparian vegetation proposed to be removed);
  - the site boundary, the footprint of the proposal in relation to the watercourses and riparian areas; and
  - proposed location of any asset protection zones.
- Photographs of the watercourses/wetlands and a map showing the point from which the photos were taken.
- A detailed description of all potential impacts on the watercourses/riparian land.
- A detailed description of all potential impacts on the wetlands, including potential impacts to the wetlands hydrologic regime; groundwater recharge; habitat and any species that depend on the wetlands.
- A description of the design features and measures to be incorporated to mitigate potential impacts.
- Geomorphic and hydrological assessment of water courses including details of stream order (Strahler System), river style and energy regimes both in channel and on adjacent floodplains.

Drill Pad, Well and Access Road Construction (applies to Coal Mines and Gas projects and Quarries and Non Coal Mine projects)

- Any construction activity within 40m of a watercourse, should be designed by a suitably qualified person, consistent with the NSW *Guidelines for Controlled Activities on Waterfront Land* (July 2012).
- Construction of all wells must be undertaken in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (3rd edition 2012) by a driller holding a bore drillers' licence valid in New South Wales.
- The length of time that a core hole is maintained as an open hole should be minimised.

Landform rehabilitation

Where significant modification to landform is proposed, the EIS must include:

- Justification of the proposed final landform with regard to its impact on local and regional surface and groundwater systems;
- A detailed description of how the site would be progressively rehabilitated and integrated into the surrounding landscape;
- Outline of proposed construction and restoration of topography and surface drainage features if affected by the project; and

- An outline of the measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation.

Additional Landform Rehabilitation Requirements for Coal mines and Gas projects and Quarries and Non Coal Mines (including final void management)

- Detailed modelling of potential groundwater volume, flow and quality impacts of the presence of an inundated final void (where relevant) on identified receptors specifically considering those environmental systems that are likely to be groundwater dependent;
- The measures that would be established for the long-term protection of local and regional aquifer systems and for the ongoing management of the site following the cessation of the project.

Consultation and general enquiries

Assessment of state significant development enquiries, or requests for review or consultation should be directed to the, Water Regulation Co-ordination Unit, water.referrals@dpi.nsw.gov.au.

A consultation guideline and further information is available online at:
www.water.nsw.gov.au/water-management/law-and-policy/planning-and-assessment

End Attachment A

DOC17/427522-01; EF13/3037 (SSD 7293)

Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Attention: Genevieve Seed

By email: genevieve.seed@planning.nsw.gov.au

Dear Ms Seed

Sancrox Quarry Extension (SSD 7293)
Reissue of Secretary's Environmental Assessment Requirements

I refer to your email to the Environment Protection Authority (EPA), dated 17 August 2017, seeking the EPA's recommended Secretary Environmental Assessment Requirements (SEARS) for the Sancrox Quarry extension proposal, SSD 7293. Provided with your email is the report titled '*Sancrox Quarry Expansion Project – Preliminary Environmental Impact Statement*', dated August 2015.

The EPA notes the request is for the reissuing of the SEARS, as previous SEARS were provided in relation to this proposal in October 2015. As the proposal, has not been altered from the previous 2015 application, the EPA has reviewed the 2015 SEARS submitted and updated them accordingly. These updates primarily relate to the guideline references.

The updated SEARS have been provided at **Attachment A** and the updated guidance material list at **Attachment B**.

The EPA's key information requirements for the project are summarised below and include an adequate description and assessment of:

1. Project proposal including size of the operation, proposed processes, operational hours, maximum and average annual production rate, staging and timing of the proposal;
2. Air quality impacts including a description of all emissions and a specific description of proposed air pollution management strategies;
3. Noise and vibration impacts associated with the proposed construction and hours of operation.
4. Water management onsite including process and stormwater management, sedimentation ponds, details and justification for any proposed discharge(s) and the sensitivity of the receiving environment.
5. Waste generation, source location, classification, quantities, reuse and management measures for activities undertaken at the premises;
6. A proposed monitoring plan to assess the impact on the environment and surrounding receivers over time;
7. An assessment of the cumulative impacts associated with this proposal and other activities in the local area; and

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8. Actions that will be taken to avoid or mitigate impacts or compensate for any unavoidable impacts associated with proposed operations.

In carrying out the assessment, the proponent should refer to the relevant guidelines listed in **Attachment B** and any relevant industry codes of practice and best practice management guidelines.

The proponent should also be aware that any commitments made in the EIS may be formalised as approval conditions and subsequently environment protection licence conditions. Pollution control measures should not be proposed if they are impractical, unrealistic or beyond the financial viability of the development. It is important that all conclusions are supported by adequate data.

If you require any further information regarding this matter, please contact me on 4908 6819 or by email to hunter.region@epa.nsw.gov.au.

Yours sincerely

30/8/17

MICHAEL HOWAT
A/Head Strategic Programs Unit - Hunter
Environment Protection Authority

Encl: **Attachment A** – EPA's Recommended Secretary's Environmental Assessment Requirements – Sancrox Quarry Extension Project (SSD 7293)

Attachment B – Guidance Material

ATTACHMENT A

EPA's Recommended Secretary's Environmental Assessment Requirements – Sancrox Quarry Extension Project (SSD 7293)

1 Environmental impacts of the project

Impacts related to the following environmental issues need to be assessed, quantified and reported on:

- Air Quality
- Noise and Vibration
- Water and Soil Quality and Management
- Waste Management
- Dangerous Goods, Chemical Storage and Bunding

The Environmental Impact Statement (EIS) should address the specific requirements outlined under each heading below and assess impacts in accordance with the relevant guidelines mentioned. A full list of guidelines is at Attachment B.

2 Licensing requirements

Should project approval be granted, the proponent will need to make a separate application to EPA for any variations to the existing Environment Protection Licence No. 5289 for the quarry. Additional information is available through EPA's *Guide to Licensing* document.
http://www.epa.nsw.gov.au/resources/licensing/licensing-guide-160369.pdf

General information on licence requirements can also be obtained from EPA's Environment Line on 131 555 during office hours, or can be found at the EPA web site at:
http://www.epa.nsw.gov.au/licensing/

3 The Proposal and Premises

The objectives of the proposal should be clearly stated and refer to:

- The size and type of the operation;
- The nature of the processes and the products, by-products and wastes produced;
- The types and quantities of any chemicals to be used and stored onsite;
- Proposed operational hours, including any heavy vehicle movements;
- Proposed maximum and average annual production rates that will occur at the premises; and
- Proposed staging and timing of the proposal.

The EIS will need to fully identify all the processes and activities intended for the site over the life of the development. This will include details of:

- The location of the proposed facility and details of the surrounding environment;
- The proposed layout of the site;
- Appropriate land use zoning;
- Ownership details of any residence and/or land likely to be affected by the proposed operations;
- Maps/diagrams showing the location of residences and properties likely to be affected and other industrial developments, conservation areas, wetlands, etc. in the locality that may be affected by the facility;
- All equipment proposed for use at the site;
- All chemicals, including fuel, used on the site and proposed methods for their transportation, storage, use and emergency management;
- Clearly detail the boundary of the premises; and
- Methods to mitigate any expected environmental impacts of the development.

4 Air Issues

Given the proposed extension of the extraction boundary and addition of potentially odorous activities such as asphalt production, the EIS should include a detailed assessment of air quality and odour impacts. The following matters should be addressed as part of the EIS.

- Assess the risk associated with potential discharges of fugitive and point source emissions for all stages of the proposal. Assessment of risk relates to environmental harm, risk to human health and amenity.

- Justify the level of assessment undertaken on the basis of risk factors, including but not limited to:
    - proposal location;
    - characteristics of the receiving environment; and
    - type and quantity of pollutants emitted.

- Describe the receiving environment in detail. The proposal must be contextualised within the receiving environment (local, regional and inter-regional as appropriate). The description must include but need not be limited to:
    - meteorology and climate;
    - topography;
    - surrounding land-use; receptors; and
    - ambient air quality.

- Include a detailed description of the proposal. All processes that could result in air emissions must be identified and described. Sufficient detail to accurately communicate the characteristics and quantity of all emissions must be provided.

- Include a consideration of 'worst case' emission scenarios and impacts at proposed emission limits.

- Account for cumulative impacts associated with existing emission sources as well as any currently approved developments linked to the receiving environment.

- Include air dispersion modelling where there is a risk of adverse air quality impacts, or where there is sufficient uncertainty to warrant a rigorous numerical impact assessment. Air dispersion modelling must be conducted in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2016).

- Demonstrate the proposal's ability to comply with the relevant regulatory framework, specifically the *Protection of the Environment Operations* (POEO) *Act* (1997) and the POEO (Clean Air) Regulation (2010).

- Provide an assessment of the project in terms of the priorities and targets adopted under the NSW State Plan 2010 and its implementation plan Action for Air.

- Detail emission control techniques/practices that will be employed by the proposal.

- Detail monitoring that will be conducted to assess the impacts of the proposal.

5 Noise and Vibration

The following matters should be addressed in relation to noise and vibration impacts associated with the proposal. This includes identification of the hours of operations, assessment of all activities where proposed, and impacts on sensitive receivers associated with the proposed hours of operation. The following matters should be addressed as part of the EIS.

General

- Construction noise associated with the proposed development should be assessed using the Interim Construction Noise Guideline (DECC, 2009).

- Vibration from all activities (including construction and operation) to be undertaken on the premises should be assessed using the guidelines contained in the Assessing Vibration: a technical guideline (DEC, 2006).

- Blast impacts should be demonstrated to be capable of complying with the guidelines contained in Australian and New Zealand Environment Council – Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC, 1990).

Industry

- Operational noise from all industrial activities (including private haul roads) to be undertaken on the premises should be assessed using the guidelines contained in the NSW Industrial Noise Policy (EPA, 2000) and Industrial Noise Policy Application Notes.

Road

- Noise on public roads from increased road traffic generated by land use developments should be assessed using the guidelines contained in the NSW Road Noise Policy (DECCW, 2011).

- Noise from new or upgraded public roads should be assessed using the NSW Road Noise Policy (DECCW, 2011).

Monitoring

- Detail monitoring that will be conducted to assess the impacts of the proposal.

6 Water and Soils

6.1 Water Quality

Describe Proposal

- Describe the proposal including position of any intakes and discharges, volumes, water quality and frequency of all water discharges.

- Demonstrate that all practical options to avoid discharges have been implemented and environmental impact minimised where discharge is necessary.

- Where relevant include a water balance for the development including water requirements (quantity, quality and source(s)) and proposed storm and wastewater disposal, including type, volumes, proposed treatment and management methods and re-use options.

Background Conditions

- Describe existing surface and groundwater quality. An assessment needs to be undertaken for any water resource likely to be affected by the proposal. Issues to be discussed should include but are not limited to:
  - a description of any impacts from existing industry or activities on water quality
  - a description of the condition of the local catchment e.g. erosion, soils, vegetation cover, etc.
  - an outline of baseline groundwater information, including, for example, depth to water table, flow direction and gradient, groundwater quality, reliance on groundwater by surrounding users and by the environment

  - historic river flow data

- State the Water Quality Objectives for the receiving waters relevant to the proposal. These refer to the community's agreed environmental values and human uses endorsed by the NSW Government as goals for ambient waters (http://www.environment.nsw.gov.au/ieo/index.htm). Where groundwater may be impacted the assessment should identify appropriate groundwater environmental values.

- State the indicators and associated trigger values or criteria for the identified environmental values. This information should be based on the ANZECC (2000) Guidelines for Fresh and Marine Water Quality as a minimum but should also be based on advice from Hunter Water Corporation given the sensitive receiving environment of Grahamstown Dam water supply.

- State any locally specific objectives, criteria or targets which have been endorsed by the NSW Government.

Impact Assessment

- Describe the nature and degree of impact that any proposed discharges will have on the receiving environment, both surface water and groundwater.
- Detail contractual and other arrangements that will be put in place to prevent pollution from haul roads and unsealed roads per se, particularly rights of carriageways not owned by the proponent.
- Assess impacts against the relevant ambient water quality outcomes. Demonstrate how the proposal will be designed and operated to:
  - protect the Water Quality Objectives for receiving waters where they are currently being achieved; and
  - contribute towards achievement of the Water Quality Objectives over time where they are not currently being achieved.
- Where a discharge is proposed that includes a mixing zone, the proposal should demonstrate how wastewater discharged to waterways will ensure the ANZECC (2000) water quality criteria for relevant chemical and non-chemical parameters are met at the edge of the initial mixing zone of the discharge, and that any impacts in the initial mixing zone are demonstrated to be reversible.
- Propose water quality limits for any discharge(s) that adequately protects the receiving environment.
- Assess impacts on groundwater and groundwater dependent ecosystems.
- Describe how stormwater will be managed both during and after construction.

Monitoring

- Describe how predicted impacts will be monitored and assessed over time.

6.2 Soil

The EIS should include:

- An assessment of potential impacts on soil and land resources should be undertaken, being guided by Soil and Landscape Issues in Environmental Impact Assessment (DLWC 2000). The nature and extent of any significant impacts should be identified. Particular attention should be given to:
  - Soil erosion and sediment transport - in accordance with Managing urban stormwater: soils and construction, vol. 1 (Landcom 2004) and vol. 2 (A. Installation of services; B Waste landfills; C. Unsealed roads; D. Main Roads; E. Mines and quarries) (DECC 2008).

- Mass movement (landslides) – in accordance with Landslide risk management guidelines presented in Australian Geomechanics Society (2007).
- Urban and regional salinity – guidance given in the Local Government Salinity Initiative booklets which includes Site Investigations for Urban Salinity (DLWC, 2002).

- A description of the mitigation and management options that will be used to prevent, control, abate or minimise identified soil and land resource impacts associated with the project. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.

7 Waste

The EIS should:

- Include a detailed plan for in-situ classification of waste material, including the sampling locations and sampling regime that will be employed to classify the waste, particularly with regards to the identification of contamination hotspots.

- Identify, quantify, characterise and classify all waste that currently exists at the site. Identify the intended end use, for example reuse or disposal, and the end use location(s) for the waste. Also, specify the mechanism under which waste will be reused or disposed, such as a Resource Recovery Exemption. Note: All waste must be classified in accordance with EPA's Classification Guidelines.

- Identify, characterise and classify all waste that will be generated onsite through excavation, demolition or construction activities, including proposed quantities of the waste.
  Note: All waste must be classified in accordance with EPA's Waste Classification Guidelines.

- Identify, characterise and classify all waste that is proposed to be disposed of to an offsite location, including proposed quantities of the waste and the disposal locations for the waste. This includes waste that is intended for re-use or recycling.
  Note: All waste must be classified in accordance with EPA's Classification Guidelines.

- Include a commitment to retaining all sampling and classification results for the life of the project to demonstrate compliance with EPA's Waste Classification Guidelines.

- Provide details of how waste will be handled and managed onsite to minimise pollution, including:

  a) Stockpile location and management
     - Labelling of stockpiles for identification, ensuring that all waste is clearly identified and stockpiled separately from other types of material (especially the separation of any contaminated and non-contaminated waste).
     - Proposed height limits for all waste to reduce the potential for dust and odour.
     - Procedures for minimising the movement of waste around the site and double handling.
     - Measures to minimise leaching from stockpiles into the surrounding environment, such as sediment fencing, geofabric liners etc.

  b) Erosion, sediment and leachate control including measures to be implemented to minimise erosion, leachate and sediment mobilisation at the site during works. The EIS should show the location of each measure to be implemented. The Proponent should consider measures such as:
     - Sediment traps
     - Diversion banks
     - Sediment fences
     - Bunds (earth, hay, mulch)

- Geofabric liners
- Other control measures as appropriate

The Proponent should also provide details of:
- how leachate from stockpiled waste material will be kept separate from stormwater runoff;
- treatment of leachate through a wastewater treatment plant (if applicable); and
- any proposed transport and disposal of leachate off-site.

- Provide details of how the waste will be handled and managed during transport to a lawful facility. If the waste possesses hazardous characteristics, the Proponent must provide details of how the waste will be treated or immobilised to render it suitable for transport and disposal.

- Include details of all procedures and protocols to be implemented to ensure that any waste leaving the site is transported and disposed of lawfully and does not pose a risk to human health or the environment.

- Include a statement demonstrating that the Proponent is aware of EPA's requirements with respect to notification and tracking of waste.

- Include a statement demonstrating that the Proponent is aware of the relevant legislative requirements for disposal of the waste, including any relevant Resource Recovery Exemptions, as gazetted by EPA from time to time.

- Outline contingency plans for any event that affects operations at the site that may result in environmental harm, including: excessive stockpiling of waste, volume of leachate generated exceeds the storage capacity available on-site etc.

8 Dangerous Goods, Chemical storage and Bunding

- The EIS must outline all details regarding the transport, handling, storage and use of dangerous goods, chemicals and products, including fuel, both on site and with ancillary activities and describe the measures proposed to minimise the potential for leakage or the migration of pollutants into the soil/waters or from the site.

- The EIS should identify any fuel or chemical storage areas proposed for the site.

- The EIS should consider compliance with the following legislation, standards and guidelines where relevant:
  - Australian Standard AS1692:1989 Tanks for Flammable and combustible liquids;
  - The DECC's "Bunding and Spill Management" Technical Guideline (November 1997)
  - Australian Standard AS 1940:2004 The Storage and Handling of Flammable and Combustible Liquids
  - Australia Standard AS 4452-1997: The Storage and Handling of Toxic Substances;
  - Australian/New Zealand Standard AS/NZS 4452:1997: The Storage and Handling of Mixed Classes of Dangerous Goods in Packages and Intermediate Bulk Containers; and
  - Road and Rail Transport (Dangerous Goods) Act 1997

9 Monitoring Programs

The EIS should include a detailed assessment of any noise, air quality, weather, water or waste monitoring required during the construction and on-going operation of the site to ensure that the development achieves a satisfactory level of environmental performance. The evaluation should include a detailed description of the monitoring locations, sample analysis methods and the level of reporting proposed.

ATTACHMENT B

Guidance Material

Title	Web address
Relevant Legislation	
Protection of the Environment Operations Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+156+1997+cd+0+N
Protection of the Environment Operations (Clean Air) Regulation 2010	http://www.legislation.nsw.gov.au/maintop/view/inforce/subordleg+428+2010+cd+0+N
Licensing	
Guide to Licensing	http://www.epa.nsw.gov.au/resources/licensing/licensing-guide-160369.pdf
Air Issues	
Air Quality	
Approved methods for the Modelling and Assessment of Air Pollutants in NSW (2016)	http://www.epa.nsw.gov.au/resources/epa/approved-methods-for-modelling-and-assessment-of-air-pollutants-in-NSW-160666.pdf
Approved methods for the Sampling and Analysis of Air Pollutants in NSW (2016)	http://www.epa.nsw.gov.au/resources/air/07001amsaap.pdf
POEO (Clean Air) Regulation 2010	http://www.legislation.nsw.gov.au/maintop/view/inforce/subordleg+428+2010+cd+0+N
Noise and Vibration	
Interim Construction Noise Guideline (DECC, 2009)	http://www.epa.nsw.gov.au/resources/noise/09265cng.pdf
Assessing Vibration: a technical guideline (DEC, 2006)	http://www.epa.nsw.gov.au/resources/noise/vibrationguide0643.pdf
Australian and New Zealand Environment Council – Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC, 1990)	http://www.epa.nsw.gov.au/resources/noise/ANZECBlasting.pdf
NSW Industrial Noise Policy	http://www.epa.nsw.gov.au/resources/noise/ind_noise.pdf
NSW Road Noise Policy (DECCW, 2011)	http://www.epa.nsw.gov.au/resources/noise/2011236nswroadnoisepolicy.pdf
Waste	
Waste Classification Guidelines (EPA, 2014)	http://www.epa.nsw.gov.au/wasteregulation/classify-guidelines.htm
Resource recovery exemption	http://www.epa.nsw.gov.au/wasteregulation/recovery-exemptions.htm
Water and Soils	
Soils – general	
Soil and Landscape Issues in Environmental Impact Assessment (DLWC 2000)	http://www.dnr.nsw.gov.au/care/soil/soil_pubs/pdfs/tech_rep_34_new.pdf

Title	Web address
Managing urban stormwater: soils and construction, vol. 1 (Landcom 2004) and vol. 2 (A. Installation of services; B Waste landfills; C. Unsealed roads; D. Main Roads; E. Mines and quarries) (DECC 2008)	Vol 1 - Available for purchase at http://www.landcom.com.au/whats-new/publications-reports/the-blue-book.aspx Vol 2 - http://www.environment.nsw.gov.au/stormwater/publications.htm
Landslide risk management guidelines	http://www.australiangeomechanics.org/resources/downloads/
Site Investigations for Urban Salinity (DLWC, 2002)	http://www.environment.nsw.gov.au/resources/salinity/booklet3siteinvestigationsforurbansalinity.pdf
Local Government Salinity Initiative Booklets	http://www.environment.nsw.gov.au/salinity/solutions/urban.htm
Water	
Water Quality Objectives	http://www.environment.nsw.gov.au/ieo/index.htm
ANZECC (2000) Guidelines for Fresh and Marine Water Quality	http://www.mincos.gov.au/publications/australian_and_new_zealand_guidelines_for_fresh_and_marine_water_quality
Applying Goals for Ambient Water Quality Guidance for Operations Officers – Mixing Zones	http://deccnet/water/resources/AWQGuidance7.pdf
Approved Methods for the Sampling and Analysis of Water Pollutant in NSW (2004)	http://www.epa.nsw.gov.au/resources/legislation/approvedmethods-water.pdf

Heritage Council of New South Wales

Level 6, 10 Valentine Avenue
Parramatta NSW 2150
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Parramatta NSW 2124
DX 8225 PARRAMATTA

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File No: EF17/9967
Ref No: DOC17/427040

Genevieve Seed
Senior Planning Officer - Resource Assessments
Department of Planning & Environment
23-33 Bridge Street
SYDNEY NSW 2000

E-mail:Genevieve.Seed@planning.nsw.gov.au

Dear Ms Seed

Request for Secretary's Environmental Assessment Requirements (SEARs) for Sancrox Quarry Extension Project (SSD 7293).

Reference is made to your correspondence received on 17 August 2017 requesting SEARs input from the Heritage Council of NSW (the Heritage Council) for the above proposal.

After a review of the documentation, it appears that the proposed State Significant Development (SSD) site does not include any items on the State Heritage Register. However, it is noted that an early grave is identified from the National Trust Register in the suburb of Sancrox and this area may have other historical archaeological potential associated with the development of the settlement of Port Macquarie Hastings Council LGA which requires consideration and management.

It is recommended that although the Proponent did not identify heritage as an issue, the following additional SEARS are included to address this potential:

- The Environmental Impact Statement (EIS) should identify if there are any potential heritage items within the proposed project area including historical archaeological potential. If any potential heritage items are likely to be affected, a Heritage Impact Statement (HIS) must be prepared in accordance with the guidelines in the NSW Heritage Manual 1996. The HIS should assess how the development would impact on any places of heritage significance in or surrounding the SSD site.
- A historical archaeological assessment should be prepared by a suitably qualified historical archaeologist in accordance with the Heritage Division, Office of Environment and Heritage Guidelines *'Assessing Significance for Historical Archaeological Sites and 'Relics'* 2009. This assessment should identify what relics, if any, are likely to be present, assess their significance and consider the impacts from the proposal on this potential resource. Where harm is likely to occur, it is recommended that the significance of the relics be considered in determining an appropriate mitigation strategy. If harm cannot be avoided in whole or part, an appropriate Research Design and Excavation Methodology should also be prepared to guide any proposed excavations.

If you have any questions regarding the above matter, please contact Felicity Barry, Senior Archaeologist, at the Heritage Division, Office of Environment and Heritage on telephone (02) 9995 6914 or by e-mail: Felicity.Barry@environment.nsw.gov.au.

Yours sincerely

25/08/2017
Katrina Stankowski
Acting Manager, Listings
Heritage Division
Office of Environment & Heritage
As Delegate of the Heritage Council of NSW

NSW GOVERNMENT | Office of Environment & Heritage

Our Ref: DOC17/428839
Your Ref: SSD 7293

Ms Genevieve Seed
Senior Planning Officer
Department of Planning & Environment
GPO Box 39
Sydney NSW 2001

Dear Ms Seed

Re: Request for OEH Environmental Assessment Requirements – Hanson Construction Materials Pty Ltd Sancrox Quarry Extension, within the Port Macquarie Hasting Council Local Government Area (SSD 7293)

Thank you for your e-mail of 18 August 2017 inviting input from the Office of Environment and Heritage (OEH) for the preparation of Secretary's Environmental Assessment Requirements (SEARs) for the Sancrox Quarry Extension proposal. I appreciate the opportunity to provide advice.

The OEH notes that the proposal will be assessed as State Significant Development/Infrastructure in accordance with Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Environmental Impact Statement (EIS) SEARs provided by OEH are limited to Aboriginal cultural heritage, biodiversity, OEH estate, historic heritage, acid sulphate soils, flooding, stormwater and coastal erosion.

We also advise that the OEH SEARs, as it relates to biodiversity, have been issued with respect to the *Biodiversity Conservation Act 2016.*

The proponent should ensure that the EIS will be sufficiently comprehensive to enable unambiguous determination of the extent of the direct and indirect impact(s) of the proposal. The EIS should include an appropriate assessment of the potential impacts on biodiversity (threatened species, ecological communities, or their habitat), and Aboriginal cultural heritage. OEH considers that this information is necessary to assess an EIS for the proposal.

The full lists of OEH's standard and project specific requirements that may need to be addressed in the EIS are provided in **Attachment A** and **Attachment B** respectively. In preparing the EIS, the proponent should refer to the relevant guidance material listed in **Attachment C.**

If you have any further questions about this issue, Ms Rachel Binskin, Regional Operations Officer, Regional Operations, OEH, can be contacted on 6659 8247or at rachel.binskin@environment.nsw.gov.au.

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ABN 30 841 387 271
www.environment.nsw.gov.au

Yours sincerely

7.9.17

KRISTER WAERN
A/Senior Team Leader Planning, North East Region
Regional Operations

Contact officer: RACHEL BINSKIN
6659 8247

Enclosure: Attachment A – OEH Standard Environmental Assessment Requirements, Attachment B – OEH Project Specific Requirements, and Attachment C – Guidelines Materials

Attachment A – OEH Standard Environmental Assessment Requirements (SSD 7036)

Biodiversity
1. Biodiversity impacts related to the proposed project are to be assessed in accordance with the Biodiversity Offset Scheme (BOS), and documented in a Biodiversity Development Assessment Report (BDAR) in accordance with Part 6 of the *Biodiversity Conservation Act 2016* (BC Act). The BDAR is to be prepared by a person accredited in accordance with s6.10 of the BC Act.
Aboriginal cultural heritage
2. The EIS must identify and describe the Aboriginal cultural heritage values that exist across the whole area that will be affected by the project and document these in the EIS. This may include the need for surface survey and test excavation. The identification of cultural heritage values should be guided by the *Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW* (DECCW, 2011) and consultation with OEH regional officers.
3. Where Aboriginal cultural heritage values are identified, consultation with Aboriginal people must be undertaken and documented in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW). The significance of cultural heritage values for Aboriginal people who have a cultural association with the land must be documented in the EIS.
4. Impacts on Aboriginal cultural heritage values are to be assessed and documented in the EIS. The EIS must demonstrate attempts to avoid impact upon cultural heritage values and identify any conservation outcomes. Where impacts are unavoidable, the EIS must outline measures proposed to mitigate impacts. Any objects recorded as part of the assessment must be documented and notified to OEH.
Historic heritage
5. The EIS must provide a heritage assessment including but not limited to an assessment of impacts to *State and local heritage* including conservation areas, natural heritage areas, places of Aboriginal heritage value, buildings, works, relics, gardens, landscapes, views, trees should be assessed. Where impacts to State or locally significant heritage items are identified, the assessment shall: a. outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) generally consistent with the NSW Heritage Manual (1996), b. be undertaken by a suitably qualified heritage consultant(s) (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria), c. include a statement of heritage impact for all heritage items (including significance assessment), d. consider impacts including, but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, landscape and vistas, and architectural noise treatment (as relevant), and e. where potential archaeological impacts have been identified develop an appropriate archaeological assessment methodology, including research design, to guide physical archaeological test excavations (terrestrial and maritime as relevant) and include the results of these test excavations.

Water and soils

6. The EIS must map the following features relevant to water and soils including:
   a. Acid sulfate soils (Class 1, 2, 3 or 4 on the Acid Sulfate Soil Planning Map).
   b. Rivers, streams, wetlands, estuaries (as described in s4 of the Biodiversity Assessment Method as part of the Landscape Context).
   c. Groundwater.
   d. Groundwater dependent ecosystems.
   e. Proposed intake and discharge locations.

7. The EIS must describe background conditions for any water resource likely to be affected by the project, including:
   a. Existing surface and groundwater.
   b. Hydrology, including volume, frequency and quality of discharges at proposed intake and discharge locations.
   c. Water Quality Objectives (as endorsed by the NSW Government http://www.environment.nsw.gov.au/ieo/index.htm) including groundwater as appropriate that represent the community's uses and values for the receiving waters.
   d. Indicators and trigger values/criteria for the environmental values identified at (c) in accordance with the ANZECC (2000) Guidelines for Fresh and Marine Water Quality and/or local objectives, criteria or targets endorsed by the NSW Government.

8. The EIS must assess the impacts of the project on water quality, including:
   a. The nature and degree of impact on receiving waters for both surface and groundwater, demonstrating how the project protects the Water Quality Objectives where they are currently being achieved, and contributes towards achievement of the Water Quality Objectives over time where they are currently not being achieved. This should include an assessment of the mitigating effects of proposed stormwater and wastewater management during and after construction.
   b. Identification of proposed monitoring of water quality.

9. The EIS must assess the impact of the project on hydrology, including:
   a. Water balance including quantity, quality and source.
   b. Effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas.
   c. Effects to downstream water-dependent fauna and flora including groundwater dependent ecosystems.
   d. Impacts to natural processes and functions within rivers, wetlands, estuaries and floodplains that affect river system and landscape health such as nutrient flow, aquatic connectivity and access to habitat for spawning and refuge (e.g. river benches).
   e. Changes to environmental water availability, both regulated/licensed and unregulated/rules-based sources of such water.
   f. Mitigating effects of proposed stormwater and wastewater management during and after construction on hydrological attributes such as volumes, flow rates, management methods and re-use options.
   g. Identification of proposed monitoring of hydrological attributes.

Flooding and coastal erosion

10. The EIS must map the following features relevant to flooding as described in the Floodplain Development Manual 2005 (NSW Government 2005) including:
    a. Flood prone land
    b. Flood planning area, the area below the flood planning level.
    c. Hydraulic categorisation (floodways and flood storage areas).
11. The EIS must describe flood assessment and modelling undertaken in determining the design flood levels for events, including a minimum of the 1 in 10 year, 1 in 100-year flood levels and the probable maximum flood, or an equivalent extreme event.
12. The EIS must model the effect of the proposed project (including fill) on the flood behaviour under the following scenarios:
    a. Current flood behaviour for a range of design events as identified in 8) above. The 1 in 200 and 1 in 500-year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.
13. Modelling in the EIS must consider and document:
    a. The impact on existing flood behaviour for a full range of flood events including up to the probable maximum flood.
    b. Impacts of the development on flood behaviour resulting in detrimental changes in potential flood affection of other developments or land. This may include redirection of flow, flow velocities, flood levels, hazards and hydraulic categories.
    c. Relevant provisions of the NSW Floodplain Development Manual 2005.
14. The EIS must assess the impacts on the proposed project on flood behaviour, including:
    a. Whether there will be detrimental increases in the potential flood affectation of other properties, assets and infrastructure.
    b. Consistency with Council floodplain risk management plans.
    c. Compatibility with the flood hazard of the land.
    d. Compatibility with the hydraulic functions of flow conveyance in floodways and storage in flood storage areas of the land.
    e. Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site.
    f. Whether there will be direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.
    g. Any impacts the development may have upon existing community emergency management arrangements for flooding. These matters are to be discussed with the SES and Council.
    h. Whether the proposal incorporates specific measures to manage risk to life from flood. These matters are to be discussed with the SES and Council.
    i. Emergency management, evacuation and access, and contingency measures for the development considering the full range or flood risk (based upon the probable maximum flood or an equivalent extreme flood event). These matters are to be discussed with and have the support of Council and the SES.
    j. Any impacts the development may have on the social and economic costs to the community as consequence of flooding.

Attachment B – OEH Project-specific Environmental Assessment Requirements (SSD 7036)

Biodiversity

1. The species listed below as 1(a) and (b) are to be included, as part of the 'potential' serious and irreversible impacts, on other threatened entities as part of s10.2.1.5 of the *Biodiversity Assessment Method 2017* (BAM), not listed in the *Guidance and criteria to assist a decision maker to determine a serious and irreversible*. Should one of these entities be identified during survey, the proponent is required to provide additional information in accordance with section 10.2 of the BAM.
    a. *Dendrobium melaleucaphilum* – Spider Orchid
    b. *Phaius australis* – Southern Swamp Orchid
2. The EIS is to include relevant local planning undertaken by the Port Macquarie - Hastings Council for the Greater Sancrox Area, in the context of the greater landscape to assess existing, and future habitat connectivity, especially in regards to alignment of subregional corridors, and local habitat linkages in accordance with s4.2.1.3 (d) of the BAM.

Aboriginal cultural heritage

3. The assessment of cultural heritage values must include a surface survey undertaken by a qualified archaeologist in areas with potential for subsurface Aboriginal deposits. The result of the surface survey is to inform the need for targeted test excavation to better assess the integrity, extent, distribution, nature and overall significance of the archaeological record. The results of surface surveys and test excavations are to be documented in the EIS.
4. The EIS must outline procedures to be followed if Aboriginal objects are found at any stage of the life of the proposal to formulate appropriate measures to manage unforeseen impacts.
5. The EIS must outline procedures to be followed in the event Aboriginal burials or skeletal material is uncovered during construction to formulate appropriate measures to manage the impacts to this material.

Flooding and coastal erosion

6. The EIS must consider the effects of sea level rise on all flood risks on the site under the following scenarios:
    a. Current sea level.
    b. Projected sea levels in 2050 and 2100 which have been peer-reviewed and widely accepted by scientific opinion.

Attachment C – OEH Guidance Material (SSD 7036)

Title	Web address
Relevant Legislation	
Biodiversity Conservation Act 2016	https://www.legislation.nsw.gov.au/~/view/act/2016/63/full
Coastal Management Act 2016	https://www.legislation.nsw.gov.au/~/view/act/2016/20
Commonwealth Environment Protection and Biodiversity Conservation Act 1999	http://www.austlii.edu.au/au/legis/cth/consol_act/epabca1999588/
Environmental Planning and Assessment Act 1979	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+203+1979+cd+0+N
Fisheries Management Act 1994	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+38+1994+cd+0+N
Marine Parks Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+64+1997+cd+0+N
National Parks and Wildlife Act 1974	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+80+1974+cd+0+N
Protection of the Environment Operations Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+156+1997+cd+0+N
Water Management Act 2000	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+92+2000+cd+0+N
Wilderness Act 1987	http://www.legislation.nsw.gov.au/viewtop/inforce/act+196+1987+FIRST+0+N
Biodiversity	
Biodiversity Conservation Regulation 2017	https://www.legislation.nsw.gov.au/~/view/regulation/2017/432
Biodiversity Conservation (Savings and Transitional) Regulation 2017	https://www.legislation.nsw.gov.au/~/view/regulation/2017/433
Biodiversity Assessment Method (OEH, 2017)	http://www.environment.nsw.gov.au/biodiversity/assessmentmethod.htm
Online Biodiversity Assessment Method Calculator	https://www.lmbc.nsw.gov.au/bamcalc
Serious and irreversible impact (OEH, 2017)	http://www.environment.nsw.gov.au/biodiversity/seriousirreversibleimpacts.htm
Offset Rules	http://www.environment.nsw.gov.au/biodiversity/offsetrules.htm
Fisheries NSW policies and guidelines	http://www.dpi.nsw.gov.au/fisheries/habitat/publications/policies,-guidelines-and-manuals/fish-habitat-conservation
List of national parks	http://www.environment.nsw.gov.au/NationalParks/parksearchatoz.aspx
Revocation, re-categorisation and road adjustment policy (OEH, 2012)	http://www.environment.nsw.gov.au/policies/RevocationOfLandPolicy.htm
Guidelines for developments adjoining land and water managed by the Department of Environment, Climate Change and Water (DECCW, 2010)	http://www.environment.nsw.gov.au/protectedareas/developmntadjoiningdecc.htm
Heritage	

Title	Web address
The Burra Charter (The Australia ICOMOS charter for places of cultural significance)	http://australia.icomos.org/wp-content/uploads/The-Burra-Charter-2013-Adopted-31.10.2013.pdf
Statements of Heritage Impact 2002 (HO & DUAP)	http://www.environment.nsw.gov.au/resources/heritagebranch/heritage/hmstatementsofhi.pdf
NSW Heritage Manual (DUAP) (scroll through alphabetical list to 'N')	http://www.environment.nsw.gov.au/Heritage/publications/
Aboriginal Cultural Heritage	
Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010)	http://www.environment.nsw.gov.au/resources/cultureheritage/commconsultation/09781ACHconsultreq.pdf
Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW, 2010)	http://www.environment.nsw.gov.au/resources/cultureheritage/10783FinalArchCoP.pdf
Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011)	http://www.environment.nsw.gov.au/resources/cultureheritage/20110263ACHguide.pdf
Aboriginal Site Recording Form	http://www.environment.nsw.gov.au/resources/parks/SiteCardMainV1_1.pdf
Aboriginal Site Impact Recording Form	http://www.environment.nsw.gov.au/resources/cultureheritage/120558asirf.pdf
Aboriginal Heritage Information Management System (AHIMS) Registrar	http://www.environment.nsw.gov.au/contact/AHIMSRegistrar.htm
Care Agreement Application form	http://www.environment.nsw.gov.au/resources/cultureheritage/20110914TransferObject.pdf
Water and Soils	
Acid sulphate soils	
Acid Sulfate Soils Planning Maps via Data NSW	http://data.nsw.gov.au/data/
Acid Sulfate Soils Manual (Stone et al. 1998)	http://www.environment.nsw.gov.au/resources/epa/Acid-Sulfate-Manual-1998.pdf
Acid Sulfate Soils Laboratory Methods Guidelines (Ahern et al. 2004)	http://www.environment.nsw.gov.au/resources/soils/acid-sulfate-soils-laboratory-methods-guidelines.pdf This replaces Chapter 4 of the Acid Sulfate Soils Manual above.
Flooding and Coastal Erosion	
Reforms to coastal erosion management	http://www.environment.nsw.gov.au/coasts/coastalerosionmgmt.htm
Floodplain development manual	http://www.environment.nsw.gov.au/floodplains/manual.htm
Guidelines for Preparing Coastal Zone Management Plans	Guidelines for Preparing Coastal Zone Management Plans http://www.environment.nsw.gov.au/resources/coasts/130224CZMPGuide.pdf
NSW Climate Impact Profile	http://climatechange.environment.nsw.gov.au/
Climate Change Impacts and Risk Management	Climate Change Impacts and Risk Management: A Guide for Business and Government, AGIC Guidelines for Climate Change Adaptation
Water	
Water Quality Objectives	http://www.environment.nsw.gov.au/ieo/index.htm

Title	Web address
ANZECC (2000) Guidelines for Fresh and Marine Water Quality	www.environment.gov.au/water/publications/quality/australian-and-new-zealand-guidelines-fresh-marine-water-quality-volume-1
Applying Goals for Ambient Water Quality Guidance for Operations Officers – Mixing Zones	http://deccnet/water/resources/AWQGuidance7.pdf
Approved Methods for the Sampling and Analysis of Water Pollutant in NSW (2004)	http://www.environment.nsw.gov.au/resources/legislation/approvedmethods-water.pdf

NSW RURAL FIRE SERVICE

The Secretary
NSW Planning & Environment
GPO Box 39
Sydney NSW 2001

Your Ref: SSD 7293
Our Ref: D15/2871
DA17082308907 AB

ATTENTION: Genevieve Seed

31 August 2017

Dear Ms Seed,

Request for Secretary's Environmental Assessment Requirements - Sancrox Quarry Extension

I refer to your email from the NSW Department of Planning & Environment dated 17 August 2017 seeking comment from the NSW Rural Fire Service on matters to be included in the Secretary's Environmental Assessment Requirements for the proposed Sancrox Quarry extension.

The subject land is mapped as bushfire prone land by Port Macquarie - Hastings Council. The NSW Rural Fire Service considers that the environmental assessment for the proposed development should address the following:

- the aim and objectives of 'Planning for Bushfire Protection 2006';
- identification of bush fire prone land within 140 metres of the proposed development;
- identification of potential ignition sources during construction and operation of the development;
- storage of fuels and other hazardous materials (e.g. explosives for blasting);
- stockpiling of any mulched vegetation;
- proposed bushfire protection measures for the development, including vegetation management and fire suppression capabilities;
- operational access for fire fighting appliances to the site; and
- emergency and evacuation planning.

Postal address
Records
NSW Rural Fire Service
Locked Bag 17
GRANVILLE NSW 2142

Street address
NSW Rural Fire Service
Planning and Environment Services (North)
Suite 1, 129 West High Street
COFFS HARBOUR NSW 2450

T (02) 6691 0400
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www.rfs.nsw.gov.au
Email: pes@rfs.nsw.gov.au

For any queries regarding this correspondence please contact Alan Bawden on 6691 0400.

Yours sincerely,

Ian Cook
Acting Manager – Planning and Environment Services North
The RFS has made getting information easier. For general information on 'Planning for Bush Fire Protection, 2006', visit the RFS web page at www.rfs.nsw.gov.au and search under 'Planning for Bush Fire Protection, 2006'.

File No: NTH12/00067/06
Your Ref: SSD_7293

The Manager
Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Attention: Genevieve Seed – Senior Planning Officer

Dear Sir / Madam,

Secretary's Environmental Assessment Requirements for SSD 7293 – Sancrox Quarry, Sancrox Road, Sancrox

I refer to your email of 17 August 2017 requesting an updated to the Secretary's Environmental Assessment Requirements (EARs) for the abovementioned state significant development.

Roles and Responsibilities

The key interests for Roads and Maritime Services are the safety and efficiency of the road network, traffic management, the integrity of infrastructure assets and the integration of land use and transport.

Port Macquarie-Hastings Council is the Roads Authority for all public roads in the subject area pursuant to Section 7 of the *Roads Act 1993* Roads and Maritime is the roads authority for freeways and can exercise road authority functions for classified roads in accordance with the Roads Act. Council is responsible setting standards, determining priorities and carrying out works on public (local) roads.

Roads and Maritime Response

Roads and Maritime requests that the Environmental Assessment be supported by a Traffic Impact Assessment (TIA) prepared by a suitably qualified person in accordance with the Austroads Guide to Traffic Management Part 12, the complementary Roads and Maritime Supplement and RTA Guide to Traffic Generating Developments. The TIA is to address the following;

- The total impact of existing and proposed development on the road network with consideration for a 10 year horizon.
- The volume and distribution of traffic generated by the proposed development.
- Intersection sight distances at key intersections along the primary haul route.
- Existing and proposed site access standards.
- Details of proposed improvements to affected intersections.
- Details of servicing and parking arrangements.

- Impact on public transport (public and school bus routes) and consideration for alternative transport modes such as walking and cycling.
- Impacts of road traffic noise and/or dust generated along the primary haul route/s.
- Consideration for Clause 16(1) of the Mining SEPP regarding;
    - Impact on school zones and residential areas.
    - Code of Conduct for haulage operators
    - Road safety assessment of key haulage route/s

  Should Council wish to condition the preparation of a Code of Conduct for haulage operators, this could include, but not be limited to;

    a. A map of the primary haulage routes highlighting critical locations.
    b. Safety initiatives for haulage through residential areas and/or school zones.
    c. An induction process for vehicle operators & regular toolbox meetings.
    d. A complaint resolution and disciplinary procedure.
    e. Any community consultation measures for peak haulage periods.

Where road safety concerns are identified at a specific location along the identified haulage route/s, Roads and Maritime suggests that the TIA be supported by a targeted Road Safety Audit undertaken by suitably qualified persons.

The current Austroads Guidelines, Australian Standards and Roads and Maritime Supplements are to be adopted for any proposed works on the classified road network.

The Developer would be required to enter into a 'Works Authorisation Deed' (WAD) with Roads and Maritime for any works deemed necessary on the classified road network. The developer would be responsible for all costs associated with the works and administration for the WAD. Further information on undertaking private developments adjacent to classified roads can be accessed at:

http://www.rms.nsw.gov.au/projects/planning-principles/index.html

Advice to the Consent Authority

Roads and Maritime highlights the Consent Authority is responsible for considering the environmental impacts of any road works which are ancillary to the development. This includes any works which form part of the proposal and/or any works deemed necessary to include as requirements in the conditions of development consent.

If you have any further enquiries regarding the above comments please contact Bill Butler, A / Manager Land Use Assessment on (02) 6640 1362 or via email at: development.northern@rms.nsw.gov.au

Yours faithfully

W.R Butler

for Liz Smith
A / Network & Safety Manager, Northern Region

Port Macquarie-Hastings Council
PO Box 84
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NSW Australia 2444
DX 7415
e council@pmhc.nsw.gov.au

ABN 11 236 901 601

PORT MACQUARIE HASTINGS COUNCIL

21 August 2017

Refers to: CRM 16196/2017
Your Ref: SSD 7293
Parcel No.: 18314, 18327, 28897 & 28898

Genevieve Seed
Senior Planning Officer
GPO Box 39
SYDNEY NSW 2001
genevieve.seed@planning.nsw.gov.au

Dear Genevieve

Updated Secretary's Environmental Assessment Requirements (SEARs) for Sancrox Quarry Extension Project (SSD 7293) at Sancrox Road, Sancrox

I refer to your email to Council dated 17 August 2017 regarding the above matter.

Please be advised that Council staff have reviewed the current proposal, the SEARs issued on 19 October 2015 and the previous requirements of the other Government Departments. A summary of the key Council matters for consideration include:

- The property is largely zoned RU1 Primary Production under the Port Macquarie Hastings Local Environmental Plan 2011. However, Lot 1 DP 704890 also contains IN1 General Industrial and SP2 Special Purposes zoning. Proposal to address permissibility of the quarry and associated aspects.
- Compliance with State Environmental Planning Policy (State and Regional Development) 2011 to be outlined.
- State Environmental Planning Policy No 33 - Hazardous and Offensive Development to be considered.
- State Environmental Planning Policy No 44 – Koala Habitat Protection to be considered.
- State Environmental Planning Policy No 55 – Remediation of Land to be considered.
- State Environmental Planning Policy No 62 – Sustainable Aquaculture to be considered given proximity to Hastings River and tributaries.
- State Environmental Planning Policy No 64 – Advertising and Signage to be considered if any signage proposed (ie quarry business identification signs).
- State Environmental Planning Policy No 71 – Coastal Protection applies to part of the land and is therefore to be considered.
- State Environmental Planning Policy (Infrastructure) 2007 to be considered. In particular, Division 17, Subdivision 2 provisions.
- State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 to be considered.
- State Environmental Planning Policy (Rural Lands) 2007 to be considered.
- Proposal to have regard for the Port Macquarie Hastings Local Environmental Plan 2011 (LEP 2011).

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WAUCHOPE OFFICE
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LAURIETON OFFICE
9 Laurie Street, Laurieton NSW 2443
t 02 6559 9958

Parcel No.: 18314, 18327, 28897 & 28898

- Lot 2 DP 574308 contains potential acid sulphate soils and is flood prone. These aspects will need to be addressed.
- Proposal should consider consolidating all the parcels of land into one lot.
- Noise, air and vibration impacts from the quarry operations, concrete batching plant etc and associated flow on activities (ie truck movements) to be addressed. Any proposed buffers will need to be contained on the quarry site or an agreement in place with impacted neighbours.
- The applicant is to contact Council's Contribution Section to ascertain if any s94A contributions, s64 contributions and/or Voluntary Planning Agreement (VPA) is required to address impacts associated with the extension.
- Details of any staging to be included in the application.
- Details of any rehabilitation and final use to be detailed in the application.
- Confirmation on what will happen to the existing consents applying to the site, including their rehabilitation and proposed final use.
- Proposal to address potential fly rock impacts on surrounding industrial and rural residential land. Any proposed buffers will need to be contained on the quarry site or an agreement in place with impacted neighbours.
- Traffic impact assessment should be required.
- Proposal to detail any existing structures/buildings to be retained and or demolished.
- Consideration should be given to closing and obtaining all of the Crown Road that traverses the site, not just the northern section.
- Stormwater management plan required.
- All processes involved in the quarry, batching plants etc to be detailed in the EIS.
- The application is to outline the proposed water and sewer supply with any connection to Council's reticulated system requiring Council approval.
- At this stage, the Sancrox area is also being considered by Council as a potential long term urban growth area.

Should you have any questions in relation to the above, please call me on 65818538 or email clinton.tink@pmhc.nsw.gov.au.

Yours sincerely

Clinton Tink
Development Assessment Planner

PORT MACQUARIE-
HASTINGS COUNCIL

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PORT MACQUARIE
HASTINGS

26 March 2014

Parcel Number: 18314, 28897

Hanson Construction Materials Pty Ltd
Locked Bag 5260
PARRAMATTA NSW 2124

Dear Sir/Madam

DA 1995/193.1 - Modification of Consent Pursuant to Section 96 (1A) of the Environmental Planning & Assessment Act 1979

I refer to your application dated 2 October 2013 to modify consent to allow a temporary increase in the extraction limit under DA 1995/193 at LOT: 353 DP: 754434, LOT: 1 DP: 720807 Sancrox Road SANCROX, Pacific Highway SANCROX.

Please be advised that pursuant to Section 96 (1A) of the Act, your application to modify the consent has been granted, subject to:

A. Add condition No's
   - A30, A31

B. Amend condition No's
   - A1, A2, A5, A12, A19, A21

C. Reimposition of all other previously approved conditions of consent as originally determined 18 November 1996 and as modified 5 June 2007, 7 January 2008 & 18 November 2009 with this approval dated 12 March 2014.

The applicant is advised that Section 97AA of the Act confers on an applicant who is dissatisfied with the determination, right of appeal to the Land and Environment Court.

A revised schedule of development consent conditions is attached.

Yours sincerely

Clinton Tink
Development Assessment Planner

SCHEDULE OF CONDITIONS ATTACHED TO THIS CONSENT

The conditions of consent referred to in the Notice of Determination for DA No 1995/193 are as follows:

The development is to be undertaken in accordance with the prescribed conditions of Part 6 - Division 8A of the *Environmental Planning & Assessment Regulations* 2000.

[1]	Modification 1	5 June 2007
[2]	Modification 2	7 January 2008
[3]	Modification 3	18 November 2009
[4]	Modification 4	12 March 2014

1. The development being completed substantially in accordance with the application and approved plan, except where varied by conditions of this consent and as modified on 14 June 2007, 7 January 2008, 18 November 2009 and 12 March 2014. [4]
2. Extraction must not exceed 70,000 cubic metres per annum. However, the annual extraction rate can increase to 175,000 cubic metres per annum for five (5) years in a row being 12 March 2014 - 12 March 2019 [4]
3. Extraction to take place in accordance with Plan Reference No. 1045/CTK51, 1045/CTK521 and 1045/CTK53 contained within the Statement of Environmental Effects.
4. A plan of survey be lodged within three months from the date of this consent to confirm the maximum area of extraction as shown on Plan Ref No. 1045/CTK53.
5. Hours of operation for the development are to be as follows:
   - 7.00am to 5.00pm Monday to Friday
   - 7.00am to 1.00pm Saturday
   - No work is to be carried out on Sundays

   In addition to the above hours of operation, activities such as the movement of trucks into the site, operation of loading equipment, loading of trucks and movement of trucks out of the site (as outlined in the modification dated 7 January 2008) will also be permitted to occur as follows:

   - 7.00am to 11.00pm Monday to Friday
   - 7.00am to 5.00pm Saturday, Sunday and Public Holidays
   - 11.00pm to 7.00am on up to twenty (20) occasions within a twelve (12) month period (with no overlapping of the twelve (12) month periods). Records are to be kept and provided to Council upon request. It should be noted the hours of operation in this consent will also apply to DA 2004/0609.

   Any work associated with the temporary intensification of the extraction rate up

to 175,000 cubic metres per annum, as per condition 2, must only occur during:

- 7.00am to 5.00pm Monday to Friday
- 7.00am to 1.00pm Saturday

In particular, the temporary intensification of the extraction rate should not occur outside standard hours of operation. [4]

6. A separate development application will be required for any future use of the processing and stockpiling area when the resource becomes exhausted. Further use of this processing plant for material other than that emanating from the onsite pits will require a separate development application.

7. Submission of engineering plans and specifications based on Australian Height Datum to the satisfaction of the Director, Development and environment for:

   A. Construction of a Type A intersection with Sancrox Road and the access road at no cost to Council including:

      i. Reconstruction of the existing pavement, if required, to provide uniform cross falls.

      ii. Bitumen sealing of all pavement widening and tapers to provide uniform skid resistance.

      iii. Bitumen sealing of the access road from Sancrox Road for a distance of 50 metres.

      iv. All necessary surface and subsoil drains.

      v. Provision of traffic signs.

      vi. Provision of all line marking.

      Construction of the above work to the satisfaction of Director of Development and Environment.

8. Compliance with the requirements of NorthPower regarding provision of electricity to serve the development.

9. Any necessary alterations to or relocations of public utility services to be carried out at no cost to Council.

10. All engineering works on Public property or involving extension or modification to public utilities under Council's control are to be carried out in accordance with plans and specifications approved by, under the supervision of and to the satisfaction of the Director Development and Environment.

11. Provision of a security deposit or bank guarantee, prior to release of approved building plans, to cover the estimated cost plus 30% of all engineering works required on public property as assessed by the Director Development and Environment prior to the release of any subsequent building approval, plus a written agreement undertaking to carry out the works required prior to commencement of occupation of the building together with an authorisation for Council to use the funds to complete any unfinished works. Such bond is to be for limited period of two (2) years and cash securities only will be for bonds less than $1,000.

12. A. An Environmental Management (EMP) and Rehabilitation Plan is to be submitted to and approved by Council within six (6) months of the date of

consent/modification. Such management plan shall be prepared in consultation with Hastings Council and all relevant statutory authorities and is to be subject to periodic review and revision as specified in the plan itself. [4]

B. The review and revision process specified in the Environmental Management and Rehabilitation Plan shall result in the production of an environmental audit for the development site. Such an audit shall overview the performance of the quarry in respects of the Statement of environmental Effects, management plan and the relevant environmental statutory provisions.

C. The EMP is to be updated to include the recommendations on managing noise, vibration, blasting and air quality in the ERM Sancrox Quarry Modification of Development Consent Noise and Vibration Impact Assessment dated July 2013 and Air Quality Assessment dated March 2013. During occupation of the site, the requirements of the EMP are to be complied with. [5]

13. The Environmental Management Plan referred to in condition No. 12 shall include the re-spreading of topsoil together with any logs, brush and rocks to facilitate natural regeneration and improve habitat value. Tree species from local seed stock should be planted to supplement natural regeneration and should be planted in clumps. Areas of regeneration shall be fenced to avoid grazing of seedlings. Details to be included in the rehabilitation plan.

14. Further to condition No. 12 relating to rehabilitation this plan shall include immediate commencement of plantings along the northern and eastern boundaries to provide visual screening from adjoining properties.

15. A. The Environmental Management and Rehabilitation Plan is to provide specific details with respect to all monitoring activities associated with ponded water in the quarry pits and the potential for groundwater contamination. In the event that adverse impacts become apparent, work is to cease pending further impact assessment and the adoption of a Council approved contingency plan.

B. The Environmental Management and Rehabilitation Plan shall detail a reporting protocol and format such that all data generated is correctly documented, analysed and submitted to Hastings Council and other relevant Statutory Authorities on a regular basis.

16. The site manager is to be responsible for the implementation of the Environmental Management and Rehabilitation Plan and all monitoring activities carried out on site.

17. The Environmental Management and Rehabilitation Plan should include measures as outlined in the Statement of Environmental Effects to maintain air quality and minimize the likelihood of air pollution.

18. The Environmental Management and Rehabilitation Plan should include measures as outlined in the Environmental Impact Statement to maintain water quality leaving the site.

19. Noise generated from the quarrying operations is not to exceed the acceptable noise limits specified in the Noise Impact Assessment (Report No. 95.993.A1) and as modified by the Acoustic Assessment by ERM dated August 2007, reference 0068650rp1 and as modified by the ERM Sancrox Quarry Modification of Development Consent Noise and Vibration Impact Assessment dated July 2013. Measures to ensure such are to be detailed in the

Environmental Management and Rehabilitation Plan. [4]

20. Should offensive noise be generated, a suitably qualified acoustic engineer shall submit details of noise mitigation works to be undertaken onsite to Council for approval.

21. Approval is to be obtained in writing from the EPA with respect to all pollution control works. Copies of all approvals and licenses shall be submitted to Council, including any changes to cover modifications. [4]

22. Sludge from the settling ponds is to be removed and combined with soil for rehabilitation purposes.

23. Fuel storage areas are to be bunded to 110% of the storage capacity and runoff is to be treated in an appropriate oil separator before being drained to the sedimentation ponds. These storage facilities are to be constructed in accordance with the relevant Australian Standard.

24. Stored liquids, quarry floor refueling areas and machinery maintenance/repair areas are to be bunded to contain spilt chemicals and lubricants.

25. The environmental management plan required to be prepared by the proponent shall address the following:

    (a) The proponent shall ensure that airblasting overpressure levels from blasting at the quarry site does not exceed the following outcomes at any residence or sensitive receiver on any privately owned land:

    Maximum normal airblast overpressure of 115 dBL with allowable exceedences up to 120dBL for 5% of the total number of blasts over a 12 month period.

    (b) The proponent shall ensure that ground vibration levels from blasting at the project site does not exceed the following outcomes at any residence or sensitive receiver or privately owned land:

    Maximum normal Peak Particle Velocity of 5mm/s with allowable exceedences up to 10mm/s for 5% of the total number of blasts over a 12 month period.

    (c) The proponent shall ensure that ground vibration and airblast overpressure levels from blastings at the project site do not exceed the following outcomes at any existing or future industrial or commercial receiver on privately owned land:

    Allowable Limits with regards to Commercial and Industrial receivers:

    Parameter Allowable Limits Vibration (peak particle velocity): 25mm/s
    Parameter Allowable Limits Airblast overpressure: 125 dBL

    (d) The proponent shall employ blasting practices in accordance with AS 2187.2 - 2006 - Explosives - Storage and Use, Part 2: Use of Explosives to:

    - minimise the potential for flyrock;
    - protect the safety of people, property and livestock; and
    - minimises dust and fumes emissions from blasting on the site

    (e) The proponent shall:

    - Notify the landowner/occupier of any residence within 1 kilometre of the quarry pit who registers an interest in being notified about blasting

schedule on site; and

- Publicly display a number on the primary entrance to the site where information regarding blasting at the quarry can be obtained.

(f) The required blasting exclusion zone, in accordance with AS 2187.2 - 2006 - Explosives - Storage and Use, Part 2: Use of Explosives, is to be maintained at all times wholly within the site itself or if provided wholly or partly outside of the site appropriate arrangements, to the satisfaction of Council, are be made with the adjoining landowner/s prior to such operations occurring. [3]

26. All existing vegetation on the site is to remain undisturbed.

27. Within 3 months from the date of approval a cultural heritage awareness programme shall be implemented with site employees in conjunction with the National Parks and Wildlife Service to ensure that employees reflect the contingencies that may arise if relics are uncovered and to ensure that employees are skilled in identifying Aboriginal heritage material.

28. Where Aboriginal relics are uncovered during development works, all works in the vicinity are to cease immediately and the National Parks and Wildlife Service is to be contacted to arrange an inspection by a suitably qualified person.

29. This consent is to be read in conjunction with the approval/consent for DA 2004/0609. Any inconsistencies will need to be referred to Council staff for determination.

30. The landowner shall:

1) Development a truck management plan to address the safety of trucks using the Sancrox Road & Pacific Highway intersection prior to completion of the Sancrox interchange. This truck management plan shall address:

a) Define appropriate driving procedures to minimize safety risk associated with accessing the site, including:

i) Left hand (northbound) and right hand (southbound) egress movements from Sancrox Road to Pacific Highway

ii) Appropriate gap acceptance

iii) Staging of peak truck movement periods to occur outside of highway peak flow periods, and

iv) Any other safety concerns determined as time continues

b) Define toolbox procedures and scheduling to ensure driver behaviour is in accordance with the management plan.

2) Obtain approval from Roads and Maritime Services for the installation of *"Trucks (crossing or entering)"* signage (or equivalent) in accordance with the applicable Australian Standards (in particular, AS 1742). The signs shall be installed on the Pacific Highway approaches to the Sancrox Road intersection. All costs shall be the responsibility of the landowner.

The management plan shall be provided to Council as the Road Authority within one (1) month of the date of determination of this consent. The plan shall be implemented, and evidence provided to Council that the RMS requirements for installation of signage have been satisfied, within 3 months of the date of determination, or prior to exceeding the standard

extraction rate of 70, 000 cubic metres, whichever is sooner. [4]

31. The applicant is to enter into and comply with the planning agreement under section 93F of the Environmental Planning and Assessment Act 1979, known as the Sancrox Employment Land & Quarry Planning Agreement between Port Macquarie Hastings Council and James John Dunn and Catherine Brigette Dunn (as trustees for the JJ & CB Dunn Superannuation Fund), Expressway Spares Pty Ltd, Hanson Construction Materials Pty Limited in relation to the carrying out of the development the subject of this consent. [4]

The conditions referred to in this schedule are imposed in conformity with the relevant provisions of the Environmental Planning and Assessment Act and Regulations, the Local Government Act and Regulations, The Building Code of Australia and with Council's Codes and Policies, LEP's, DCP's or any other ancillary Act or Regulation in force at the time of the date of determination and are aimed at protecting the natural environment, preserving our heritage and providing a safe and health built environment.

Rights of Appeal

If you are dissatisfied with this decision a request for a review of the determination may be made to Council, under the provisions of Section 82A of the Environmental Planning and Assessment Act 1979.

If you are dissatisfied with this decision, Section 97 of the Environmental Planning and Assessment Act 1979 gives you the right of appeal to the Land and Environment Court.

Yours sincerely

Clinton Tink
Development Assessment Planner

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Fax: 6581 8788

ABN: 11 236 901 601

PORT MACQUARIE
HASTINGS

4 July 2007

Our ref : DA 2004/609
PN: 18314 , 28897 , 28898

Hopkins Consultants Pty Ltd
PO Box 1556
PORT MACQUARIE NSW 2444

Dear Sir/Madam

Re: DA 2004/609 - Modification of Consent Pursuant to Section 96 (1A) of the Environmental Planning & Assessment Act 1979

I refer to your application dated 27/10/2006 to modify the extension of the quarry under DA 2004/609 at Lot 353 DP 754434, Lot 1 DP 720807, Lot 1 DP 704890 Sancrox Road SANCROX.

Please be advised that pursuant to Section 96 (1A) of the Act, your application to modify the consent has been granted, subject to:

A. Amend original Conditions A (1), A (12) and A (15)
B. Delete original Condition A (9)
C. Add new Condition A (16)

The applicant is advised that Section 96 (6) of the Act confers on an applicant who is dissatisfied with the determination, right of appeal to the Land and Environment Court within 12 months after the date on which you have received this notice.

A revised schedule of development consent conditions is attached.

Yours faithfully

Clinton Tink
Development Assessment Planner

08 Nov 2007 10:21AM HANSON SANCROX# 02 6585 1088 p.2

SCHEDULE OF CONDITIONS ATTACHED TO THIS CONSENT

The conditions of consent referred to in the Notice of Determination for DA No 2004/0609 are as follows:

A - GENERAL MATTERS

(1) (DDA0000101) Except as provided by these conditions of consent, the development shall be carried out in accordance with the approved plans and details submitted to Council, stamped and returned with this consent and as amended on 2 July 2007.

(2) (DDA0000127) Dust nuisance shall not be generated as a result of the undertaking of the development.

(3) (DDA0000176) Wastes including vegetation waste shall not be disposed of by burning.

(4) (DDA0000197) The annual extraction limit of 70,000m^3 shall not be exceeded without Council consent.

(5) (DDA0000198) Internal unsealed roadways, quarry floor and stockpiles are to be watered as required to minimise dust generation impacting on the natural or built environment. A water truck is to be available onsite at all times to enable compliance.

(6) (DDA0000199) No truck carrying extracted or crusher/washed products from the site shall use any public road unless its load is fully covered by a suitable material to prevent spillage or dust falling from the truck. Should any accidental spillage occur from the trucks owned and/or operated by the extraction operator it shall be cleaned up by the operator as soon as practicable.

(7) All vehicles and machinery used must comply with the Environment Protection Authority (EPA) requirements and be fitted with properly maintained emission controls relevant to their date of manufacture.

(8) Approval pursuant to Section 138 of the Roads Act 1993, to carry out works required by the development consent on or within Council's road reserve is to be obtained from Hastings Council. A copy of the approval is to be submitted with the application for construction certificate.

(9) Haulage route from the quarry is to be restricted to Sancrox Road between the quarry entrance and Pacific Highway. Sancrox Road west of the quarry entrance is only to be used as a haulage route for Sancrox and Rawdon island area local deliveries.

(10) Lodgement with Council of a security deposit or bank guarantee in favour of Hastings Council, prior to the issue of the Section 138 certificate the amount to guarantee the satisfactory completion of all infrastructure works associated with developments as required by consent (roadworks/drainage). The bond shall cover the estimated cost plus 30% of public works.

Such bond is to be for limited period of two (2) years and cash securities only, will be for bonds less than $5,000.

(11) The Environmental Management Plan for the quarry shall be amended and updated to cater for the quarry extension. The amended Plan shall be submitted to Council for approval within three (3) months from the date of consent/modification of consent.

(12) (DDPO000551) Landscaped areas being completed prior to work commencing beyond the fault/slip area.

(13) (DDPCC00218) Detailed landscaping plans shall be submitted to Council for approval. Landscaping plans shall be in accordance with Councils adopted AUS-SPEC Development and Construction Guidelines, relevant DCP and Policies. Landscaping plans shall indicate:

- Location of proposed planted shrubs and trees.
- Botanical name of shrubs and trees to be planted.
- Mature height of trees to be planted.
- Location of grassed areas.
- Location of trees identified for retention in the development application plans.

(Note: Special attention should be provided in creating and maintaining boundary vegetation to minimise visual impact).

(14) (DDPCC00226) The proponent shall submit to the Principal Certifying authority for approval engineering plans for the construction of the following road works together with associated stormwater drainage structures, traffic, sediment and erosion control devices that have been designed in accordance with Council's adopted AUS-SPEC Design and Construction Guidelines. The proponent shall be responsible for all costs, including maintenance, for a period of three months from the date of approval of completion of the work. Required road works include:

RURAL SEAL

Rehabilitation of Sancrox Road from the eastern boundary of Lot 3 DP 1000080 (Expressway Spares) to a point 10m west of the access road to Hansons Quarry. Rehabilitation shall include removing the existing seal, reworking the subbase pavement and where necessary adding a minimum 100mm depth of base material (DGB20) to obtain a minimum pavement design of 1×10^6 ESA's prior to resealing the pavement with a minimum two (2) coat, 14/10 bitumen seal. All works to be carried out in accordance with Port Macquarie-Hastings Council AUSPEC Specifications and completed within two (2) years of date of determination of the amended consent.

(15) (DDPCC00246) An Erosion and Sediment Control Management Plan be prepared. The plan shall include measures to:

a) Prevent site vehicles tracking sediment and other pollutants from the development site.

b) Dust control measures.

c) Safety measures for temporary and permanent water bodies including fencing and maximum batter slopes.

d) Contingencies in the event of flooding.

(16) This approval is to be read in conjunction with the approval/consent for DA 1995/193. Any inconsistencies will need to be referred to Council staff for determination.

B - PRIOR TO ANY WORK COMMENCING ON SITE

(1) (DDPW000314) Erosion and sediment controls in accordance with the approved management plan shall be in place prior to the commencement of any works or soil disturbance on the site.

C - DURING WORK

(1) (DDDW000424) Where Aboriginal relics are uncovered during development works, all works in the vicinity are to cease immediately and the National Parks and Wildlife Service is to be contacted to arrange inspection by a suitable qualified person.

(2) (DDDW000455) Stockpiles of topsoil, sand, aggregates, spoil or other material shall be stored clear of any natural drainage path, constructed drainage systems, easement, water bodies, or road surface and located wholly within the site with measures in place to prevent erosion or movement of sediments in accordance with the approved management plan. All spillage of materials, as a result of delivery or handling, must be removed as soon as practicable and placed into suitable receptacles for reclamation or disposal in a manner that does not cause pollution of the environment.

(3) (DDDW000456) Open and piped drains, gutters, roadways and access ways shall be maintained free of sediment for the duration of the work. When necessary, roadways shall be swept and drains and gutters cleaned of sediment build up.

(4) (DDDW000460) The capacity and effectiveness of erosion and sediment control measures shall be maintained at all times in accordance with the approved management plan until such time as the site is made stable by permanent vegetation cover or hard surface.

(5) (DDDW000480) Uncontaminated surface water shall be diverted from the extraction area.

(6) (DDDW000497) Trees are to be inspected for koalas prior to their removal.

D – PRIOR TO extraction commencing from the new area

(1) (DDPO000537) Any necessary alterations to or relocations of public utility services to be carried out at no cost to Council and in accordance with the requirements of the relevant authority including the provision of easements over existing and proposed public infrastructure.

E - OCCUPATION OF THE SITE

(1) (DDOCC00610) All driveways, visitor parking spaces and turning areas shall be kept clear of obstructions at all times.

(2) (DDOCC00614) The development shall be operated in accordance with the Environmental Management Plan as approved by Council.

(3) (DDOCC00618) Materials stockpiles and handling areas shall be maintained in a condition which prevents wind blown or traffic generated dust.

(4) (DDOCC00621) Noise from the development (measured as the L_{Aeq} noise level) shall not exceed the background noise level (measured as the L_{A90} noise level in the absence of the source) by more that 5dB (A) in any Octave Band Centre Frequency, at the boundary of any residence.

(5) (DDOCC00630) Hours of operation of the development are restricted to the following times:

- 7.00 am to 6.00 pm – Mondays to Saturdays
- No work is to be carried out on Sundays and Public Holidays

(6) (DDOCC00697) All loading and unloading in connection with the use must be carried out wholly within the property.

F - ADVICE

(1) (DDADV00732) Pursuant to Section 80A(2) of the Environmental Planning and Assessment Act, 1979, the following works shall not be assessed for the purpose of compliance, or otherwise deemed acceptable, by any person other than Hastings Council:

Stormwater disposal plan/s and works

Plans and works associated with approvals under Section 138 of the Roads Act.

The conditions referred to in this schedule are imposed in conformity with the relevant provisions of the Environmental Planning and Assessment Act and Regulations, the Local Government Act and Regulations, The Building Code of Australia and with Council's Codes and Policies, LEP's, DCP's or any other ancillary Act or Regulation in force at the time of the date of determination and are aimed at protecting the natural environment, preserving our heritage and providing a safe and health built environment.

Rights of Appeal

If you are dissatisfied with this decision a request for a review of the determination may be made to Council, under the provisions of Section 82A of the Environmental Planning and Assessment Act 1979, within 12 months after the date on which you have received this notice.

If you are dissatisfied with this decision, Section 97 of the Environmental Planning and Assessment Act 1979 gives you the right of appeal to the Land and Environment Court within 12 months after the date on which you have received this notice.

Yours faithfully

Clinton Tink
Development Assessment Planner

Port Macquarie-Hastings Council
PO Box 84
Port Macquarie NSW 2444
DX 7415
Email: council@pmhc.nsw.gov.au
Website: www.pmhc.nsw.gov.au
Fax: 6581 8788
ABN: 11 236 901 601

PORT MACQUARIE
HASTINGS

14 June 2007

Our ref : DA 1995/193
PN: 18314 , 28897

Hanson Const Materials Pty Ltd
14 Blackbutt Road
PORT MACQUARIE NSW 2444

Dear Sir/Madam

Re: DA 1995/193 - Modification of Consent Pursuant to Section 96 (1A) of the Environmental Planning & Assessment Act 1979

I refer to your application dated 05/06/2007 to modify condition of consent relating to operating hours under DA 1995/193 at Lot 353 DP 754434 and Lot 1 DP 720807 Sancrox Road SANCROX.

Please be advised that pursuant to Section 96 (1A) of the Act, your application to modify the consent has been granted, subject to:

A. Amend Conditions 5 and 20.
B. Add additional Condition 28 – Advice.

The applicant is advised that Section 96 (6) of the Act confers on an applicant who is dissatisfied with the determination, right of appeal to the Land and Environment Court within 12 months after the date on which you have received this notice.

A revised schedule of development consent conditions is attached.

Yours faithfully

Clinton Tink
Development Control Planner

13 Nov 2007 8:29AM HANSON SANCROX# 02 6585 1088 p.2

SCHEDULE OF CONDITIONS ATTACHED TO THIS CONSENT

The conditions of consent referred to in the Notice of Determination for DA No 1995/0193 are as follows:

1. The development being completed substantially in accordance with the application and approved plan, except where varied by conditions of this consent and as modified on 14 June 2007.
2. Extraction must not exceed 70,000 cubic metres in any twelve month period.
3. Extraction to take place in accordance with Plan Reference No. 1045/CTK51, 1045/CTK521 and 1045/CTK53 contained within the Statement of Environmental Effects.
4. A plan of survey be lodged within three months from the date of this consent to confirm the maximum area of extraction as shown on Plan Ref No. 1045/CTK53.
5. Hours of operation for the development are to be as follows:
   - 7.00am to 5.00pm Monday to Friday
   - 7.00am to 1.00pm Saturday
   - No work is to be carried out on Sundays

   The exception to the above is that the quarry will be permitted to operate until 12.00 midnight for two (2) days during the period of 18 June 2007 to 29 June 2007. Adjoining property owners are to be notified of the extended hours prior to each extended hours event occurring. The extended hours are approved as a one-off with any future requests requiring detailed assessment. The extended hours are to be used as a trial and it is recommended that noise monitoring occur for inclusion in any future applications.
6. A separate development application will be required for any future use of the processing and stockpiling area when the resource becomes exhausted. Further use of this processing plant for material other than that emanating from the onsite pits will require a separate development application.
7. Submission of engineering plans and specifications based on Australian Height Datum to the satisfaction of the Director, Development and environment for:
   A. Construction of a Type A intersection with Sancrox Road and the access road at no cost to Council including:
      i. Reconstruction of the existing pavement, if required, to provide uniform cross falls.
      ii. Bitumen sealing of all pavement widening and tapers to provide uniform skid resistance.
      iii. Bitumen sealing of the access road from Sancrox Road for a distance of 50 metres.
      iv. All necessary surface and subsoil drains.
      v. Provision of traffic signs.
      vi. Provision of all line marking.

13 Nov 2007 8:29AM HANSON SANCROX# 02 6585 1088 p.3

Construction of the above work to the satisfaction of Director of Development and Environment.

8. Compliance with the requirements of NorthPower regarding provision of electricity to serve the development.

9. Any necessary alterations to or relocations of public utility services to be carried out at no cost to Council.

10. All engineering works on Public property or involving extension or modification to public utilities under Council's control are to be carried out in accordance with plans and specifications approved by, under the supervision of and to the satisfaction of the Director Development and Environment.

11. Provision of a security deposit or bank guarantee, prior to release of approved building plans, to cover the estimated cost plus 30% of all engineering works required on public property as assessed by the Director Development and Environment prior to the release of any subsequent building approval, plus a written agreement undertaking to carry out the works required prior to commencement of occupation of the building together with an authorisation for Council to use the funds to complete any unfinished works. Such bond is to be for limited period of two (2) years and cash securities only will be for bonds less than $1,000.

12. A. An Environmental Management and Rehabilitation Plan is to be submitted to and approved by Council within six (6) months of the date of consent. Such management plan shall be prepared in consultation with Hastings Council and all relevant statutory authorities and is to be subject to periodic review and revision as specified in the plan itself.

    B. The review and revision process specified in the Environmental Management and Rehabilitation Plan shall result in the production of an environmental audit for the development site. Such an audit shall overview the performance of the quarry in respects of the Statement of environmental Effects, management plan and the relevant environmental statutory provisions.

13. The Environmental Management Plan referred to in condition No. 12 shall include the re-spreading of topsoil together with any logs, brush and rocks to facilitate natural regeneration and improve habitat value. Tree species from local seed stock should be planted to supplement natural regeneration and should be planted in clumps. Areas of regeneration shall be fenced to avoid grazing of seedlings. Details to be included in the rehabilitation plan.

14. Further to condition No. 12 relating to rehabilitation this plan shall include immediate commencement of plantings along the northern and eastern boundaries to provide visual screening from adjoining properties.

15. A. The Environmental Management and Rehabilitation Plan is to provide specific details with respect to all monitoring activities associated with ponded water in the quarry pits and the potential for groundwater contamination. In the event that adverse impacts become apparent, work is to cease pending further impact assessment and the adoption of a Council approved contingency plan.

    B. The Environmental Management and Rehabilitation Plan shall detail a reporting protocol and format such that all data generated is correctly documented, analysed and submitted to Hastings Council and other relevant Statutory Authorities on a

regular basis.

16. The site manager is to be responsible for the implementation of the Environmental Management and Rehabilitation Plan and all monitoring activities carried out on site.

17. The Environmental Management and Rehabilitation Plan should include measures as outlined in the Statement of Environmental Effects to maintain air quality and minimize the likelihood of air pollution.

18. The Environmental Management and Rehabilitation Plan should include measures as outlined in the Environmental Impact Statement to maintain water quality leaving the site.

19. Noise generated from the quarrying operations is not to exceed the acceptable noise limits specified in the Noise Impact Assessment (Report No. 95.993.A1). Measures to ensure such are to be detailed in the Environmental Management and Rehabilitation Plan.

20. Approval is to be obtained in writing from the EPA with respect to all pollution control works. Copies of all approvals and licenses shall be submitted to Council, including any changes to cover modification.

21. Sludge from the settling ponds is to be removed and combined with soil for rehabilitation purposes.

22. Fuel storage areas are to be bunded to 110% of the storage capacity and runoff is to be treated in an appropriate oil separator before being drained to the sedimentation ponds. These storage facilities are to be constructed in accordance with the relevant Australian Standard.

23. Stored liquids, quarry floor refueling areas and machinery maintenance/repair areas are to be bunded to contain spilt chemicals and lubricants.

24. Blasting is restricted to between the hours of 9.00am to 3.00pm Monday to Saturday with a maximum instantaneous charge of 37kg. Blasting carried out within 375 metres of the southern residence is to be restricted to a maximum instantaneous charge of 15kg.

25. All existing vegetation on the site is to remain undisturbed.

26. Within 3 months from the date of approval a cultural heritage awareness programme shall be implemented with site employees in conjunction with the National Parks and Wildlife Service to ensure that employees reflect the contingencies that may arise if relics are uncovered and to ensure that employees are skilled in identifying Aboriginal heritage material.

27. Where Aboriginal relics are uncovered during development works, all works in the vicinity are to cease immediately and the National Parks and Wildlife Service is to be contacted to arrange an inspection by a suitably qualified person.

28. Advice:

    It is advised that noise monitoring occur during the extended hours approved for the period between 18 June 2007 and 29 June 2007 for use in any future application/modification.

The conditions referred to in this schedule are imposed in conformity with the relevant provisions of the Environmental Planning and Assessment Act and Regulations, the Local Government Act and Regulations, The Building Code of Australia and with Council's Codes and Policies, LEP's, DCP's or any other ancillary Act or Regulation in force at the time of the date of determination and are aimed at protecting the natural environment, preserving our heritage and providing a safe and health built environment.

Rights of Appeal

If you are dissatisfied with this decision a request for a review of the determination may be made to Council, under the provisions of Section 82A of the Environmental Planning and Assessment Act 1979, within 12 months after the date on which you have received this notice.

If you are dissatisfied with this decision, Section 97 of the Environmental Planning and Assessment Act 1979 gives you the right of appeal to the Land and Environment Court within 12 months after the date on which you have received this notice.

Yours faithfully

Clinton Tink
Development Control Planner

Consent

6581 8788

13 December 2006

Our ref: DA 2006/497
PN: 18314 , 28897, 28898

Planning Workshop Australia
GPO Box 3275
SYDNEY NSW 2001

Dear Sir/Madam

Notice to applicant of determination of a development application under Section 81(1) (a) of the Environmental Planning and Assessment Act 1979 and Section 99 of the Local Government Act 1993

Subject Development	Install & Operate a Temporary Asphalt Plant
Property Description	DP 754434 Lot 353, DP 704890 Lot 1, DP 720807 Lot 1, Sancrox Road SANCROX
Applicant	Planning Workshop Australia
Owner	Pioneer Concrete (Qld) Pty Ltd (aka Hanson Construction Materials Pty Ltd)

Notice is hereby given of the determination by the consent authority of your development application by granting of consent subject to the conditions detailed on the schedule attached to this notice.

Approvals under the Local Government Act, 1993

Local Government Act 1993 approvals granted under Section 78A of the Environmental Planning & Assessment Act 1979 are as follows:

nil

Notes to this consent

1. The date of determination is 11 December 2006.
2. The date from which this consent operates is 13 December 2006 and will lapse unless building, engineering or construction work or a use related to this consent is physically commenced within five (5) years of this date.
3. The period for which this consent can operate may be limited by conditions of this consent.

Yours faithfully

Clinton Tink
Development Control Planner

SCHEDULE OF CONDITIONS ATTACHED TO THIS CONSENT

The conditions of consent referred to in the Notice of Determination for DA No 2006/497 are as follows:

A - GENERAL MATTERS

(1) (DA001) Except as provided by these conditions of consent, the development shall be carried out in accordance with the approved plans and details submitted to Council, stamped and returned with this consent.

(2) (DA002) No work shall commence until a Construction Certificate has been issued and the applicant has notified Council of:

- the appointment of a Principal Certifying Authority; and
- the date on which work will commence.

Such notice shall include details of the Principal Certifying Authority and must be submitted to Council at least two (2) days before work commences.

(3) (DA003) All building work must comply with the provisions of the Building Code of Australia (BCA).

(4) (DA016) The general terms of approval from the Department of Natural Resources are set out in the schedule attached to this consent and form part of the consent conditions for this approval.

(5) (DA057) Any interruption to the natural overland flow of stormwater drainage, which could result in the disruption of the amenity, or drainage or deterioration to any other property is not permitted.

(6) (DA082) Dust nuisance shall not be generated as a result of the undertaking of the development.

(7) (DA083) Wastes including vegetation shall not be disposed of by burning.

(8) (DA097) The demolition of any existing structure shall be carried out in accordance with Australian Standard AS 2601-1991: *The Demolition of Structures*. No demolition materials shall be burnt or buried on site. The person responsible for the demolition works shall ensure that all vehicles leaving the site carrying demolition materials have their loads covered and do not track soil or waste materials onto the road. Should the demolition works obstruct or inconvenience pedestrian or vehicular traffic on an adjoining public road or reserve, separate application shall be made to Council to enclose the public place with a hoarding fence.

Should asbestos be present, its removal shall be carried out in accordance with the National OH&S Committee – Code of Practice for Safe Removal of Asbestos and its Code of Practice for the Management and Control of Asbestos in the Workplace.

(9) (DA099) The proponent shall provide electricity and telecommunication services in accordance with the requirements of the relevant authority.

(10) Operation of the temporary Sewage Management Facility must:

- Comply with the recommendations of Martens Consultants Report (contained within the SoEE).

- Provide adequate access for removal of waste.
- Ensure that the effluent holding chamber be pumped out immediately when there is evidence that the facility is approaching a level where surcharge into the environment is likely.
- Ensure removal of generated waste is undertaken by a licensed contractor (copies of receipts are required to be provided to Council).
- Make certain all waste removed is disposed of to a recognised waste treatment facility (copies of receipts are required to be provided to Council).

(11) All facilities used in the operation of the Sewage Management Facility must be maintained in a sanitary condition and must be operated in accordance with the requirements of the Local Government (General) Regulation, 2005.

(12) The owner/occupier is to ensure that the operation of the Sewage Management Facility meets the performance standards of Division 7 of the Local Government (General) Regulation, 2005. The standards relate to prevention of the spread of disease, foul odours, contamination of water, degradation of soil and vegetation, discouragement of insects and vermin, ensuring persons do not come in contact with sewage or effluent (whether treated or not) and minimisation of adverse impacts on the amenity of the premises and adjoining land.

(13) In the event that the operation of the Sewage Management Facility fails to meet the performance requirements, Council reserves the right to require the installation of another approved system or facility.

(14) Works must not result in any erosion or degradation of both soils and waterways on-site.

(15) On site car parking to be provided for use by both staff and patrons of the development. Five (5) car spaces and six (6) truck parking/waiting areas are required onsite as part of this consent, as per the approved plans/documentation included with the application. The parking spaces need to comply with the dimensional requirements of Development Control Plan No. 18 – *Off Street Parking Code* and will need to be installed onsite prior to the release of the occupation certificate and maintained at all times.

(16) The asphalt plant shall cease operation upon cessation of two (2) years from the date of the release of the occupation certificate, unless separate approval has been granted to extend the life of the proposal.

(17) The application is to comply with the recommendations listed in the ecological report prepared by Darkheart Eco-Consultancy dated Monday 27 February 2006. Council's Tree Preservation Officer is to be contacted prior to any tree clearing occurring to ensure the recommendations pertaining to tree removal have/will be complied with.

(18) This consent will become null and void if an approval/permit is required under the Native Vegetation Act and is subsequently not granted by the Catchment Management Authority. Therefore, prior to the commencement of any clearing, the Catchment Management Authority is to be contacted to ascertain whether or not a separate approval/permit is required under the Native Vegetation Act.

B - PRIOR TO ISSUE OF A CONSTRUCTION CERTIFICATE

(1) (DB004) Submission to the Principal Certifying Authority prior to the issue of a Construction Certificate detailed design plans for the following works associated with the developments;

1. Earthworks, including filling of the land for flood protection in accordance with;
    a. AUSPEC Design Specification D6, Port Macquarie-Hastings Council current version.
2. Public parking areas including;
    - Driveways and access aisles;
    - Parking bays;
    - Delivery vehicle service bays & turning areas

    in accordance with AS2890.1 - 2001.
3. Stormwater systems in accordance with;
    a. AUSPEC Design Specification D5, Port Macquarie-Hastings Council current version.
4. Erosion & Sedimentation controls in accordance with AUSPEC D7, Port Macquarie-Hastings Council current version.
5. Location of all existing utility services including;
    - Conduits for electricity supply and communication services.
    - Water supply
    - Sewerage
    - Stormwater

An application and checking fee in accordance with Council's Management Plan shall be payable upon submission of engineering design plans.

(2) (DB036) Driveways, access aisles and parking areas shall be provided with a bitumen sealed surface. Such a surface shall be on a suitable pavement, constructed and maintained in accordance with Council's Development, Design and Construction Manuals (as amended).

(3) A vegetation management plan shall be submitted and approved by Council prior to the release of the construction certificate. The plan shall outline, but not be limited to the following:

- Details of plantings of endemic species to provide compensation for the loss of potential habitat on-site through the clearing. The replanting will need to be done upon cessation of the plant.
- Identification and flagging of all senescent/significant trees and areas of vegetation to be preserved on the site.
- Process for removing and disposing of felled trees and vegetation.
- Process of protecting trees to be retained during clearing works.

The plan is to be consistent with/incorporate the recommendations of the ecological report prepared by Darkheart Eco-Consultancy, dated 27 February 2006. In addition, the vegetation management plan (once approved by Council) will form part of this consent and is to be complied with at all times.

C - PRIOR TO ANY WORK COMMENCING ON SITE

(1) (DC006) Erosion and sediment controls in accordance with the approved management plan shall be in place prior to the commencement of any works or soil disturbance on the site.

(2) (DC027) Prior to the any works commencing on the site a Demolition Waste Management Plan shall be prepared and submitted to Council. Such plan is to detail the nature and volume of all demolition wastes and shall detail the methods disposal of wastes. No work shall commence on the site until the management plan has been approved by Port Macquarie-Hastings Council.

D - DURING WORK

(1) (DD006) The capacity and effectiveness of erosion and sediment control measures shall be maintained at all times in accordance with the approved management plan until such time as the site is made stable by permanent vegetation cover or hard surface.

(2) (DD028) Building equipment and/or materials shall be contained wholly within the site and shall not be stored or operated on the footpath or roadway, unless specific written approval has been obtained from Council beforehand.

(3) (DD036) The site shall be left free of wastes and debris following completion of the demolition work.

(4) (DD037) Dust or airborne particles shall not be allowed to escape from the site. The use of fine mesh dust proof screens, fine water sprays or other approved methods are required.

(5) (DD038) In buildings constructed prior to 1970, all existing accumulations of dust (eg in ceiling voids, wall cavities, walls, floors etc) shall be removed by the use of an industrial vacuum fitted with a high efficiency particulate air filter.

(6) (DD039) Demolition works performed on buildings with materials containing asbestos or lead shall be carried out strictly in accordance with the requirements of the Workcover Authority and National OH&S Committee – *Code of Practice for the Safe Removal of Asbestos* and *Code of Practice for the Management and Control of Asbestos in Workplaces.*

(7) (DD040) All asbestos and lead wastes shall be sealed and disposed of in labelled plastic wrapping or bags at Council's Waste Management Facility in accordance with the directions of the Facility Manager. Arrangements are to be made with Council's Services Division prior to disposal.

(8) (DD041) All demolition waste is to be disposed of at the Council Waste Management Facility.

At the completion of demolition activities, Waste Management Centre weighbridge dockets are to be provided to Port Macquarie-Hastings Council to demonstrate compliance with this condition.

(9) (DD045) Should any Aboriginal objects be discovered in any areas of the site then all excavation or disturbance to the area is to stop immediately and the National Parks and Wildlife Service, Department of Environment and conservation is to be informed in accordance with Section 91 of the *National Parks and Wildlife Act 1974.* Subject to an assessment of the extent, integrity and significance of any

exposed objects, applications under either Section 87 or Section 90 of the *National Parks and Wildlife Act 1974* may be required before work resumes.

(10) (DD047) Stockpiles of topsoil, sand, aggregates, spoil or other material shall be stored clear of any natural drainage path, constructed drainage systems, easement, water bodies, or road surface and located wholly within the site with measures in place to prevent erosion or movement of sediments in accordance with the approved management plan. All spillage of materials, as a result of delivery or handling, must be removed as soon as practicable and placed into suitable receptacles for reclamation or disposal in a manner that does not cause pollution of the environment.

(11) (DD048) Open and piped drains, gutters, roadways and access ways shall be maintained free of sediment for the duration of the work. When necessary, roadways shall be swept and drains and gutters cleaned of sediment build up.

E - PRIOR TO THE ISSUE OF OCCUPATION OR SUBDIVISION CERTIFICATE

(1) (DE001) The building/use shall not be occupied or used in whole or in part until an Occupation Certificate has been issued by the Principal Certifying Authority.

(2) (DE043) A Professional Civil Engineer/Registered Surveyor is required to furnish a Compliance Certificate to the Principal Certifying Authority confirming:

a. all drainage lines have been located within the respective easements, and

b. any other drainage structures are located in accordance with the Construction Certificate.

c. all stormwater has been directed to a Council approved drainage system

d. all conditions of consent/ construction certificate approval have been complied with.

e. any on site detention system (if applicable) will function hydraulically in accordance with the approved construction certificate.

(3) (DE044) Each onsite detention system is to be marked by a plate in a prominent position which states:

"This is an onsite detention system. It is an offence to reduce the volume of the tank or basin or interfere with any part of the structure that controls the outflow".

This plate is to be fixed into position prior to the issue of the occupation or subdivision certificate.

(4) (DE072) Any necessary alterations to, or relocations of, public utility services to be carried out at no cost to Council and in accordance with the requirements of the relevant authority including the provision of easements over existing and proposed public infrastructure. Any alterations to or relocation of street lighting to be approved in writing from Port Macquarie-Hastings Council.

(5) (DE073) Ancillary works shall be undertaken at no cost to Council to make the engineering works required by this Consent effective to the satisfaction of Director of Council's Infrastructure Division. Such works shall include, but are not limited to the following:

a. The relocation of underground services where required by civil works being carried out.

b. The relocation of above ground power and telephone services

c. The relocation of street lighting

d. The matching of new infrastructure into existing or future design infrastructure

(6) (DE195) The stormwater pollution controls measures specified in the Water Cycle Management Plan prepared by Martens Consulting Engineers dated July 2006 shall be constructed prior to the issue of the Occupation Certificate.

F - OCCUPATION OF THE SITE

(1) (DF003) All driveways, visitor parking spaces and turning areas shall be kept clear of obstructions at all times.

(2) (DF016) The development shall be operated in accordance with the Environmental Management Plan referred to as Planning Workshop Australia and dated August 2006 as approved by Council.

(3) (DF018) Offensive odours shall not be generated by the development, including the process of processing of asphalt.

(4) (DF019) Materials stockpiles and handling areas shall be maintained in a condition that prevents wind blown or traffic generated dust.

(5) (DF022) Noise from the development (measured as the L_{AeqT} noise level) shall not exceed the background noise level (measured as the L_{A90} noise level in the absence of the source) by more that 5 dB(A) in any Octave Band Centre Frequency, at the boundary of any residence.

(6) (DF023) The development is to be conducted in accordance with the noise impact statement prepared by Hunter Acoustics and dated 27 July 2006.

(7) (DF026) All solid waste generated by the development which cannot be reused or recycled, shall be disposed of at Council's waste management facilities.

(8) (DF027) Wastes awaiting collection and disposal shall be stored in a manner that prevents pollution. All liquid wastes shall be stored in a roofed and bunded area. The bund shall be capable of containing 110% of the capacity of the largest container stored, or 25% of the total storage volume, whichever is greatest.

(9) (DF029) Spills and contaminated runoff from the asphalt plant area where necessary should be prevented from entering the stormwater system. In this regard, adequate spill containment equipment should be maintained on site at all times.

(10) (DF030) Offensive noise shall not be generated as a result of the operation of the development.

(11) (DF195) All loading and unloading in connection with the use must be carried out wholly within the property.

(12) (DF196) Any proposed garbage areas are to be screened from the street.

(13) (DF197) The development shall be operated in accordance with the Water Cycle Management Plan prepared by Martens Consulting Engineers dated July 2006.

(14) (DF198) The applicant shall submit to Council a report, within one month of the plant commissioning, prepared by a suitably qualified acoustical consultant, certifying that the operational noise levels of the development comply with the development consent and the Acoustic Assessment prepared by Hunter Acoustics

dated 27 July 2006. Where the development fails to comply with the Acoustic Assessment, the applicant shall submit a further report for approval to implement further noise mitigation measures. Such measures must be installed and assessed as soon as practicable.

(15) The applicant shall submit to Council a report, within one month of the plant commissioning, prepared by a suitably qualified consultant, certifying that the wet scrubber system is functioning effectively.

Should the wet scrubber system fail/stop, the overall asphalt plant is also to cease operation until the wet scrubber system is fixed.

(16) The applicant shall submit annual reports on production levels to Council.

(17) The applicant shall submit to Council a report, within one month of the plant de-commissioning, prepared by a suitably qualified contaminated site consultant, certifying that the soil has not been contaminated and rendered unsuitable for its current use. Where the report indicates that remediation is required, such remediation shall be undertaken as soon as practicable and a further report shall be submitted to Council following completion of the remediation works.

G - ADVICE

(1) Separate development consent will be required to erect any advertising sign onsite or change the use of the buildings, unless considered exempt development by Council.

(2) This approval does not apply any restriction on the hours of operation.

(3) Further approval will be required to produce more than 30,000 tonnes per year or 150 tonnes per day of asphalt material.

The conditions referred to in this schedule are imposed in conformity with the relevant provisions of the Environmental Planning and Assessment Act and Regulations, the Local Government Act and Regulations, The Building Code of Australia and with Council's Codes and Policies, LEP's, DCP's or any other ancillary Act or Regulation in force at the time of the date of determination and are aimed at protecting the natural environment, preserving our heritage and providing a safe and health built environment.

Rights of Appeal

If you are dissatisfied with this decision a request for a review of the determination may be made to Council, under the provisions of Section 82A of the Environmental Planning and Assessment Act 1979, within 12 months after the date on which you have received this notice.

If you are dissatisfied with this decision, Section 97 of the Environmental Planning and Assessment Act 1979 gives you the right of appeal to the Land and Environment Court within 12 months after the date on which you have received this notice.

Yours faithfully

Clinton Tink
Development Control Planner

Annex B

Consultation

Environmental Resources Management Australia Pty Ltd

Level 15, 309 Kent Street
Sydney NSW 2000
AUSTRALIA

Locked Bag 3012
Australia Square NSW 1215
AUSTRALIA

Telephone +61 2 8584 8888
Facsimile +61 2 9299 7502

www.erm.com

14 February, 2018

Mr Clinton Tink
Development Assessment Planner
Port Macquarie Hastings Council
PO Box 84
Port Macquarie NSW 2444

Our Reference: 0418291_Sancrox Quarry EIS

Attention: Mr Clinton Tink

Dear Clinton

RE: SANCROX QUARRY EXPANSION PROJECT (SSD 15_7293) EIS CONSULTATION

Environmental Resources Management Australia (ERM) has been engaged by Hanson Construction Materials Pty Ltd (Hanson) to prepare an Environmental Impact Statement (EIS) for the proposed expansion of the Sancrox Quarry, near Port Macquarie, NSW. The purpose of this letter is to inform Port Macquarie Hastings Council that the EIS process for the Project is underway and provide the opportunity for additional comments to be provided.

Sancrox Quarry has been owned and operated by Hanson since 1998 and is located 8 kilometres (km) west of Port Macquarie, within the Port Macquarie Hastings Council local government area (*Figure 1*). The site compromises Lot 1 DP 704890, Lot 1 DP 720807, Lot 2 DP 574308 and Lot 353 DP 754434. The site also includes Crown lands enclosure permit 49229.

Hanson currently has ownership of approximately 145ha, of which approximately 11.6ha is currently used in the extraction, processing and storage of aggregates. The Sancrox Quarry Expansion Project will involve:

- extending the life of the quarry from the current 20 years to 30 years and expanding the area of extraction to the west of the existing pit;
- increasing the maximum annual rate of extraction from 455,000 tpa to 750,000 tpa;
- upgrading and relocating existing infrastructure (including processing plant, offices, weighbridge and workshop); and
- constructing a concrete batching plant and recycling facility, asphalt production plant and pug mill on site.

Environmental Resources Management Australia Pty Ltd
A.C.N. 002 773 248
A.B.N. 12 002 773 248

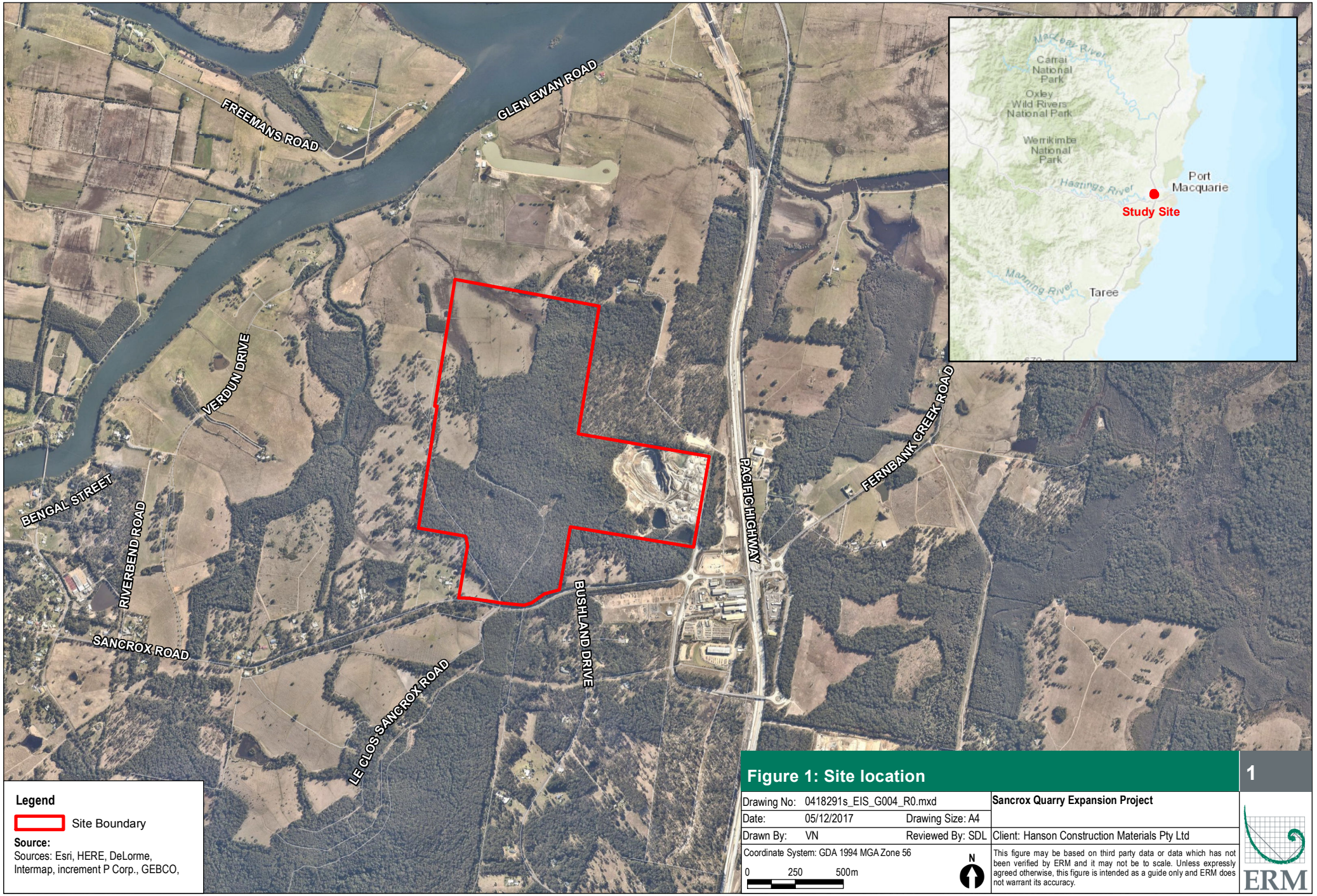
Offices worldwide

The Secretary's Environmental Assessment Requirements (SEARs) for the Project were re-issued on 18 September 2017 (refer to Attachment). We understand that Port Macquarie Hastings Council were consulted by the NSW Department of Planning and Environment (DP&E) in the preparation of the SEARs. The EIS will be prepared in accordance with the SEARs and ERM has no questions or concerns relating to your area of environmental expertise. The EIS is scheduled to be on Public Exhibition around mid-2018.

Should you wish to provide any additional comments, written submissions can be made within 21 days of the date on this letter, and should be forwarded to matthew.errington@erm.com or Matthew Errington, ERM, Locked Bag 3012, Australia Square NSW 1215.

Yours sincerely,

Paul Douglass, Partner
for Environmental Resources Management Australia Pty Ltd


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
MacLeay River
Carrai National Park
Oxley Wild Rivers National Park
Werrikimba National Park
Hastings River
Port Macquarie
Study Site
Manning River
Taree
Legend
Site Boundary
Source:
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO,
Figure 1: Site location
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Drawing No: 0418291s_EIS_G004_R0.mxd
Sancrox Quarry Expansion Project
Date: 05/12/2017
Drawing Size: A4
Drawn By: VN
Reviewed By: SDL
Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

Planning Services
Resource Assessments
Contact: Anthony Barnes
Phone: 8289 6709
Email: anthony.barnes@planning.nsw.gov.au

Matt Errington
Principal Environmental Consultant
Environmental Resources Management Australia
Locked Bag 3012 Australia Square
NSW 1215

Dear Mr Errington

Reissue of State Significant Development - Secretary's Requirements
Sancrox Quarry Extension Project (SSD 7293)

I have enclosed updated Secretary's requirements for the preparation of an Environmental Impact Statement (EIS) for the Sancrox Quarry Extension Project which replace the Secretary's requirements issued on 19 October 2015.

These requirements are based on the information you have previously provided, and reflect previous consultation with relevant government agencies.

Your attention is drawn to the environmental planning instruments (EPI), policies and guidelines to be addressed in your EIS (see Attachment 1). Please note that where these EPIs, guidelines and policies have changed or been updated, your EIS will need to address the latest available version.

The agencies' previous comments are attached for your information (see Attachment 2). You must have regard to these comments in the preparation of the EIS.

Please note that the Department may alter these requirements at any time, and that you must consult further with the Department if you do not lodge a development application and EIS for the project within the next two years.

You should establish whether the proposal requires a separate approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as soon as possible. If such an approval is required, please notify the Department immediately, as the Commonwealth approval process is likely to be integrated with the NSW approval process (under the bilateral agreement), and supplementary requirements will need to be issued.

Please contact the Department at least two weeks before you plan to submit the development application and EIS for the project. This will enable the Department to:

- confirm the applicable fee (see Division 1AA, Part 15 of the *Environmental Planning and Assessment Regulation 2000*); and
- determine the required number of copies of the EIS (hard copy and digital).

It is important for you to recognise that the Department will review the EIS for the project carefully before putting it on public exhibition. If it fails to adequately address these requirements, then you will be required to submit an amended EIS.

If you have any enquiries about these requirements, please contact Anthony Barnes on the details listed above.

Yours sincerely

Howard Reed

Howard Reed 18.9.17
Director
Resource Assessments
as the Secretary's delegate

Secretary's Environmental Assessment Requirements

State Significant Development

Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*
Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*

Application Number	SSD 7293
Proposal	The Sancrox Quarry Extension Project, which involves: • extending the approved extraction boundary by approximately 52 hectares, • extending the quarry life by ten years (from 20 to 30 years), • increasing the production limit from 455,000 tonnes per annum (tpa) to 750,000 tpa, • constructing and operating a concrete batching plant producing 20,000m^3 per annum (p/a), • constructing and operating a concrete recycling facility processing 20,000 tonnes p/a, • increasing truck movements and equipment loading from 7am–11pm weekdays, and 7am–1pm weekends and public holidays to 24 hours per day 7 days per week, • increasing quarry operations from 7am–5pm weekdays, and 7am–1pm Saturday to 24 hours per day 7 days per week, • transporting material off-site via public roads; and • Constructing and operating an asphalt plant producing 50,000 tonnes per annum.
Location	Sancrox Road Sancrox, Lot 2 DP 574308 Lot 353 DP 754434 Lot 1 DP 704890 Lot 1 DP 720807
Applicant	Hanson Construction Materials Pty Ltd (Hanson)
Date of Issue	18 September 2017
General Requirements	The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.* In particular, the EIS must include: • a stand-alone executive summary; • a full description of the development, including: – the resource to be extracted, including the amount, type and composition; – the site layout and extraction plan, including cross-sectional plans; – the production process and processing activities, including the in-flow and out-flow of materials and points of discharge to the environment; – surface infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate approvals process); – a waste (overburden, rejects, tailings etc) management strategy; – a water management strategy; – a rehabilitation strategy to apply during, and after completion of, extraction operations, and proposed final use of site; and – the likely interactions between the development and any existing, approved or proposed development in the vicinity of the site; • a strategic justification of the development focusing on site selection and the suitability of the proposed site; • a list of any approvals that must be obtained before the development may

	commence; • an assessment of the likely impacts of the development on the environment, focussing on the key issues identified below, including: – a description of the existing environment likely to be affected by the development, using sufficient baseline data; – an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice; – a description of the measures that would be implemented to avoid, minimise, mitigate and/or offset the likely impacts of the development, and an assessment of: o whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; o the likely effectiveness of these measures; and o whether contingency measures would be necessary to manage any residual risks; and – a description of the measures that would be implemented to monitor and report on the environmental performance of the development; • a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; • consideration of the development against all relevant environmental planning instruments (including Part 3 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007)*; • the reasons why the development should be approved, having regard to: - relevant matters for consideration under the *Environmental Planning and Assessment Act 1979*, including the objects of the Act; - the biophysical, economic and social impacts of the project, including the principles of ecologically sustainable development; - the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses; - feasible alternatives to the development (and its key components), including the consequences of not carrying out the development; • a signed declaration from the author of the EIS, certifying that the information contained within the document is neither false nor misleading. While not exhaustive, Attachment 1 contains a list of some of the environmental planning instruments, guidelines, policies, and plans that may be relevant to the environmental assessment of this development. In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*, the development application must be accompanied by a signed report from a suitably qualified expert that includes an accurate estimate of the capital investment value (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the development, including details of all the assumptions and components from which the capital investment value calculation is derived.
Key Issues	The EIS must address the following key issues: • **Noise & Blasting** – including: - a detailed assessment of the likely construction, operational and off-site transport noise impacts of the development in accordance with the *Interim Construction Noise Guideline*, *NSW Industrial Noise Policy* and the *NSW Road Noise Policy* respectively, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - if a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the *Interim Construction Noise Guideline*; - proposed blasting hours, frequency and methods; - a detailed assessment of the likely blasting impacts of the development (including noise, vibrations, overpressure, visual and odour) on people,

	animals, buildings, infrastructure and significant natural features, having regard to the relevant ANZEC guidelines; - reasonable and feasible mitigation measures to minimise noise emissions; and - monitoring and management measures, in particular real-time and attended noise monitoring; • **Air Quality** – including: - a detailed assessment of potential construction and operational impacts, in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW,* and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - an assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products; - reasonable and feasible mitigation measures to minimise dust and emissions; and - monitoring and management measures, in particular, real-time air quality monitoring; • **Water** – including: - a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures; - identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*; - demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP); - a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo; - an assessment of any likely flooding impacts of the development; - an assessment of the likely impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives; - an assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users; and - a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts; • **Biodiversity** – including: - accurate predictions of any vegetation clearing on site; - a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, and having regard to the *NSW Biodiversity Offsets Policy for Major Projects* and the *Framework for Biodiversity Assessment*; and - a strategy to offset any residual impacts of the development in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*, including evidence that the appropriate type and quantum of offsets will be available; • **Heritage** – including: - an assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including evidence of appropriate consultation with relevant Aboriginal communities/parties and documentation of the views of these stakeholders regarding the likely impact of the development on their cultural heritage; and - identification of historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items, having regard to the relevant policies and guidelines listed in

	Attachment 1; • **Traffic & Transport** – including: - accurate predictions of the road traffic generated by the construction and operation of the development, including a description of the types of vehicles likely to be used for transportation of quarry products; - a detailed assessment of potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road network (as identified above), including a road safety audit; and - a description of the measures that would be implemented to mitigate any impacts, including concept plans of any proposed upgrades, developed in consultation with the relevant road and rail authorities (if required); • **Land Resources** – including a detailed assessment of: - potential impacts on soils and land capability (including potential erosion and land contamination) and the proposed mitigation, management and remedial measures (as appropriate); - potential impacts on landforms (topography), paying particular attention to the long term geotechnical stability of any new landforms (such as overburden dumps, bunds etc); and - the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements in Clause 12 of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries)* 2007, paying particular attention to the agricultural land use in the region; • **Waste –** including estimates of the quantity and nature of the waste streams that would be generated or received by the development and any measures that would be implemented to minimise, manage or dispose of these waste streams; • **Hazards –** including an assessment of the likely risks to public safety, paying particular attention to the transport, handling and use of any hazardous or dangerous goods; • **Visual** – including a detailed assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, paying particular attention to any new landforms, and to minimising the lighting impacts of the development; • **Social & Economic** – including: - a detailed assessment of the likely social impacts of the development on the local and regional community in accordance with the *Social impact assessment guideline for State significant mining, petroleum production and extractive industry development*; and - a detailed assessment of the likely economic impacts of the development, paying particular attention to: o the significance of the resource; o the costs and benefits of the project; identifying whether the development as a whole would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates; and o the demand for the provision of local infrastructure and services; and • **Rehabilitation** – including the proposed rehabilitation strategy for the site having regard to the key principles in the *Strategic Framework for Mine Closure*, including: - rehabilitation objectives, progressive rehabilitation commitments, methodology, monitoring programs, performance standards and proposed completion criteria; - nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and - the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.
Consultation	During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities, service providers, Aboriginal stakeholders, community groups and affected landowners. You must:

	• consult with: - affected landowners; - community groups; - Port Macquarie-Hastings Council; - Office of Environment and Heritage (including the Heritage Branch); - Environment Protection Authority; - Division of Resources and Geoscience within the Department; - Department of Primary Industries (including the DPI Water, NSW Forestry, Agriculture and Fisheries sections and Crown Lands division); - North Coast Local Land Services; - Roads and Maritime Services; - NSW Rural Fire Service; and • establish a Community Consultative Committee for the project in accordance with the *Community Consultative Committee Guidelines for State Significant Projects,* and consult with the committee during the preparation of the EIS.
Further consultation after 2 years	If you do not lodge a development application and EIS for the development within 2 years of the issue date of these requirements, you must consult further with the Secretary in relation to the preparation of the EIS.

ATTACHMENT 1

Environmental Planning Instruments, Policies, Guidelines & Plans

Air	
	Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (DP&E)
	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA)
	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (EPA)
	Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'
	National Greenhouse Accounts Factors (Commonwealth)
Noise & Blasting	
	Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (DP&E)
	NSW Industrial Noise Policy (EPA)
	Interim Construction Noise Guideline (DECC)
	NSW Road Noise Policy (EPA)
	Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC)
Water	
Groundwater	NSW State Groundwater Policy Framework Document (NOW)
	NSW State Groundwater Quality Protection Policy (NOW)
	NSW State Groundwater Quantity Management Policy (NOW)
	NSW Aquifer Interference Policy 2012 (NOW)
	Office of Water Guidelines for Controlled Activities (2012)
	Groundwater Monitoring and Modelling Plans – Information for prospective mining and petroleum exploration activities (NOW)
	Australian Groundwater Modelling Guidelines 2012 (Commonwealth)
	National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
	Guidelines for the Assessment & Management of Groundwater Contamination (EPA)
Surface Water	NSW Government Water Quality and River Flow Objectives (EPA)
	Using the ANZECC Guideline and Water Quality Objectives in NSW (EPA)
	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Effluent Management (ARMCANZ/ANZECC)
	NSW Water Conservation Strategy (2000)
	State Water Management Outcomes Plan
	NSW State Rivers and Estuary Policy (1993)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (EPA)
	Managing Urban Stormwater: Soils & Construction (Landcom) and associated Volume 2E: Mines and Quarries (EPA)
	Managing Urban Stormwater: Treatment Techniques (EPA)
	Managing Urban Stormwater: Source Control (EPA)
	Technical Guidelines: Bunding & Spill Management (EPA)
	Environmental Guidelines: Use of Effluent by Irrigation (EPA)
	A Rehabilitation Manual for Australian Streams (LWRRDC and CRCCH)
	NSW Guidelines for Controlled Activities on Waterfront Land (NOW)

Land	
	Soil and Landscape Issues in Environmental Impact Assessment (NOW)
	Agfact AC.25: Agricultural Land Classification (NSW Agriculture)
	Agricultural Issues for Extractive Industries (NSW Trade and Investment)
	State Environmental Planning Policy No. 55 – Remediation of Land
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC)
Traffic	
	Guide to Traffic Generating Development (RMS)
	Road Design Guide (RMS) & relevant Austroads Standards
Biodiversity	
	Biodiversity Offsets Scheme (OEH)
	Guidelines for Threatened Species Assessment (DP&E)
	NSW State Groundwater Dependent Ecosystem Policy (NOW)
	Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW)
	State Environmental Planning Policy No. 44 – Koala Habitat Protection
Heritage	
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
	Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DP&E)
	Aboriginal Cultural Heritage Consultation Requirements for Proponents (OEH)
	Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (OEH)
	Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH)
	NSW Heritage Manual (OEH)
	Statements of Heritage Impact (OEH)
	Port Macquarie-Hastings Local Environmental Plan 2011
Hazards	
	State Environmental Planning Policy No. 33 – Hazardous and Offensive Development
	Hazardous and Offensive Development Application Guidelines – Applying SEPP 33
	Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis
Waste	
	Waste Classification Guidelines (EPA)
Rehabilitation	
	Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Strategic Framework for Mine Closure (ANZMEC-MCA)
Social & Economic	
	Social impact assessment guideline for State significant mining, petroleum production and extractive industry development (DP&E)
Environmental Planning Instruments - General	
	State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007
	State Environmental Planning Policy (State and Regional Development) 2011
	State Environmental Planning Policy (Infrastructure) 2007
	State Environmental Planning Policy 55 – Remediation of Land
	Port Macquarie-Hastings Local Environmental Plan 2011

ATTACHMENT 2

Agency Correspondence

Environmental Resources Management Australia Pty Ltd

Level 15, 309 Kent Street
Sydney NSW 2000
AUSTRALIA

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Australia Square NSW 1215
AUSTRALIA

Telephone +61 2 8584 8888
Facsimile +61 2 9299 7502

www.erm.com

16 February, 2018

Planning and Assessment Team
Division of Resources and Geoscience
NSW Department of Planning and Environment
PO Box K348
Haymarket NSW 1240
via email: minres.webcoordinator@industry.nsw.gov.au

Our Reference: 0418291_Sancrox Quarry EIS

Attention: Planning and Assessment Team

Dear Sir/Madam,

RE: SANCROX QUARRY EXPANSION PROJECT (SSD 15_7293) EIS CONSULTATION

Environmental Resources Management Australia (ERM) has been engaged by Hanson Construction Materials Pty Ltd (Hanson) to prepare an Environmental Impact Statement (EIS) for the proposed expansion of the Sancrox Quarry, near Port Macquarie, NSW. The purpose of this letter is to inform the NSW Department of Planning and Environment (DP&E) Division of Resources and Geoscience that the EIS process for the Project is underway and provide the opportunity for additional comments to be provided.

Sancrox Quarry has been owned and operated by Hanson since 1998 and is located 8 kilometres (km) west of Port Macquarie, within the Port Macquarie Hastings Council (PMHC) local government area (*Figure 1*). The site compromises Lot 1 DP 704890, Lot 1 DP 720807, Lot 2 DP 574308 and Lot 353 DP 754434. The site also includes Crown lands enclosure permit 49229.

Hanson currently has ownership of approximately 145ha, of which approximately 11.6ha is currently used in the extraction, processing and storage of aggregates. The Sancrox Quarry Expansion Project will involve:

- extending the life of the quarry from the current 20 years to 30 years and expanding the area of extraction to the west of the existing pit;
- increasing the maximum annual rate of extraction from 455,000 tpa to 750,000 tpa;
- upgrading and relocating existing infrastructure (including processing plant, offices, weighbridge and workshop); and
- constructing a concrete batching plant and recycling facility, asphalt production plant and pug mill on site.

Environmental Resources Management Australia Pty Ltd
A.C.N. 002 773 248
A.B.N. 12 002 773 248

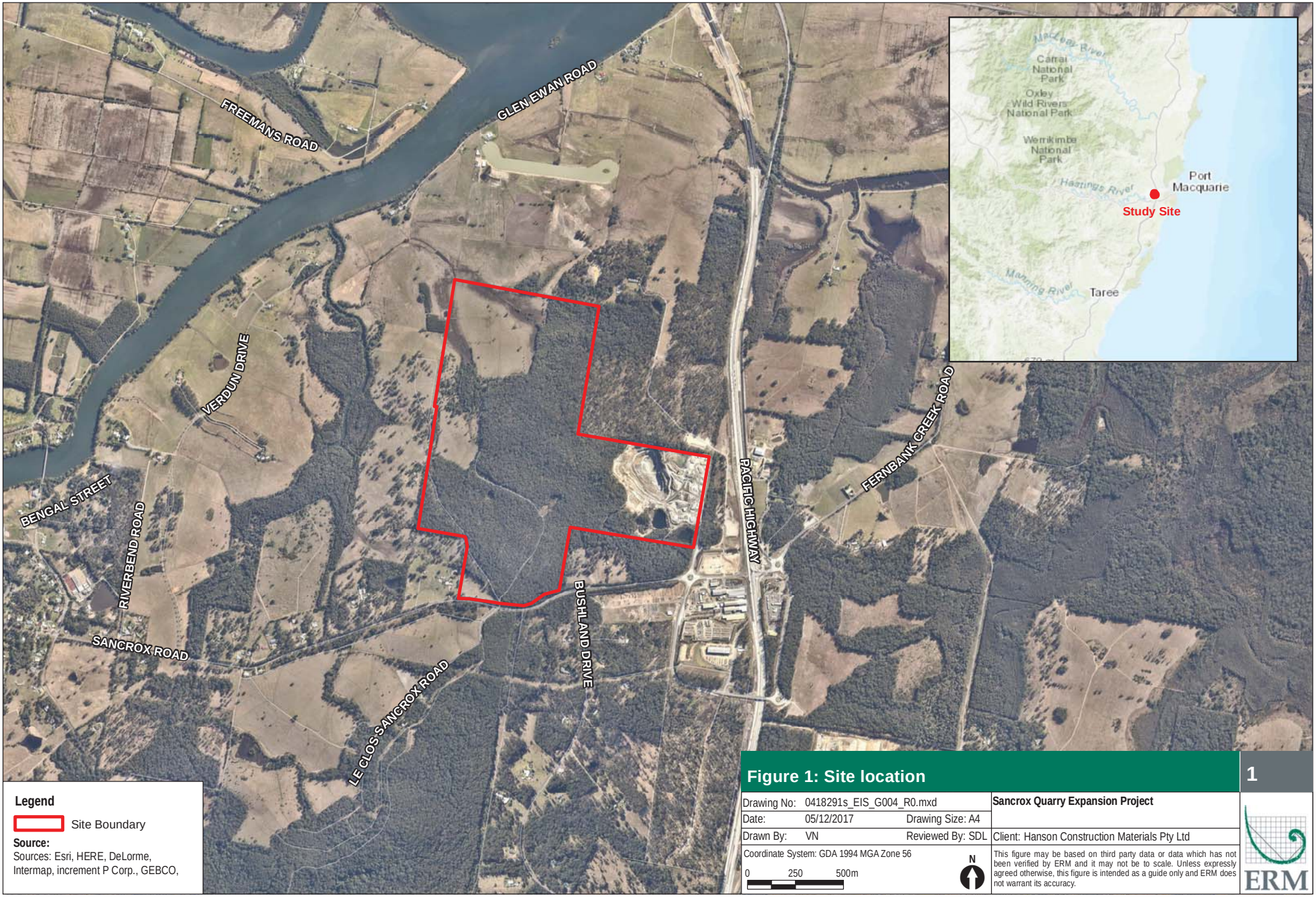
Offices worldwide

The Secretary's Environmental Assessment Requirements (SEARs) for the Project were re-issued on 18 September 2017 (refer to Attachment). We understand that the Division of Resources and Geoscience were consulted by the DP&E in the preparation of the SEARs. The EIS will be prepared in accordance with the SEARs and ERM has no questions or concerns relating to your area of environmental expertise. The EIS is scheduled to be on Public Exhibition around mid-2018.

Should you wish to provide any additional comments, written submissions can be made within 21 days of the date on this letter, and should be forwarded to matthew.errington@erm.com or Matthew Errington, ERM, Locked Bag 3012, Australia Square NSW 1215.

Yours sincerely,

Paul Douglass, Partner
for Environmental Resources Management Australia Pty Ltd



Legend

Site Boundary

Source:
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO,

Figure 1: Site location

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Drawing No:	0418291s_EIS_G004_R0.mxd		**Sancrox Quarry Expansion Project**
Date:	05/12/2017	Drawing Size: A4	
Drawn By:	VN	Reviewed By: SDL	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

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Secretary's Environmental Assessment Requirements

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Key Issues	The EIS must address the following key issues: • **Noise & Blasting** – including: - a detailed assessment of the likely construction, operational and off-site transport noise impacts of the development in accordance with the *Interim Construction Noise Guideline*, *NSW Industrial Noise Policy* and the *NSW Road Noise Policy* respectively, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - if a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the *Interim Construction Noise Guideline*; - proposed blasting hours, frequency and methods; - a detailed assessment of the likely blasting impacts of the development (including noise, vibrations, overpressure, visual and odour) on people,

	animals, buildings, infrastructure and significant natural features, having regard to the relevant ANZEC guidelines; - reasonable and feasible mitigation measures to minimise noise emissions; and - monitoring and management measures, in particular real-time and attended noise monitoring; • **Air Quality** – including: - a detailed assessment of potential construction and operational impacts, in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW,* and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - an assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products; - reasonable and feasible mitigation measures to minimise dust and emissions; and - monitoring and management measures, in particular, real-time air quality monitoring; • **Water** – including: - a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures; - identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*; - demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP); - a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo; - an assessment of any likely flooding impacts of the development; - an assessment of the likely impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives; - an assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users; and - a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts; • **Biodiversity** – including: - accurate predictions of any vegetation clearing on site; - a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, and having regard to the *NSW Biodiversity Offsets Policy for Major Projects* and the *Framework for Biodiversity Assessment*; and - a strategy to offset any residual impacts of the development in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*, including evidence that the appropriate type and quantum of offsets will be available; • **Heritage** – including: - an assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including evidence of appropriate consultation with relevant Aboriginal communities/parties and documentation of the views of these stakeholders regarding the likely impact of the development on their cultural heritage; and - identification of historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items, having regard to the relevant policies and guidelines listed in

	Attachment 1; • **Traffic & Transport** – including: - accurate predictions of the road traffic generated by the construction and operation of the development, including a description of the types of vehicles likely to be used for transportation of quarry products; - a detailed assessment of potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road network (as identified above), including a road safety audit; and - a description of the measures that would be implemented to mitigate any impacts, including concept plans of any proposed upgrades, developed in consultation with the relevant road and rail authorities (if required); • **Land Resources** – including a detailed assessment of: - potential impacts on soils and land capability (including potential erosion and land contamination) and the proposed mitigation, management and remedial measures (as appropriate); - potential impacts on landforms (topography), paying particular attention to the long term geotechnical stability of any new landforms (such as overburden dumps, bunds etc); and - the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements in Clause 12 of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries)* 2007, paying particular attention to the agricultural land use in the region; • **Waste –** including estimates of the quantity and nature of the waste streams that would be generated or received by the development and any measures that would be implemented to minimise, manage or dispose of these waste streams; • **Hazards –** including an assessment of the likely risks to public safety, paying particular attention to the transport, handling and use of any hazardous or dangerous goods; • **Visual** – including a detailed assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, paying particular attention to any new landforms, and to minimising the lighting impacts of the development; • **Social & Economic** – including: - a detailed assessment of the likely social impacts of the development on the local and regional community in accordance with the *Social impact assessment guideline for State significant mining, petroleum production and extractive industry development*; and - a detailed assessment of the likely economic impacts of the development, paying particular attention to: o the significance of the resource; o the costs and benefits of the project; identifying whether the development as a whole would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates; and o the demand for the provision of local infrastructure and services; and • **Rehabilitation** – including the proposed rehabilitation strategy for the site having regard to the key principles in the *Strategic Framework for Mine Closure*, including: - rehabilitation objectives, progressive rehabilitation commitments, methodology, monitoring programs, performance standards and proposed completion criteria; - nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and - the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.
Consultation	During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities, service providers, Aboriginal stakeholders, community groups and affected landowners. You must:

	• consult with: - affected landowners; - community groups; - Port Macquarie-Hastings Council; - Office of Environment and Heritage (including the Heritage Branch); - Environment Protection Authority; - Division of Resources and Geoscience within the Department; - Department of Primary Industries (including the DPI Water, NSW Forestry, Agriculture and Fisheries sections and Crown Lands division); - North Coast Local Land Services; - Roads and Maritime Services; - NSW Rural Fire Service; and • establish a Community Consultative Committee for the project in accordance with the *Community Consultative Committee Guidelines for State Significant Projects,* and consult with the committee during the preparation of the EIS.
Further consultation after 2 years	If you do not lodge a development application and EIS for the development within 2 years of the issue date of these requirements, you must consult further with the Secretary in relation to the preparation of the EIS.

ATTACHMENT 1

Environmental Planning Instruments, Policies, Guidelines & Plans

Air	
	Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (DP&E)
	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA)
	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (EPA)
	Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'
	National Greenhouse Accounts Factors (Commonwealth)
Noise & Blasting	
	Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (DP&E)
	NSW Industrial Noise Policy (EPA)
	Interim Construction Noise Guideline (DECC)
	NSW Road Noise Policy (EPA)
	Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC)
Water	
Groundwater	NSW State Groundwater Policy Framework Document (NOW)
	NSW State Groundwater Quality Protection Policy (NOW)
	NSW State Groundwater Quantity Management Policy (NOW)
	NSW Aquifer Interference Policy 2012 (NOW)
	Office of Water Guidelines for Controlled Activities (2012)
	Groundwater Monitoring and Modelling Plans – Information for prospective mining and petroleum exploration activities (NOW)
	Australian Groundwater Modelling Guidelines 2012 (Commonwealth)
	National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
	Guidelines for the Assessment & Management of Groundwater Contamination (EPA)
Surface Water	NSW Government Water Quality and River Flow Objectives (EPA)
	Using the ANZECC Guideline and Water Quality Objectives in NSW (EPA)
	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Effluent Management (ARMCANZ/ANZECC)
	NSW Water Conservation Strategy (2000)
	State Water Management Outcomes Plan
	NSW State Rivers and Estuary Policy (1993)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (EPA)
	Managing Urban Stormwater: Soils & Construction (Landcom) and associated Volume 2E: Mines and Quarries (EPA)
	Managing Urban Stormwater: Treatment Techniques (EPA)
	Managing Urban Stormwater: Source Control (EPA)
	Technical Guidelines: Bunding & Spill Management (EPA)
	Environmental Guidelines: Use of Effluent by Irrigation (EPA)
	A Rehabilitation Manual for Australian Streams (LWRRDC and CRCCH)
	NSW Guidelines for Controlled Activities on Waterfront Land (NOW)

Land	
	Soil and Landscape Issues in Environmental Impact Assessment (NOW)
	Agfact AC.25: Agricultural Land Classification (NSW Agriculture)
	Agricultural Issues for Extractive Industries (NSW Trade and Investment)
	State Environmental Planning Policy No. 55 – Remediation of Land
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC)
Traffic	
	Guide to Traffic Generating Development (RMS)
	Road Design Guide (RMS) & relevant Austroads Standards
Biodiversity	
	Biodiversity Offsets Scheme (OEH)
	Guidelines for Threatened Species Assessment (DP&E)
	NSW State Groundwater Dependent Ecosystem Policy (NOW)
	Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW)
	State Environmental Planning Policy No. 44 – Koala Habitat Protection
Heritage	
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
	Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DP&E)
	Aboriginal Cultural Heritage Consultation Requirements for Proponents (OEH)
	Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (OEH)
	Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH)
	NSW Heritage Manual (OEH)
	Statements of Heritage Impact (OEH)
	Port Macquarie-Hastings Local Environmental Plan 2011
Hazards	
	State Environmental Planning Policy No. 33 – Hazardous and Offensive Development
	Hazardous and Offensive Development Application Guidelines – Applying SEPP 33
	Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis
Waste	
	Waste Classification Guidelines (EPA)
Rehabilitation	
	Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Strategic Framework for Mine Closure (ANZMEC-MCA)
Social & Economic	
	Social impact assessment guideline for State significant mining, petroleum production and extractive industry development (DP&E)
Environmental Planning Instruments - General	
	State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007
	State Environmental Planning Policy (State and Regional Development) 2011
	State Environmental Planning Policy (Infrastructure) 2007
	State Environmental Planning Policy 55 – Remediation of Land
	Port Macquarie-Hastings Local Environmental Plan 2011

ATTACHMENT 2

Agency Correspondence

Environmental Resources Management Australia Pty Ltd

Level 15, 309 Kent Street
Sydney NSW 2000
AUSTRALIA

Locked Bag 3012
Australia Square NSW 1215
AUSTRALIA

Telephone +61 2 8584 8888
Facsimile +61 2 9299 7502

www.erm.com

14 February, 2018

Mr Mitchell Isaacs
Director
Planning Policy & Assessment Advice
NSW Department of Primary Industries
Level 49, 19 Martin Place
Sydney NSW 2000

Our Reference: 0418291_Sancrox Quarry EIS

Attention: Mr Mitchell Isaacs

Dear Mitchell

RE: SANCROX QUARRY EXPANSION PROJECT (SSD 15_7293) EIS CONSULTATION

Environmental Resources Management Australia (ERM) has been engaged by Hanson Construction Materials Pty Ltd (Hanson) to prepare an Environmental Impact Statement (EIS) for the proposed expansion of the Sancrox Quarry, near Port Macquarie, NSW. The purpose of this letter is to inform the NSW Department of Primary Industries that the EIS process for the Project is underway and provide the opportunity for additional comments to be provided.

Sancrox Quarry has been owned and operated by Hanson since 1998 and is located 8 kilometres (km) west of Port Macquarie, within the Port Macquarie Hastings Council (PMHC) local government area (*Figure 1*). The site compromises Lot 1 DP 704890, Lot 1 DP 720807, Lot 2 DP 574308 and Lot 353 DP 754434. The site also includes Crown lands enclosure permit 49229.

Hanson currently has ownership of approximately 145ha, of which approximately 11.6ha is currently used in the extraction, processing and storage of aggregates. The Sancrox Quarry Expansion Project will involve:

- extending the life of the quarry from the current 20 years to 30 years and expanding the area of extraction to the west of the existing pit;
- increasing the maximum annual rate of extraction from 455,000 tpa to 750,000 tpa;
- upgrading and relocating existing infrastructure (including processing plant, offices, weighbridge and workshop); and
- constructing a concrete batching plant and recycling facility, asphalt production plant and pug mill on site.

Environmental Resources Management Australia Pty Ltd
A.C.N. 002 773 248
A.B.N. 12 002 773 248

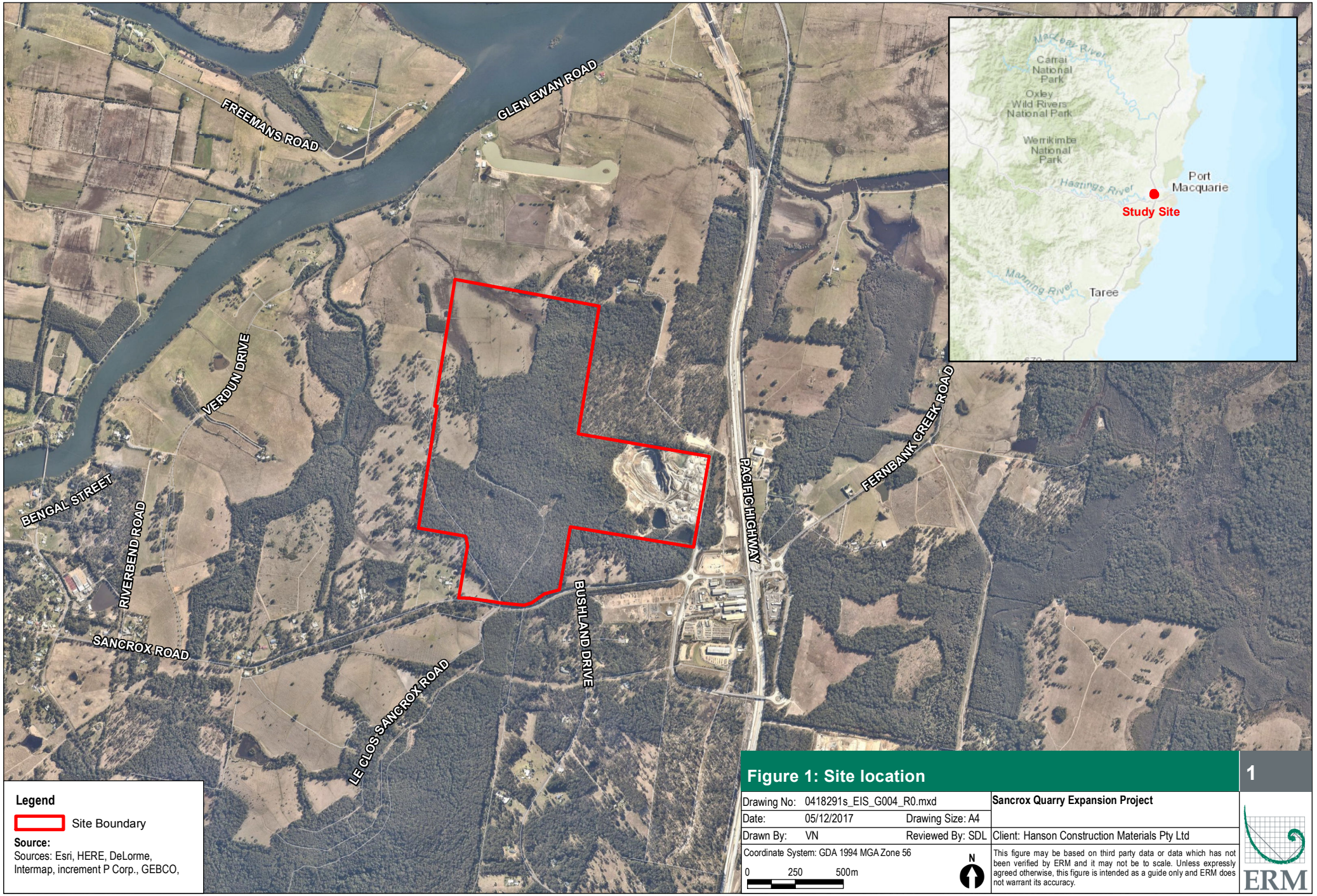
Offices worldwide

The Secretary's Environmental Assessment Requirements (SEARs) for the Project were re-issued on 18 September 2017 (refer to Attachment). We understand that the NSW Department of Primary Industries (including DPI Water, NSW Forestry, Agriculture and Fisheries sections and Crown Lands division) were consulted by the NSW Department of Planning and Environment (DP&E) in the preparation of the SEARs. The EIS will be prepared in accordance with the SEARs and ERM has no questions or concerns relating to your area of environmental expertise. The EIS is scheduled to be on Public Exhibition around mid-2018.

Should you wish to provide any additional comments, written submissions can be made within 21 days of the date on this letter, and should be forwarded to matthew.errington@erm.com or Matthew Errington, ERM, Locked Bag 3012, Australia Square NSW 1215.

Yours sincerely,

Paul Douglass, Partner
for Environmental Resources Management Australia Pty Ltd


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
MacLeay River
Carrai National Park
Oxley Wild Rivers National Park
Werrikimba National Park
Hastings River
Port Macquarie
Study Site
Manning River
Taree
Legend
Site Boundary
Source:
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO,
Figure 1: Site location
1
Drawing No: 0418291s_EIS_G004_R0.mxd
Sancrox Quarry Expansion Project
Date: 05/12/2017
Drawing Size: A4
Drawn By: VN
Reviewed By: SDL
Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

Planning Services
Resource Assessments
Contact: Anthony Barnes
Phone: 8289 6709
Email: anthony.barnes@planning.nsw.gov.au

Matt Errington
Principal Environmental Consultant
Environmental Resources Management Australia
Locked Bag 3012 Australia Square
NSW 1215

Dear Mr Errington

Reissue of State Significant Development - Secretary's Requirements
Sancrox Quarry Extension Project (SSD 7293)

I have enclosed updated Secretary's requirements for the preparation of an Environmental Impact Statement (EIS) for the Sancrox Quarry Extension Project which replace the Secretary's requirements issued on 19 October 2015.

These requirements are based on the information you have previously provided, and reflect previous consultation with relevant government agencies.

Your attention is drawn to the environmental planning instruments (EPI), policies and guidelines to be addressed in your EIS (see Attachment 1). Please note that where these EPIs, guidelines and policies have changed or been updated, your EIS will need to address the latest available version.

The agencies' previous comments are attached for your information (see Attachment 2). You must have regard to these comments in the preparation of the EIS.

Please note that the Department may alter these requirements at any time, and that you must consult further with the Department if you do not lodge a development application and EIS for the project within the next two years.

You should establish whether the proposal requires a separate approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as soon as possible. If such an approval is required, please notify the Department immediately, as the Commonwealth approval process is likely to be integrated with the NSW approval process (under the bilateral agreement), and supplementary requirements will need to be issued.

Please contact the Department at least two weeks before you plan to submit the development application and EIS for the project. This will enable the Department to:

- confirm the applicable fee (see Division 1AA, Part 15 of the *Environmental Planning and Assessment Regulation 2000*); and
- determine the required number of copies of the EIS (hard copy and digital).

It is important for you to recognise that the Department will review the EIS for the project carefully before putting it on public exhibition. If it fails to adequately address these requirements, then you will be required to submit an amended EIS.

If you have any enquiries about these requirements, please contact Anthony Barnes on the details listed above.

Yours sincerely

Howard Reed

Howard Reed 18.9.17
Director
Resource Assessments
as the Secretary's delegate

Secretary's Environmental Assessment Requirements

State Significant Development

Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*
Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*

Application Number	SSD 7293
Proposal	The Sancrox Quarry Extension Project, which involves: • extending the approved extraction boundary by approximately 52 hectares, • extending the quarry life by ten years (from 20 to 30 years), • increasing the production limit from 455,000 tonnes per annum (tpa) to 750,000 tpa, • constructing and operating a concrete batching plant producing 20,000m^3 per annum (p/a), • constructing and operating a concrete recycling facility processing 20,000 tonnes p/a, • increasing truck movements and equipment loading from 7am–11pm weekdays, and 7am–1pm weekends and public holidays to 24 hours per day 7 days per week, • increasing quarry operations from 7am–5pm weekdays, and 7am–1pm Saturday to 24 hours per day 7 days per week, • transporting material off-site via public roads; and • Constructing and operating an asphalt plant producing 50,000 tonnes per annum.
Location	Sancrox Road Sancrox, Lot 2 DP 574308 Lot 353 DP 754434 Lot 1 DP 704890 Lot 1 DP 720807
Applicant	Hanson Construction Materials Pty Ltd (Hanson)
Date of Issue	18 September 2017
General Requirements	The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.* In particular, the EIS must include: • a stand-alone executive summary; • a full description of the development, including: – the resource to be extracted, including the amount, type and composition; – the site layout and extraction plan, including cross-sectional plans; – the production process and processing activities, including the in-flow and out-flow of materials and points of discharge to the environment; – surface infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate approvals process); – a waste (overburden, rejects, tailings etc) management strategy; – a water management strategy; – a rehabilitation strategy to apply during, and after completion of, extraction operations, and proposed final use of site; and – the likely interactions between the development and any existing, approved or proposed development in the vicinity of the site; • a strategic justification of the development focusing on site selection and the suitability of the proposed site; • a list of any approvals that must be obtained before the development may

	commence; • an assessment of the likely impacts of the development on the environment, focussing on the key issues identified below, including: – a description of the existing environment likely to be affected by the development, using sufficient baseline data; – an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice; – a description of the measures that would be implemented to avoid, minimise, mitigate and/or offset the likely impacts of the development, and an assessment of: o whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; o the likely effectiveness of these measures; and o whether contingency measures would be necessary to manage any residual risks; and – a description of the measures that would be implemented to monitor and report on the environmental performance of the development; • a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; • consideration of the development against all relevant environmental planning instruments (including Part 3 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007)*; • the reasons why the development should be approved, having regard to: - relevant matters for consideration under the *Environmental Planning and Assessment Act 1979*, including the objects of the Act; - the biophysical, economic and social impacts of the project, including the principles of ecologically sustainable development; - the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses; - feasible alternatives to the development (and its key components), including the consequences of not carrying out the development; • a signed declaration from the author of the EIS, certifying that the information contained within the document is neither false nor misleading. While not exhaustive, Attachment 1 contains a list of some of the environmental planning instruments, guidelines, policies, and plans that may be relevant to the environmental assessment of this development. In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*, the development application must be accompanied by a signed report from a suitably qualified expert that includes an accurate estimate of the capital investment value (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the development, including details of all the assumptions and components from which the capital investment value calculation is derived.
Key Issues	The EIS must address the following key issues: • **Noise & Blasting** – including: - a detailed assessment of the likely construction, operational and off-site transport noise impacts of the development in accordance with the *Interim Construction Noise Guideline*, *NSW Industrial Noise Policy* and the *NSW Road Noise Policy* respectively, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - if a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the *Interim Construction Noise Guideline*; - proposed blasting hours, frequency and methods; - a detailed assessment of the likely blasting impacts of the development (including noise, vibrations, overpressure, visual and odour) on people,

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	• consult with: - affected landowners; - community groups; - Port Macquarie-Hastings Council; - Office of Environment and Heritage (including the Heritage Branch); - Environment Protection Authority; - Division of Resources and Geoscience within the Department; - Department of Primary Industries (including the DPI Water, NSW Forestry, Agriculture and Fisheries sections and Crown Lands division); - North Coast Local Land Services; - Roads and Maritime Services; - NSW Rural Fire Service; and • establish a Community Consultative Committee for the project in accordance with the *Community Consultative Committee Guidelines for State Significant Projects,* and consult with the committee during the preparation of the EIS.
Further consultation after 2 years	If you do not lodge a development application and EIS for the development within 2 years of the issue date of these requirements, you must consult further with the Secretary in relation to the preparation of the EIS.

ATTACHMENT 1

Environmental Planning Instruments, Policies, Guidelines & Plans

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ATTACHMENT 2

Agency Correspondence

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14 February, 2018

Mr Michael Howat
Assistant Head
Strategic Programs Unit - Hunter
NSW Environmental Protection Agency
PO Box 488G
Newcastle NSW 2300

Our Reference: 0418291_Sancrox Quarry EIS

Attention: Mr Michael Howat

Dear Michael

RE: SANCROX QUARRY EXPANSION PROJECT (SSD 15_7293) EIS CONSULTATION

Environmental Resources Management Australia (ERM) has been engaged by Hanson Construction Materials Pty Ltd (Hanson) to prepare an Environmental Impact Statement (EIS) for the proposed expansion of the Sancrox Quarry, near Port Macquarie, NSW. The purpose of this letter is to inform the NSW EPA that the EIS process for the Project is underway and provide the opportunity for additional comments to be provided.

Sancrox Quarry has been owned and operated by Hanson since 1998 and is located 8 kilometres (km) west of Port Macquarie, within the Port Macquarie Hastings Council (PMHC) local government area (*Figure 1*). The site compromises Lot 1 DP 704890, Lot 1 DP 720807, Lot 2 DP 574308 and Lot 353 DP 754434. The site also includes Crown lands enclosure permit 49229.

Hanson currently has ownership of approximately 145ha, of which approximately 11.6ha is currently used in the extraction, processing and storage of aggregates. The Sancrox Quarry Expansion Project will involve:

- extending the life of the quarry from the current 20 years to 30 years and expanding the area of extraction to the west of the existing pit;
- increasing the maximum annual rate of extraction from 455,000 tpa to 750,000 tpa;
- upgrading and relocating existing infrastructure (including processing plant, offices, weighbridge and workshop); and
- constructing a concrete batching plant and recycling facility, asphalt production plant and pug mill on site.

Environmental Resources Management Australia Pty Ltd
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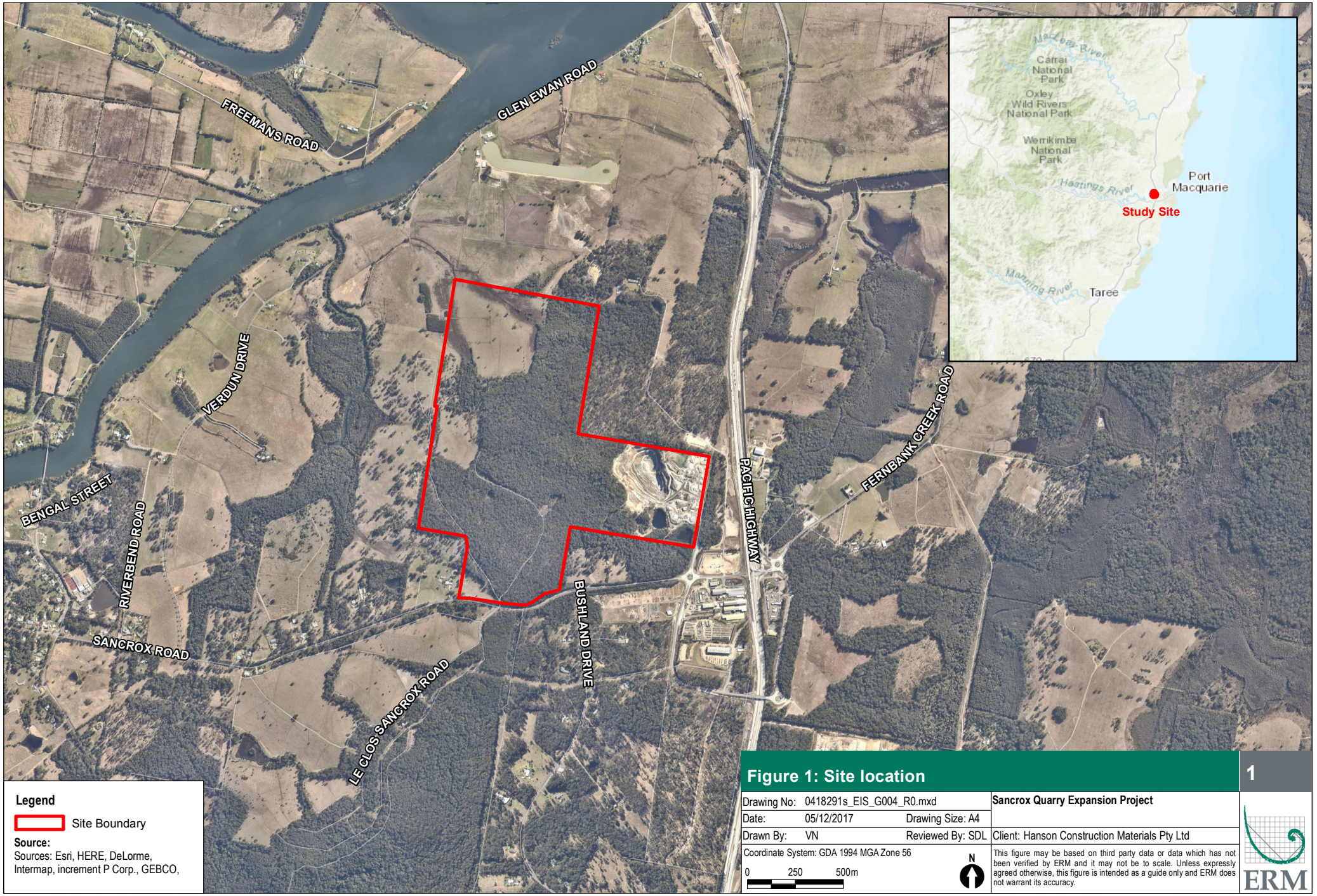
Offices worldwide

The Secretary's Environmental Assessment Requirements (SEARs) for the Project were re-issued on 18 September 2017 (refer to Attachment). We understand that the NSW EPA were consulted by the NSW Department of Planning and Environment (DP&E) in the preparation of the SEARs. The EIS will be prepared in accordance with the SEARs and ERM has no questions or concerns relating to your area of environmental expertise. The EIS is scheduled to be on Public Exhibition around mid-2018.

Should you wish to provide any additional comments, written submissions can be made within 21 days of the date on this letter, and should be forwarded to matthew.errington@erm.com or Matthew Errington, ERM, Locked Bag 3012, Australia Square NSW 1215.

Yours sincerely,

Paul Douglass, Partner
for Environmental Resources Management Australia Pty Ltd


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
MacLeay River
Carrai National Park
Oxley Wild Rivers National Park
Werrikimba National Park
Hastings River
Port Macquarie
Study Site
Manning River
Taree
Legend
Site Boundary
Source:
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO,
Figure 1: Site location
1
Drawing No: 0418291s_EIS_G004_R0.mxd
Sancrox Quarry Expansion Project
Date: 05/12/2017
Drawing Size: A4
Drawn By: VN
Reviewed By: SDL
Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

Planning Services
Resource Assessments
Contact: Anthony Barnes
Phone: 8289 6709
Email: anthony.barnes@planning.nsw.gov.au

Matt Errington
Principal Environmental Consultant
Environmental Resources Management Australia
Locked Bag 3012 Australia Square
NSW 1215

Dear Mr Errington

Reissue of State Significant Development - Secretary's Requirements
Sancrox Quarry Extension Project (SSD 7293)

I have enclosed updated Secretary's requirements for the preparation of an Environmental Impact Statement (EIS) for the Sancrox Quarry Extension Project which replace the Secretary's requirements issued on 19 October 2015.

These requirements are based on the information you have previously provided, and reflect previous consultation with relevant government agencies.

Your attention is drawn to the environmental planning instruments (EPI), policies and guidelines to be addressed in your EIS (see Attachment 1). Please note that where these EPIs, guidelines and policies have changed or been updated, your EIS will need to address the latest available version.

The agencies' previous comments are attached for your information (see Attachment 2). You must have regard to these comments in the preparation of the EIS.

Please note that the Department may alter these requirements at any time, and that you must consult further with the Department if you do not lodge a development application and EIS for the project within the next two years.

You should establish whether the proposal requires a separate approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as soon as possible. If such an approval is required, please notify the Department immediately, as the Commonwealth approval process is likely to be integrated with the NSW approval process (under the bilateral agreement), and supplementary requirements will need to be issued.

Please contact the Department at least two weeks before you plan to submit the development application and EIS for the project. This will enable the Department to:

- confirm the applicable fee (see Division 1AA, Part 15 of the *Environmental Planning and Assessment Regulation 2000*); and
- determine the required number of copies of the EIS (hard copy and digital).

It is important for you to recognise that the Department will review the EIS for the project carefully before putting it on public exhibition. If it fails to adequately address these requirements, then you will be required to submit an amended EIS.

If you have any enquiries about these requirements, please contact Anthony Barnes on the details listed above.

Yours sincerely

Howard Reed

Howard Reed 18.9.17
Director
Resource Assessments
as the Secretary's delegate

Secretary's Environmental Assessment Requirements

State Significant Development

Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*
Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*

Application Number	SSD 7293
Proposal	The Sancrox Quarry Extension Project, which involves: • extending the approved extraction boundary by approximately 52 hectares, • extending the quarry life by ten years (from 20 to 30 years), • increasing the production limit from 455,000 tonnes per annum (tpa) to 750,000 tpa, • constructing and operating a concrete batching plant producing 20,000m^3 per annum (p/a), • constructing and operating a concrete recycling facility processing 20,000 tonnes p/a, • increasing truck movements and equipment loading from 7am–11pm weekdays, and 7am–1pm weekends and public holidays to 24 hours per day 7 days per week, • increasing quarry operations from 7am–5pm weekdays, and 7am–1pm Saturday to 24 hours per day 7 days per week, • transporting material off-site via public roads; and • Constructing and operating an asphalt plant producing 50,000 tonnes per annum.
Location	Sancrox Road Sancrox, Lot 2 DP 574308 Lot 353 DP 754434 Lot 1 DP 704890 Lot 1 DP 720807
Applicant	Hanson Construction Materials Pty Ltd (Hanson)
Date of Issue	18 September 2017
General Requirements	The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.* In particular, the EIS must include: • a stand-alone executive summary; • a full description of the development, including: – the resource to be extracted, including the amount, type and composition; – the site layout and extraction plan, including cross-sectional plans; – the production process and processing activities, including the in-flow and out-flow of materials and points of discharge to the environment; – surface infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate approvals process); – a waste (overburden, rejects, tailings etc) management strategy; – a water management strategy; – a rehabilitation strategy to apply during, and after completion of, extraction operations, and proposed final use of site; and – the likely interactions between the development and any existing, approved or proposed development in the vicinity of the site; • a strategic justification of the development focusing on site selection and the suitability of the proposed site; • a list of any approvals that must be obtained before the development may

	commence; • an assessment of the likely impacts of the development on the environment, focussing on the key issues identified below, including: – a description of the existing environment likely to be affected by the development, using sufficient baseline data; – an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice; – a description of the measures that would be implemented to avoid, minimise, mitigate and/or offset the likely impacts of the development, and an assessment of: o whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; o the likely effectiveness of these measures; and o whether contingency measures would be necessary to manage any residual risks; and – a description of the measures that would be implemented to monitor and report on the environmental performance of the development; • a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; • consideration of the development against all relevant environmental planning instruments (including Part 3 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007)*; • the reasons why the development should be approved, having regard to: - relevant matters for consideration under the *Environmental Planning and Assessment Act 1979*, including the objects of the Act; - the biophysical, economic and social impacts of the project, including the principles of ecologically sustainable development; - the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses; - feasible alternatives to the development (and its key components), including the consequences of not carrying out the development; • a signed declaration from the author of the EIS, certifying that the information contained within the document is neither false nor misleading. While not exhaustive, Attachment 1 contains a list of some of the environmental planning instruments, guidelines, policies, and plans that may be relevant to the environmental assessment of this development. In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*, the development application must be accompanied by a signed report from a suitably qualified expert that includes an accurate estimate of the capital investment value (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the development, including details of all the assumptions and components from which the capital investment value calculation is derived.
Key Issues	The EIS must address the following key issues: • **Noise & Blasting** – including: - a detailed assessment of the likely construction, operational and off-site transport noise impacts of the development in accordance with the *Interim Construction Noise Guideline*, *NSW Industrial Noise Policy* and the *NSW Road Noise Policy* respectively, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - if a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the *Interim Construction Noise Guideline*; - proposed blasting hours, frequency and methods; - a detailed assessment of the likely blasting impacts of the development (including noise, vibrations, overpressure, visual and odour) on people,

	animals, buildings, infrastructure and significant natural features, having regard to the relevant ANZEC guidelines; - reasonable and feasible mitigation measures to minimise noise emissions; and - monitoring and management measures, in particular real-time and attended noise monitoring; • **Air Quality** – including: - a detailed assessment of potential construction and operational impacts, in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW,* and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - an assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products; - reasonable and feasible mitigation measures to minimise dust and emissions; and - monitoring and management measures, in particular, real-time air quality monitoring; • **Water** – including: - a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures; - identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*; - demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP); - a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo; - an assessment of any likely flooding impacts of the development; - an assessment of the likely impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives; - an assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users; and - a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts; • **Biodiversity** – including: - accurate predictions of any vegetation clearing on site; - a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, and having regard to the *NSW Biodiversity Offsets Policy for Major Projects* and the *Framework for Biodiversity Assessment*; and - a strategy to offset any residual impacts of the development in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*, including evidence that the appropriate type and quantum of offsets will be available; • **Heritage** – including: - an assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including evidence of appropriate consultation with relevant Aboriginal communities/parties and documentation of the views of these stakeholders regarding the likely impact of the development on their cultural heritage; and - identification of historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items, having regard to the relevant policies and guidelines listed in

	Attachment 1; • **Traffic & Transport** – including: - accurate predictions of the road traffic generated by the construction and operation of the development, including a description of the types of vehicles likely to be used for transportation of quarry products; - a detailed assessment of potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road network (as identified above), including a road safety audit; and - a description of the measures that would be implemented to mitigate any impacts, including concept plans of any proposed upgrades, developed in consultation with the relevant road and rail authorities (if required); • **Land Resources** – including a detailed assessment of: - potential impacts on soils and land capability (including potential erosion and land contamination) and the proposed mitigation, management and remedial measures (as appropriate); - potential impacts on landforms (topography), paying particular attention to the long term geotechnical stability of any new landforms (such as overburden dumps, bunds etc); and - the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements in Clause 12 of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries)* 2007, paying particular attention to the agricultural land use in the region; • **Waste –** including estimates of the quantity and nature of the waste streams that would be generated or received by the development and any measures that would be implemented to minimise, manage or dispose of these waste streams; • **Hazards –** including an assessment of the likely risks to public safety, paying particular attention to the transport, handling and use of any hazardous or dangerous goods; • **Visual** – including a detailed assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, paying particular attention to any new landforms, and to minimising the lighting impacts of the development; • **Social & Economic** – including: - a detailed assessment of the likely social impacts of the development on the local and regional community in accordance with the *Social impact assessment guideline for State significant mining, petroleum production and extractive industry development*; and - a detailed assessment of the likely economic impacts of the development, paying particular attention to: o the significance of the resource; o the costs and benefits of the project; identifying whether the development as a whole would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates; and o the demand for the provision of local infrastructure and services; and • **Rehabilitation** – including the proposed rehabilitation strategy for the site having regard to the key principles in the *Strategic Framework for Mine Closure*, including: - rehabilitation objectives, progressive rehabilitation commitments, methodology, monitoring programs, performance standards and proposed completion criteria; - nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and - the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.
Consultation	During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities, service providers, Aboriginal stakeholders, community groups and affected landowners. You must:

	• consult with: - affected landowners; - community groups; - Port Macquarie-Hastings Council; - Office of Environment and Heritage (including the Heritage Branch); - Environment Protection Authority; - Division of Resources and Geoscience within the Department; - Department of Primary Industries (including the DPI Water, NSW Forestry, Agriculture and Fisheries sections and Crown Lands division); - North Coast Local Land Services; - Roads and Maritime Services; - NSW Rural Fire Service; and • establish a Community Consultative Committee for the project in accordance with the *Community Consultative Committee Guidelines for State Significant Projects,* and consult with the committee during the preparation of the EIS.
Further consultation after 2 years	If you do not lodge a development application and EIS for the development within 2 years of the issue date of these requirements, you must consult further with the Secretary in relation to the preparation of the EIS.

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Agency Correspondence

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16 February, 2018

The General Manager
North Coast Local Land Services
PO Box 1417
Coffs Harbour NSW 2450
via email: admin.northcoast@lls.nsw.gov.au

Our Reference: 0418291_Sancrox Quarry EIS

Attention: The General Manager

Dear Sir/Madam,

RE: SANCROX QUARRY EXPANSION PROJECT (SSD 15_7293) EIS CONSULTATION

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Environmental Resources Management Australia Pty Ltd
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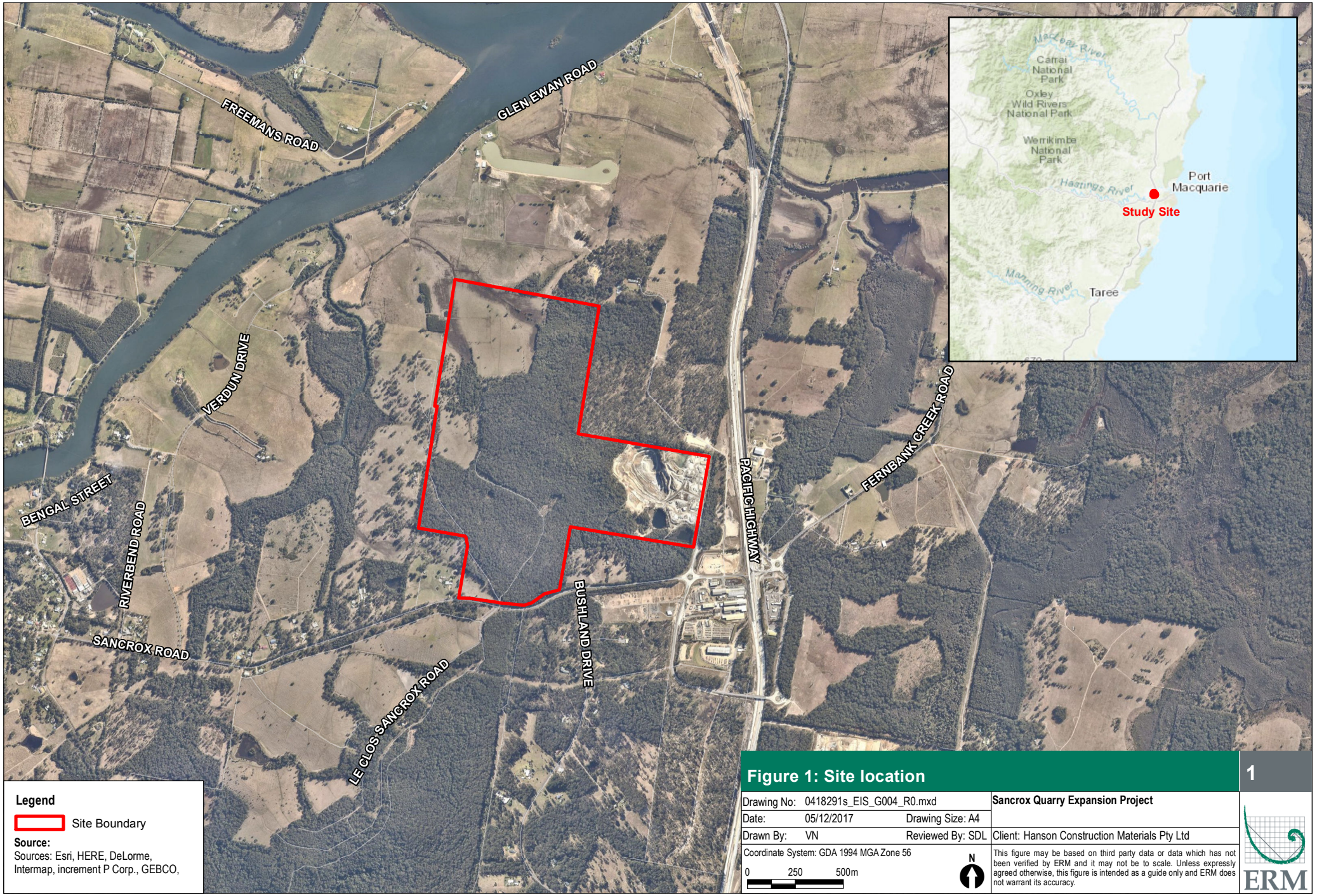
Should you wish to provide any additional comments, written submissions can be made within 21 days of the date on this letter, and should be forwarded to matthew.errington@erm.com or Matthew Errington, ERM, Locked Bag 3012, Australia Square NSW 1215.

Yours sincerely,

Paul Douglass, Partner
for Environmental Resources Management Australia Pty Ltd


FREEMANS ROAD
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SANCROX ROAD
LE CLOS SANCROX ROAD
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PACIFIC HIGHWAY
FERNBANK CREEK ROAD
MacLeay River
Carrai National Park
Oxley Wild Rivers National Park
Werrikimba National Park
Hastings River
Port Macquarie
Study Site
Manning River
Taree
Legend
Site Boundary
Source:
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO,
Figure 1: Site location
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Sancrox Quarry Expansion Project
Date: 05/12/2017
Drawing Size: A4
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Reviewed By: SDL
Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56
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ERM

Planning Services
Resource Assessments
Contact: Anthony Barnes
Phone: 8289 6709
Email: anthony.barnes@planning.nsw.gov.au

Matt Errington
Principal Environmental Consultant
Environmental Resources Management Australia
Locked Bag 3012 Australia Square
NSW 1215

Dear Mr Errington

Reissue of State Significant Development - Secretary's Requirements
Sancrox Quarry Extension Project (SSD 7293)

I have enclosed updated Secretary's requirements for the preparation of an Environmental Impact Statement (EIS) for the Sancrox Quarry Extension Project which replace the Secretary's requirements issued on 19 October 2015.

These requirements are based on the information you have previously provided, and reflect previous consultation with relevant government agencies.

Your attention is drawn to the environmental planning instruments (EPI), policies and guidelines to be addressed in your EIS (see Attachment 1). Please note that where these EPIs, guidelines and policies have changed or been updated, your EIS will need to address the latest available version.

The agencies' previous comments are attached for your information (see Attachment 2). You must have regard to these comments in the preparation of the EIS.

Please note that the Department may alter these requirements at any time, and that you must consult further with the Department if you do not lodge a development application and EIS for the project within the next two years.

You should establish whether the proposal requires a separate approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as soon as possible. If such an approval is required, please notify the Department immediately, as the Commonwealth approval process is likely to be integrated with the NSW approval process (under the bilateral agreement), and supplementary requirements will need to be issued.

Please contact the Department at least two weeks before you plan to submit the development application and EIS for the project. This will enable the Department to:

- confirm the applicable fee (see Division 1AA, Part 15 of the *Environmental Planning and Assessment Regulation 2000*); and
- determine the required number of copies of the EIS (hard copy and digital).

It is important for you to recognise that the Department will review the EIS for the project carefully before putting it on public exhibition. If it fails to adequately address these requirements, then you will be required to submit an amended EIS.

If you have any enquiries about these requirements, please contact Anthony Barnes on the details listed above.

Yours sincerely

Howard Reed

Howard Reed 18.9.17
Director
Resource Assessments
as the Secretary's delegate

Secretary's Environmental Assessment Requirements

State Significant Development

Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*
Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*

Application Number	SSD 7293
Proposal	The Sancrox Quarry Extension Project, which involves: • extending the approved extraction boundary by approximately 52 hectares, • extending the quarry life by ten years (from 20 to 30 years), • increasing the production limit from 455,000 tonnes per annum (tpa) to 750,000 tpa, • constructing and operating a concrete batching plant producing 20,000m^3 per annum (p/a), • constructing and operating a concrete recycling facility processing 20,000 tonnes p/a, • increasing truck movements and equipment loading from 7am–11pm weekdays, and 7am–1pm weekends and public holidays to 24 hours per day 7 days per week, • increasing quarry operations from 7am–5pm weekdays, and 7am–1pm Saturday to 24 hours per day 7 days per week, • transporting material off-site via public roads; and • Constructing and operating an asphalt plant producing 50,000 tonnes per annum.
Location	Sancrox Road Sancrox, Lot 2 DP 574308 Lot 353 DP 754434 Lot 1 DP 704890 Lot 1 DP 720807
Applicant	Hanson Construction Materials Pty Ltd (Hanson)
Date of Issue	18 September 2017
General Requirements	The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.* In particular, the EIS must include: • a stand-alone executive summary; • a full description of the development, including: – the resource to be extracted, including the amount, type and composition; – the site layout and extraction plan, including cross-sectional plans; – the production process and processing activities, including the in-flow and out-flow of materials and points of discharge to the environment; – surface infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate approvals process); – a waste (overburden, rejects, tailings etc) management strategy; – a water management strategy; – a rehabilitation strategy to apply during, and after completion of, extraction operations, and proposed final use of site; and – the likely interactions between the development and any existing, approved or proposed development in the vicinity of the site; • a strategic justification of the development focusing on site selection and the suitability of the proposed site; • a list of any approvals that must be obtained before the development may

	commence; • an assessment of the likely impacts of the development on the environment, focussing on the key issues identified below, including: – a description of the existing environment likely to be affected by the development, using sufficient baseline data; – an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice; – a description of the measures that would be implemented to avoid, minimise, mitigate and/or offset the likely impacts of the development, and an assessment of: o whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; o the likely effectiveness of these measures; and o whether contingency measures would be necessary to manage any residual risks; and – a description of the measures that would be implemented to monitor and report on the environmental performance of the development; • a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; • consideration of the development against all relevant environmental planning instruments (including Part 3 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007)*; • the reasons why the development should be approved, having regard to: - relevant matters for consideration under the *Environmental Planning and Assessment Act 1979*, including the objects of the Act; - the biophysical, economic and social impacts of the project, including the principles of ecologically sustainable development; - the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses; - feasible alternatives to the development (and its key components), including the consequences of not carrying out the development; • a signed declaration from the author of the EIS, certifying that the information contained within the document is neither false nor misleading. While not exhaustive, Attachment 1 contains a list of some of the environmental planning instruments, guidelines, policies, and plans that may be relevant to the environmental assessment of this development. In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*, the development application must be accompanied by a signed report from a suitably qualified expert that includes an accurate estimate of the capital investment value (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the development, including details of all the assumptions and components from which the capital investment value calculation is derived.
Key Issues	The EIS must address the following key issues: • **Noise & Blasting** – including: - a detailed assessment of the likely construction, operational and off-site transport noise impacts of the development in accordance with the *Interim Construction Noise Guideline*, *NSW Industrial Noise Policy* and the *NSW Road Noise Policy* respectively, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - if a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the *Interim Construction Noise Guideline*; - proposed blasting hours, frequency and methods; - a detailed assessment of the likely blasting impacts of the development (including noise, vibrations, overpressure, visual and odour) on people,

	animals, buildings, infrastructure and significant natural features, having regard to the relevant ANZEC guidelines; - reasonable and feasible mitigation measures to minimise noise emissions; and - monitoring and management measures, in particular real-time and attended noise monitoring; • **Air Quality** – including: - a detailed assessment of potential construction and operational impacts, in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW,* and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - an assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products; - reasonable and feasible mitigation measures to minimise dust and emissions; and - monitoring and management measures, in particular, real-time air quality monitoring; • **Water** – including: - a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures; - identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*; - demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP); - a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo; - an assessment of any likely flooding impacts of the development; - an assessment of the likely impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives; - an assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users; and - a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts; • **Biodiversity** – including: - accurate predictions of any vegetation clearing on site; - a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, and having regard to the *NSW Biodiversity Offsets Policy for Major Projects* and the *Framework for Biodiversity Assessment*; and - a strategy to offset any residual impacts of the development in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*, including evidence that the appropriate type and quantum of offsets will be available; • **Heritage** – including: - an assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including evidence of appropriate consultation with relevant Aboriginal communities/parties and documentation of the views of these stakeholders regarding the likely impact of the development on their cultural heritage; and - identification of historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items, having regard to the relevant policies and guidelines listed in

	Attachment 1; • **Traffic & Transport** – including: - accurate predictions of the road traffic generated by the construction and operation of the development, including a description of the types of vehicles likely to be used for transportation of quarry products; - a detailed assessment of potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road network (as identified above), including a road safety audit; and - a description of the measures that would be implemented to mitigate any impacts, including concept plans of any proposed upgrades, developed in consultation with the relevant road and rail authorities (if required); • **Land Resources** – including a detailed assessment of: - potential impacts on soils and land capability (including potential erosion and land contamination) and the proposed mitigation, management and remedial measures (as appropriate); - potential impacts on landforms (topography), paying particular attention to the long term geotechnical stability of any new landforms (such as overburden dumps, bunds etc); and - the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements in Clause 12 of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries)* 2007, paying particular attention to the agricultural land use in the region; • **Waste –** including estimates of the quantity and nature of the waste streams that would be generated or received by the development and any measures that would be implemented to minimise, manage or dispose of these waste streams; • **Hazards –** including an assessment of the likely risks to public safety, paying particular attention to the transport, handling and use of any hazardous or dangerous goods; • **Visual** – including a detailed assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, paying particular attention to any new landforms, and to minimising the lighting impacts of the development; • **Social & Economic** – including: - a detailed assessment of the likely social impacts of the development on the local and regional community in accordance with the *Social impact assessment guideline for State significant mining, petroleum production and extractive industry development*; and - a detailed assessment of the likely economic impacts of the development, paying particular attention to: o the significance of the resource; o the costs and benefits of the project; identifying whether the development as a whole would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates; and o the demand for the provision of local infrastructure and services; and • **Rehabilitation** – including the proposed rehabilitation strategy for the site having regard to the key principles in the *Strategic Framework for Mine Closure*, including: - rehabilitation objectives, progressive rehabilitation commitments, methodology, monitoring programs, performance standards and proposed completion criteria; - nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and - the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.
Consultation	During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities, service providers, Aboriginal stakeholders, community groups and affected landowners. You must:

	• consult with: - affected landowners; - community groups; - Port Macquarie-Hastings Council; - Office of Environment and Heritage (including the Heritage Branch); - Environment Protection Authority; - Division of Resources and Geoscience within the Department; - Department of Primary Industries (including the DPI Water, NSW Forestry, Agriculture and Fisheries sections and Crown Lands division); - North Coast Local Land Services; - Roads and Maritime Services; - NSW Rural Fire Service; and • establish a Community Consultative Committee for the project in accordance with the *Community Consultative Committee Guidelines for State Significant Projects,* and consult with the committee during the preparation of the EIS.
Further consultation after 2 years	If you do not lodge a development application and EIS for the development within 2 years of the issue date of these requirements, you must consult further with the Secretary in relation to the preparation of the EIS.

ATTACHMENT 1

Environmental Planning Instruments, Policies, Guidelines & Plans

Air	
	Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (DP&E)
	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA)
	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (EPA)
	Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'
	National Greenhouse Accounts Factors (Commonwealth)
Noise & Blasting	
	Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (DP&E)
	NSW Industrial Noise Policy (EPA)
	Interim Construction Noise Guideline (DECC)
	NSW Road Noise Policy (EPA)
	Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC)
Water	
Groundwater	NSW State Groundwater Policy Framework Document (NOW)
	NSW State Groundwater Quality Protection Policy (NOW)
	NSW State Groundwater Quantity Management Policy (NOW)
	NSW Aquifer Interference Policy 2012 (NOW)
	Office of Water Guidelines for Controlled Activities (2012)
	Groundwater Monitoring and Modelling Plans – Information for prospective mining and petroleum exploration activities (NOW)
	Australian Groundwater Modelling Guidelines 2012 (Commonwealth)
	National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
	Guidelines for the Assessment & Management of Groundwater Contamination (EPA)
Surface Water	NSW Government Water Quality and River Flow Objectives (EPA)
	Using the ANZECC Guideline and Water Quality Objectives in NSW (EPA)
	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Effluent Management (ARMCANZ/ANZECC)
	NSW Water Conservation Strategy (2000)
	State Water Management Outcomes Plan
	NSW State Rivers and Estuary Policy (1993)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (EPA)
	Managing Urban Stormwater: Soils & Construction (Landcom) and associated Volume 2E: Mines and Quarries (EPA)
	Managing Urban Stormwater: Treatment Techniques (EPA)
	Managing Urban Stormwater: Source Control (EPA)
	Technical Guidelines: Bunding & Spill Management (EPA)
	Environmental Guidelines: Use of Effluent by Irrigation (EPA)
	A Rehabilitation Manual for Australian Streams (LWRRDC and CRCCH)
	NSW Guidelines for Controlled Activities on Waterfront Land (NOW)

Land	
	Soil and Landscape Issues in Environmental Impact Assessment (NOW)
	Agfact AC.25: Agricultural Land Classification (NSW Agriculture)
	Agricultural Issues for Extractive Industries (NSW Trade and Investment)
	State Environmental Planning Policy No. 55 – Remediation of Land
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC)
Traffic	
	Guide to Traffic Generating Development (RMS)
	Road Design Guide (RMS) & relevant Austroads Standards
Biodiversity	
	Biodiversity Offsets Scheme (OEH)
	Guidelines for Threatened Species Assessment (DP&E)
	NSW State Groundwater Dependent Ecosystem Policy (NOW)
	Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW)
	State Environmental Planning Policy No. 44 – Koala Habitat Protection
Heritage	
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
	Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DP&E)
	Aboriginal Cultural Heritage Consultation Requirements for Proponents (OEH)
	Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (OEH)
	Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH)
	NSW Heritage Manual (OEH)
	Statements of Heritage Impact (OEH)
	Port Macquarie-Hastings Local Environmental Plan 2011
Hazards	
	State Environmental Planning Policy No. 33 – Hazardous and Offensive Development
	Hazardous and Offensive Development Application Guidelines – Applying SEPP 33
	Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis
Waste	
	Waste Classification Guidelines (EPA)
Rehabilitation	
	Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Strategic Framework for Mine Closure (ANZMEC-MCA)
Social & Economic	
	Social impact assessment guideline for State significant mining, petroleum production and extractive industry development (DP&E)
Environmental Planning Instruments - General	
	State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007
	State Environmental Planning Policy (State and Regional Development) 2011
	State Environmental Planning Policy (Infrastructure) 2007
	State Environmental Planning Policy 55 – Remediation of Land
	Port Macquarie-Hastings Local Environmental Plan 2011

ATTACHMENT 2

Agency Correspondence

Environmental Resources Management Australia Pty Ltd

Level 15, 309 Kent Street
Sydney NSW 2000
AUSTRALIA

Locked Bag 3012
Australia Square NSW 1215
AUSTRALIA

Telephone +61 2 8584 8888
Facsimile +61 2 9299 7502

www.erm.com

14 February, 2018

Ms Rachel Binskin
Regional Operations Officer
Regional Operations
Locked Bag 914
Coffs Harbour NSW 2450

Our Reference: 0418291_Sancrox Quarry EIS

Attention: Ms Rachel Binskin

Dear Rachel

RE: SANCROX QUARRY EXPANSION PROJECT (SSD 15_7293) EIS CONSULTATION

Environmental Resources Management Australia (ERM) has been engaged by Hanson Construction Materials Pty Ltd (Hanson) to prepare an Environmental Impact Statement (EIS) for the proposed expansion of the Sancrox Quarry, near Port Macquarie, NSW. The purpose of this letter is to inform the NSW Office of Environment and Heritage that the EIS process for the Project is underway and provide the opportunity for additional comments to be provided.

Sancrox Quarry has been owned and operated by Hanson since 1998 and is located 8 kilometres (km) west of Port Macquarie, within the Port Macquarie Hastings Council (PMHC) local government area (*Figure 1*). The site compromises Lot 1 DP 704890, Lot 1 DP 720807, Lot 2 DP 574308 and Lot 353 DP 754434. The site also includes Crown lands enclosure permit 49229.

Hanson currently has ownership of approximately 145ha, of which approximately 11.6ha is currently used in the extraction, processing and storage of aggregates. The Sancrox Quarry Expansion Project will involve:

- extending the life of the quarry from the current 20 years to 30 years and expanding the area of extraction to the west of the existing pit;
- increasing the maximum annual rate of extraction from 455,000 tpa to 750,000 tpa;
- upgrading and relocating existing infrastructure (including processing plant, offices, weighbridge and workshop); and
- constructing a concrete batching plant and recycling facility, asphalt production plant and pug mill on site.

Environmental Resources Management Australia Pty Ltd
A.C.N. 002 773 248
A.B.N. 12 002 773 248

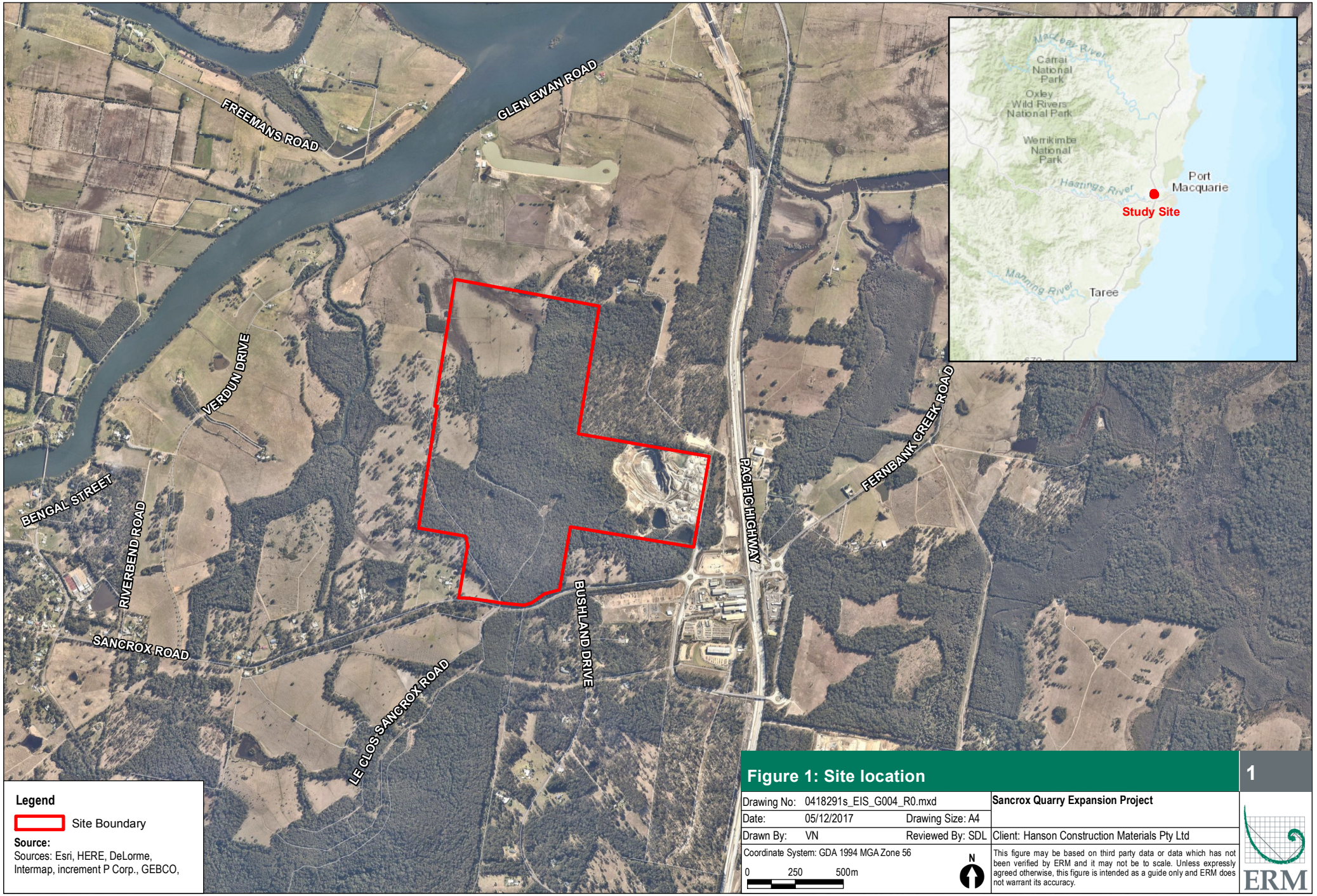
Offices worldwide

The Secretary's Environmental Assessment Requirements (SEARs) for the Project were re-issued on 18 September 2017 (refer to Attachment). We understand that the NSW Office of Environment and Heritage were consulted by the NSW Department of Planning and Environment (DP&E) in the preparation of the SEARs. The EIS will be prepared in accordance with the SEARs and ERM has no questions or concerns relating to your area of environmental expertise. The EIS is scheduled to be on Public Exhibition around mid-2018.

Should you wish to provide any additional comments, written submissions can be made within 21 days of the date on this letter, and should be forwarded to matthew.errington@erm.com or Matthew Errington, ERM, Locked Bag 3012, Australia Square NSW 1215.

Yours sincerely,

Paul Douglass, Partner
for Environmental Resources Management Australia Pty Ltd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Planning Services
Resource Assessments
Contact: Anthony Barnes
Phone: 8289 6709
Email: anthony.barnes@planning.nsw.gov.au

Matt Errington
Principal Environmental Consultant
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Yours sincerely

Howard Reed

Howard Reed 18.9.17
Director
Resource Assessments
as the Secretary's delegate

Secretary's Environmental Assessment Requirements

State Significant Development

Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*
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General Requirements	The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.* In particular, the EIS must include: • a stand-alone executive summary; • a full description of the development, including: – the resource to be extracted, including the amount, type and composition; – the site layout and extraction plan, including cross-sectional plans; – the production process and processing activities, including the in-flow and out-flow of materials and points of discharge to the environment; – surface infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate approvals process); – a waste (overburden, rejects, tailings etc) management strategy; – a water management strategy; – a rehabilitation strategy to apply during, and after completion of, extraction operations, and proposed final use of site; and – the likely interactions between the development and any existing, approved or proposed development in the vicinity of the site; • a strategic justification of the development focusing on site selection and the suitability of the proposed site; • a list of any approvals that must be obtained before the development may

	commence; • an assessment of the likely impacts of the development on the environment, focussing on the key issues identified below, including: – a description of the existing environment likely to be affected by the development, using sufficient baseline data; – an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice; – a description of the measures that would be implemented to avoid, minimise, mitigate and/or offset the likely impacts of the development, and an assessment of: o whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; o the likely effectiveness of these measures; and o whether contingency measures would be necessary to manage any residual risks; and – a description of the measures that would be implemented to monitor and report on the environmental performance of the development; • a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; • consideration of the development against all relevant environmental planning instruments (including Part 3 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007)*; • the reasons why the development should be approved, having regard to: - relevant matters for consideration under the *Environmental Planning and Assessment Act 1979*, including the objects of the Act; - the biophysical, economic and social impacts of the project, including the principles of ecologically sustainable development; - the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses; - feasible alternatives to the development (and its key components), including the consequences of not carrying out the development; • a signed declaration from the author of the EIS, certifying that the information contained within the document is neither false nor misleading. While not exhaustive, Attachment 1 contains a list of some of the environmental planning instruments, guidelines, policies, and plans that may be relevant to the environmental assessment of this development. In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*, the development application must be accompanied by a signed report from a suitably qualified expert that includes an accurate estimate of the capital investment value (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the development, including details of all the assumptions and components from which the capital investment value calculation is derived.
Key Issues	The EIS must address the following key issues: • **Noise & Blasting** – including: - a detailed assessment of the likely construction, operational and off-site transport noise impacts of the development in accordance with the *Interim Construction Noise Guideline*, *NSW Industrial Noise Policy* and the *NSW Road Noise Policy* respectively, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - if a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the *Interim Construction Noise Guideline*; - proposed blasting hours, frequency and methods; - a detailed assessment of the likely blasting impacts of the development (including noise, vibrations, overpressure, visual and odour) on people,

	animals, buildings, infrastructure and significant natural features, having regard to the relevant ANZEC guidelines; - reasonable and feasible mitigation measures to minimise noise emissions; and - monitoring and management measures, in particular real-time and attended noise monitoring; • **Air Quality** – including: - a detailed assessment of potential construction and operational impacts, in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW,* and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - an assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products; - reasonable and feasible mitigation measures to minimise dust and emissions; and - monitoring and management measures, in particular, real-time air quality monitoring; • **Water** – including: - a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures; - identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*; - demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP); - a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo; - an assessment of any likely flooding impacts of the development; - an assessment of the likely impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives; - an assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users; and - a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts; • **Biodiversity** – including: - accurate predictions of any vegetation clearing on site; - a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, and having regard to the *NSW Biodiversity Offsets Policy for Major Projects* and the *Framework for Biodiversity Assessment*; and - a strategy to offset any residual impacts of the development in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*, including evidence that the appropriate type and quantum of offsets will be available; • **Heritage** – including: - an assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including evidence of appropriate consultation with relevant Aboriginal communities/parties and documentation of the views of these stakeholders regarding the likely impact of the development on their cultural heritage; and - identification of historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items, having regard to the relevant policies and guidelines listed in

	Attachment 1; • **Traffic & Transport** – including: - accurate predictions of the road traffic generated by the construction and operation of the development, including a description of the types of vehicles likely to be used for transportation of quarry products; - a detailed assessment of potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road network (as identified above), including a road safety audit; and - a description of the measures that would be implemented to mitigate any impacts, including concept plans of any proposed upgrades, developed in consultation with the relevant road and rail authorities (if required); • **Land Resources** – including a detailed assessment of: - potential impacts on soils and land capability (including potential erosion and land contamination) and the proposed mitigation, management and remedial measures (as appropriate); - potential impacts on landforms (topography), paying particular attention to the long term geotechnical stability of any new landforms (such as overburden dumps, bunds etc); and - the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements in Clause 12 of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries)* 2007, paying particular attention to the agricultural land use in the region; • **Waste –** including estimates of the quantity and nature of the waste streams that would be generated or received by the development and any measures that would be implemented to minimise, manage or dispose of these waste streams; • **Hazards –** including an assessment of the likely risks to public safety, paying particular attention to the transport, handling and use of any hazardous or dangerous goods; • **Visual** – including a detailed assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, paying particular attention to any new landforms, and to minimising the lighting impacts of the development; • **Social & Economic** – including: - a detailed assessment of the likely social impacts of the development on the local and regional community in accordance with the *Social impact assessment guideline for State significant mining, petroleum production and extractive industry development*; and - a detailed assessment of the likely economic impacts of the development, paying particular attention to: o the significance of the resource; o the costs and benefits of the project; identifying whether the development as a whole would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates; and o the demand for the provision of local infrastructure and services; and • **Rehabilitation** – including the proposed rehabilitation strategy for the site having regard to the key principles in the *Strategic Framework for Mine Closure*, including: - rehabilitation objectives, progressive rehabilitation commitments, methodology, monitoring programs, performance standards and proposed completion criteria; - nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and - the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.
Consultation	During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities, service providers, Aboriginal stakeholders, community groups and affected landowners. You must:

	• consult with: - affected landowners; - community groups; - Port Macquarie-Hastings Council; - Office of Environment and Heritage (including the Heritage Branch); - Environment Protection Authority; - Division of Resources and Geoscience within the Department; - Department of Primary Industries (including the DPI Water, NSW Forestry, Agriculture and Fisheries sections and Crown Lands division); - North Coast Local Land Services; - Roads and Maritime Services; - NSW Rural Fire Service; and • establish a Community Consultative Committee for the project in accordance with the *Community Consultative Committee Guidelines for State Significant Projects,* and consult with the committee during the preparation of the EIS.
Further consultation after 2 years	If you do not lodge a development application and EIS for the development within 2 years of the issue date of these requirements, you must consult further with the Secretary in relation to the preparation of the EIS.

ATTACHMENT 1

Environmental Planning Instruments, Policies, Guidelines & Plans

Air	
	Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (DP&E)
	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA)
	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (EPA)
	Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'
	National Greenhouse Accounts Factors (Commonwealth)
Noise & Blasting	
	Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (DP&E)
	NSW Industrial Noise Policy (EPA)
	Interim Construction Noise Guideline (DECC)
	NSW Road Noise Policy (EPA)
	Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC)
Water	
Groundwater	NSW State Groundwater Policy Framework Document (NOW)
	NSW State Groundwater Quality Protection Policy (NOW)
	NSW State Groundwater Quantity Management Policy (NOW)
	NSW Aquifer Interference Policy 2012 (NOW)
	Office of Water Guidelines for Controlled Activities (2012)
	Groundwater Monitoring and Modelling Plans – Information for prospective mining and petroleum exploration activities (NOW)
	Australian Groundwater Modelling Guidelines 2012 (Commonwealth)
	National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
	Guidelines for the Assessment & Management of Groundwater Contamination (EPA)
Surface Water	NSW Government Water Quality and River Flow Objectives (EPA)
	Using the ANZECC Guideline and Water Quality Objectives in NSW (EPA)
	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Effluent Management (ARMCANZ/ANZECC)
	NSW Water Conservation Strategy (2000)
	State Water Management Outcomes Plan
	NSW State Rivers and Estuary Policy (1993)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (EPA)
	Managing Urban Stormwater: Soils & Construction (Landcom) and associated Volume 2E: Mines and Quarries (EPA)
	Managing Urban Stormwater: Treatment Techniques (EPA)
	Managing Urban Stormwater: Source Control (EPA)
	Technical Guidelines: Bunding & Spill Management (EPA)
	Environmental Guidelines: Use of Effluent by Irrigation (EPA)
	A Rehabilitation Manual for Australian Streams (LWRRDC and CRCCH)
	NSW Guidelines for Controlled Activities on Waterfront Land (NOW)

Land	
	Soil and Landscape Issues in Environmental Impact Assessment (NOW)
	Agfact AC.25: Agricultural Land Classification (NSW Agriculture)
	Agricultural Issues for Extractive Industries (NSW Trade and Investment)
	State Environmental Planning Policy No. 55 – Remediation of Land
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC)
Traffic	
	Guide to Traffic Generating Development (RMS)
	Road Design Guide (RMS) & relevant Austroads Standards
Biodiversity	
	Biodiversity Offsets Scheme (OEH)
	Guidelines for Threatened Species Assessment (DP&E)
	NSW State Groundwater Dependent Ecosystem Policy (NOW)
	Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW)
	State Environmental Planning Policy No. 44 – Koala Habitat Protection
Heritage	
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
	Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DP&E)
	Aboriginal Cultural Heritage Consultation Requirements for Proponents (OEH)
	Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (OEH)
	Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH)
	NSW Heritage Manual (OEH)
	Statements of Heritage Impact (OEH)
	Port Macquarie-Hastings Local Environmental Plan 2011
Hazards	
	State Environmental Planning Policy No. 33 – Hazardous and Offensive Development
	Hazardous and Offensive Development Application Guidelines – Applying SEPP 33
	Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis
Waste	
	Waste Classification Guidelines (EPA)
Rehabilitation	
	Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Strategic Framework for Mine Closure (ANZMEC-MCA)
Social & Economic	
	Social impact assessment guideline for State significant mining, petroleum production and extractive industry development (DP&E)
Environmental Planning Instruments - General	
	State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007
	State Environmental Planning Policy (State and Regional Development) 2011
	State Environmental Planning Policy (Infrastructure) 2007
	State Environmental Planning Policy 55 – Remediation of Land
	Port Macquarie-Hastings Local Environmental Plan 2011

ATTACHMENT 2

Agency Correspondence

Environmental Resources Management Australia Pty Ltd

Level 15, 309 Kent Street
Sydney NSW 2000
AUSTRALIA

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Australia Square NSW 1215
AUSTRALIA

Telephone +61 2 8584 8888
Facsimile +61 2 9299 7502

www.erm.com

16 February, 2018

Mr Alan Bawdin
NSW Rural Fire Service
Locked Bag 17
Granville NSW 2142
via email: pes@rfs.nsw.gov.au

Our Reference: 0418291_Sancrox Quarry EIS

Attention: Mr Adam Bawdin

Dear Adam,

RE: SANCROX QUARRY EXPANSION PROJECT (SSD 15_7293) EIS CONSULTATION

Environmental Resources Management Australia (ERM) has been engaged by Hanson Construction Materials Pty Ltd (Hanson) to prepare an Environmental Impact Statement (EIS) for the proposed expansion of the Sancrox Quarry, near Port Macquarie, NSW. The purpose of this letter is to inform the NSW Rural Fire Service that the EIS process for the Project is underway and provide the opportunity for additional comments to be provided.

Sancrox Quarry has been owned and operated by Hanson since 1998 and is located 8 kilometres (km) west of Port Macquarie, within the Port Macquarie Hastings Council (PMHC) local government area (*Figure 1*). The site compromises Lot 1 DP 704890, Lot 1 DP 720807, Lot 2 DP 574308 and Lot 353 DP 754434. The site also includes Crown lands enclosure permit 49229.

Hanson currently has ownership of approximately 145ha, of which approximately 11.6ha is currently used in the extraction, processing and storage of aggregates. The Sancrox Quarry Expansion Project will involve:

- extending the life of the quarry from the current 20 years to 30 years and expanding the area of extraction to the west of the existing pit;
- increasing the maximum annual rate of extraction from 455,000 tpa to 750,000 tpa;
- upgrading and relocating existing infrastructure (including processing plant, offices, weighbridge and workshop); and
- constructing a concrete batching plant and recycling facility, asphalt production plant and pug mill on site.

Environmental Resources Management Australia Pty Ltd
A.C.N. 002 773 248
A.B.N. 12 002 773 248

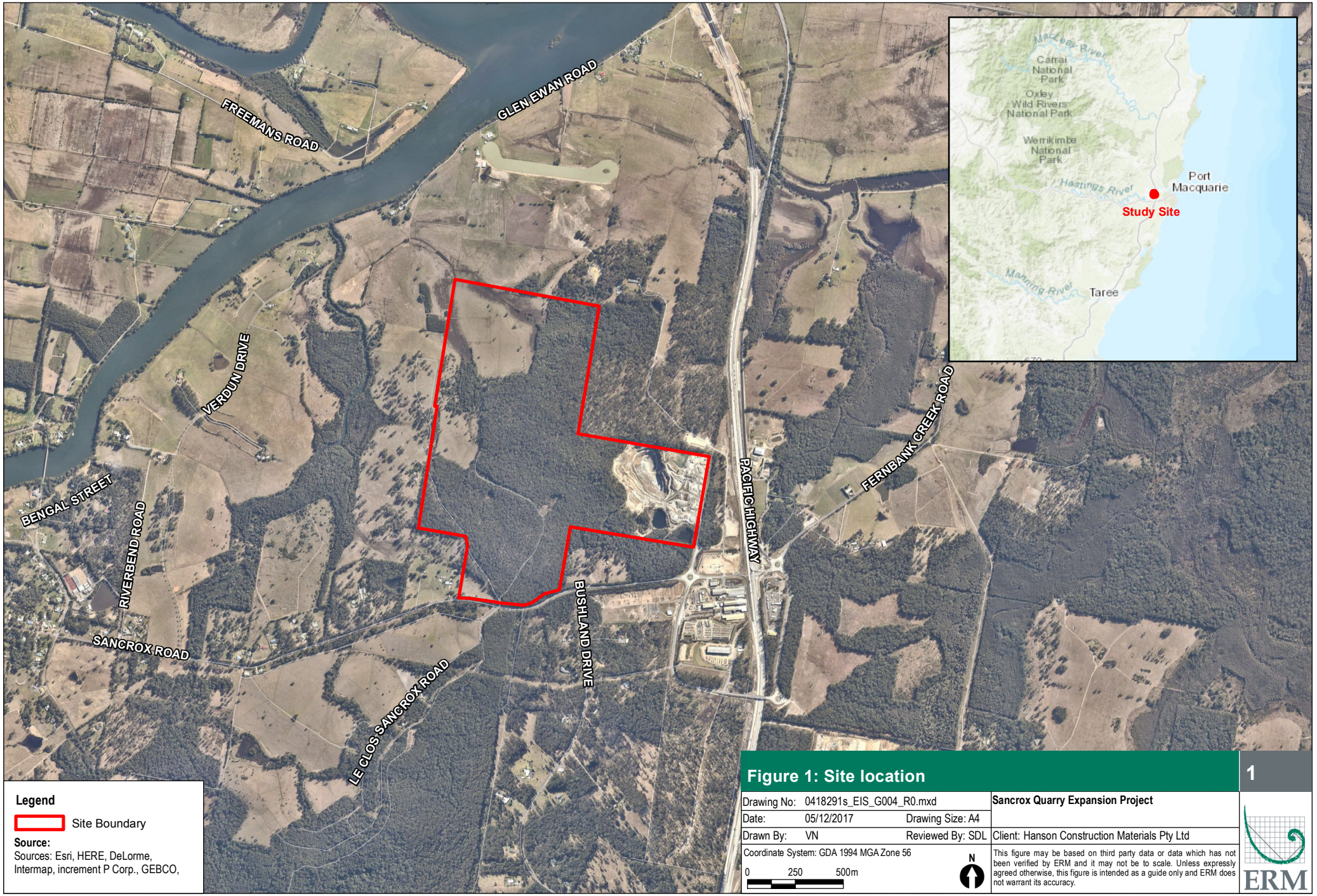
Offices worldwide

The Secretary's Environmental Assessment Requirements (SEARs) for the Project were re-issued on 18 September 2017 (refer to Attachment). We understand that the NSW Rural Fire Service were consulted by the NSW Department of Planning and Environment (DP&E) in the preparation of the SEARs. The EIS will be prepared in accordance with the SEARs and ERM has no questions or concerns relating to your area of environmental expertise. The EIS is scheduled to be on Public Exhibition around mid-2018.

Should you wish to provide any additional comments, written submissions can be made within 21 days of the date on this letter, and should be forwarded to matthew.errington@erm.com or Matthew Errington, ERM, Locked Bag 3012, Australia Square NSW 1215.

Yours sincerely,

Paul Douglass, Partner
for Environmental Resources Management Australia Pty Ltd


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
MacLeay River
Carrai National Park
Oxley Wild Rivers National Park
Werrikimba National Park
Hastings River
Port Macquarie
Study Site
Manning River
Taree
Legend
Site Boundary
Source:
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO,
Figure 1: Site location
1
Drawing No: 0418291s_EIS_G004_R0.mxd
Sancrox Quarry Expansion Project
Date: 05/12/2017
Drawing Size: A4
Drawn By: VN
Reviewed By: SDL
Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

Planning Services
Resource Assessments
Contact: Anthony Barnes
Phone: 8289 6709
Email: anthony.barnes@planning.nsw.gov.au

Matt Errington
Principal Environmental Consultant
Environmental Resources Management Australia
Locked Bag 3012 Australia Square
NSW 1215

Dear Mr Errington

Reissue of State Significant Development - Secretary's Requirements
Sancrox Quarry Extension Project (SSD 7293)

I have enclosed updated Secretary's requirements for the preparation of an Environmental Impact Statement (EIS) for the Sancrox Quarry Extension Project which replace the Secretary's requirements issued on 19 October 2015.

These requirements are based on the information you have previously provided, and reflect previous consultation with relevant government agencies.

Your attention is drawn to the environmental planning instruments (EPI), policies and guidelines to be addressed in your EIS (see Attachment 1). Please note that where these EPIs, guidelines and policies have changed or been updated, your EIS will need to address the latest available version.

The agencies' previous comments are attached for your information (see Attachment 2). You must have regard to these comments in the preparation of the EIS.

Please note that the Department may alter these requirements at any time, and that you must consult further with the Department if you do not lodge a development application and EIS for the project within the next two years.

You should establish whether the proposal requires a separate approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as soon as possible. If such an approval is required, please notify the Department immediately, as the Commonwealth approval process is likely to be integrated with the NSW approval process (under the bilateral agreement), and supplementary requirements will need to be issued.

Please contact the Department at least two weeks before you plan to submit the development application and EIS for the project. This will enable the Department to:

- confirm the applicable fee (see Division 1AA, Part 15 of the *Environmental Planning and Assessment Regulation 2000*); and
- determine the required number of copies of the EIS (hard copy and digital).

It is important for you to recognise that the Department will review the EIS for the project carefully before putting it on public exhibition. If it fails to adequately address these requirements, then you will be required to submit an amended EIS.

If you have any enquiries about these requirements, please contact Anthony Barnes on the details listed above.

Yours sincerely

Howard Reed

Howard Reed 18.9.17
Director
Resource Assessments
as the Secretary's delegate

Secretary's Environmental Assessment Requirements

State Significant Development

Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*
Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*

Application Number	SSD 7293
Proposal	The Sancrox Quarry Extension Project, which involves: • extending the approved extraction boundary by approximately 52 hectares, • extending the quarry life by ten years (from 20 to 30 years), • increasing the production limit from 455,000 tonnes per annum (tpa) to 750,000 tpa, • constructing and operating a concrete batching plant producing 20,000m^3 per annum (p/a), • constructing and operating a concrete recycling facility processing 20,000 tonnes p/a, • increasing truck movements and equipment loading from 7am–11pm weekdays, and 7am–1pm weekends and public holidays to 24 hours per day 7 days per week, • increasing quarry operations from 7am–5pm weekdays, and 7am–1pm Saturday to 24 hours per day 7 days per week, • transporting material off-site via public roads; and • Constructing and operating an asphalt plant producing 50,000 tonnes per annum.
Location	Sancrox Road Sancrox, Lot 2 DP 574308 Lot 353 DP 754434 Lot 1 DP 704890 Lot 1 DP 720807
Applicant	Hanson Construction Materials Pty Ltd (Hanson)
Date of Issue	18 September 2017
General Requirements	The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.* In particular, the EIS must include: • a stand-alone executive summary; • a full description of the development, including: – the resource to be extracted, including the amount, type and composition; – the site layout and extraction plan, including cross-sectional plans; – the production process and processing activities, including the in-flow and out-flow of materials and points of discharge to the environment; – surface infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate approvals process); – a waste (overburden, rejects, tailings etc) management strategy; – a water management strategy; – a rehabilitation strategy to apply during, and after completion of, extraction operations, and proposed final use of site; and – the likely interactions between the development and any existing, approved or proposed development in the vicinity of the site; • a strategic justification of the development focusing on site selection and the suitability of the proposed site; • a list of any approvals that must be obtained before the development may

	commence; • an assessment of the likely impacts of the development on the environment, focussing on the key issues identified below, including: – a description of the existing environment likely to be affected by the development, using sufficient baseline data; – an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice; – a description of the measures that would be implemented to avoid, minimise, mitigate and/or offset the likely impacts of the development, and an assessment of: o whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; o the likely effectiveness of these measures; and o whether contingency measures would be necessary to manage any residual risks; and – a description of the measures that would be implemented to monitor and report on the environmental performance of the development; • a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; • consideration of the development against all relevant environmental planning instruments (including Part 3 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007)*; • the reasons why the development should be approved, having regard to: - relevant matters for consideration under the *Environmental Planning and Assessment Act 1979*, including the objects of the Act; - the biophysical, economic and social impacts of the project, including the principles of ecologically sustainable development; - the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses; - feasible alternatives to the development (and its key components), including the consequences of not carrying out the development; • a signed declaration from the author of the EIS, certifying that the information contained within the document is neither false nor misleading. While not exhaustive, Attachment 1 contains a list of some of the environmental planning instruments, guidelines, policies, and plans that may be relevant to the environmental assessment of this development. In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*, the development application must be accompanied by a signed report from a suitably qualified expert that includes an accurate estimate of the capital investment value (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the development, including details of all the assumptions and components from which the capital investment value calculation is derived.
Key Issues	The EIS must address the following key issues: • **Noise & Blasting** – including: - a detailed assessment of the likely construction, operational and off-site transport noise impacts of the development in accordance with the *Interim Construction Noise Guideline*, *NSW Industrial Noise Policy* and the *NSW Road Noise Policy* respectively, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - if a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the *Interim Construction Noise Guideline*; - proposed blasting hours, frequency and methods; - a detailed assessment of the likely blasting impacts of the development (including noise, vibrations, overpressure, visual and odour) on people,

	animals, buildings, infrastructure and significant natural features, having regard to the relevant ANZEC guidelines; - reasonable and feasible mitigation measures to minimise noise emissions; and - monitoring and management measures, in particular real-time and attended noise monitoring; • **Air Quality** – including: - a detailed assessment of potential construction and operational impacts, in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW,* and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - an assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products; - reasonable and feasible mitigation measures to minimise dust and emissions; and - monitoring and management measures, in particular, real-time air quality monitoring; • **Water** – including: - a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures; - identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*; - demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP); - a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo; - an assessment of any likely flooding impacts of the development; - an assessment of the likely impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives; - an assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users; and - a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts; • **Biodiversity** – including: - accurate predictions of any vegetation clearing on site; - a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, and having regard to the *NSW Biodiversity Offsets Policy for Major Projects* and the *Framework for Biodiversity Assessment*; and - a strategy to offset any residual impacts of the development in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*, including evidence that the appropriate type and quantum of offsets will be available; • **Heritage** – including: - an assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including evidence of appropriate consultation with relevant Aboriginal communities/parties and documentation of the views of these stakeholders regarding the likely impact of the development on their cultural heritage; and - identification of historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items, having regard to the relevant policies and guidelines listed in

	Attachment 1; • **Traffic & Transport** – including: - accurate predictions of the road traffic generated by the construction and operation of the development, including a description of the types of vehicles likely to be used for transportation of quarry products; - a detailed assessment of potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road network (as identified above), including a road safety audit; and - a description of the measures that would be implemented to mitigate any impacts, including concept plans of any proposed upgrades, developed in consultation with the relevant road and rail authorities (if required); • **Land Resources** – including a detailed assessment of: - potential impacts on soils and land capability (including potential erosion and land contamination) and the proposed mitigation, management and remedial measures (as appropriate); - potential impacts on landforms (topography), paying particular attention to the long term geotechnical stability of any new landforms (such as overburden dumps, bunds etc); and - the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements in Clause 12 of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries)* 2007, paying particular attention to the agricultural land use in the region; • **Waste –** including estimates of the quantity and nature of the waste streams that would be generated or received by the development and any measures that would be implemented to minimise, manage or dispose of these waste streams; • **Hazards –** including an assessment of the likely risks to public safety, paying particular attention to the transport, handling and use of any hazardous or dangerous goods; • **Visual** – including a detailed assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, paying particular attention to any new landforms, and to minimising the lighting impacts of the development; • **Social & Economic** – including: - a detailed assessment of the likely social impacts of the development on the local and regional community in accordance with the *Social impact assessment guideline for State significant mining, petroleum production and extractive industry development*; and - a detailed assessment of the likely economic impacts of the development, paying particular attention to: o the significance of the resource; o the costs and benefits of the project; identifying whether the development as a whole would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates; and o the demand for the provision of local infrastructure and services; and • **Rehabilitation** – including the proposed rehabilitation strategy for the site having regard to the key principles in the *Strategic Framework for Mine Closure*, including: - rehabilitation objectives, progressive rehabilitation commitments, methodology, monitoring programs, performance standards and proposed completion criteria; - nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and - the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.
Consultation	During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities, service providers, Aboriginal stakeholders, community groups and affected landowners. You must:

	• consult with: - affected landowners; - community groups; - Port Macquarie-Hastings Council; - Office of Environment and Heritage (including the Heritage Branch); - Environment Protection Authority; - Division of Resources and Geoscience within the Department; - Department of Primary Industries (including the DPI Water, NSW Forestry, Agriculture and Fisheries sections and Crown Lands division); - North Coast Local Land Services; - Roads and Maritime Services; - NSW Rural Fire Service; and • establish a Community Consultative Committee for the project in accordance with the *Community Consultative Committee Guidelines for State Significant Projects,* and consult with the committee during the preparation of the EIS.
Further consultation after 2 years	If you do not lodge a development application and EIS for the development within 2 years of the issue date of these requirements, you must consult further with the Secretary in relation to the preparation of the EIS.

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	A Rehabilitation Manual for Australian Streams (LWRRDC and CRCCH)
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Land	
	Soil and Landscape Issues in Environmental Impact Assessment (NOW)
	Agfact AC.25: Agricultural Land Classification (NSW Agriculture)
	Agricultural Issues for Extractive Industries (NSW Trade and Investment)
	State Environmental Planning Policy No. 55 – Remediation of Land
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC)
Traffic	
	Guide to Traffic Generating Development (RMS)
	Road Design Guide (RMS) & relevant Austroads Standards
Biodiversity	
	Biodiversity Offsets Scheme (OEH)
	Guidelines for Threatened Species Assessment (DP&E)
	NSW State Groundwater Dependent Ecosystem Policy (NOW)
	Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW)
	State Environmental Planning Policy No. 44 – Koala Habitat Protection
Heritage	
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
	Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DP&E)
	Aboriginal Cultural Heritage Consultation Requirements for Proponents (OEH)
	Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (OEH)
	Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH)
	NSW Heritage Manual (OEH)
	Statements of Heritage Impact (OEH)
	Port Macquarie-Hastings Local Environmental Plan 2011
Hazards	
	State Environmental Planning Policy No. 33 – Hazardous and Offensive Development
	Hazardous and Offensive Development Application Guidelines – Applying SEPP 33
	Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis
Waste	
	Waste Classification Guidelines (EPA)
Rehabilitation	
	Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Strategic Framework for Mine Closure (ANZMEC-MCA)
Social & Economic	
	Social impact assessment guideline for State significant mining, petroleum production and extractive industry development (DP&E)
Environmental Planning Instruments - General	
	State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007
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	State Environmental Planning Policy (Infrastructure) 2007
	State Environmental Planning Policy 55 – Remediation of Land
	Port Macquarie-Hastings Local Environmental Plan 2011

ATTACHMENT 2

Agency Correspondence

Environmental Resources Management Australia Pty Ltd

Level 15, 309 Kent Street
Sydney NSW 2000
AUSTRALIA

Locked Bag 3012
Australia Square NSW 1215
AUSTRALIA

Telephone +61 2 8584 8888
Facsimile +61 2 9299 7502

www.erm.com

14 February, 2018

Mr Bill Butler
Assistant Manager
Land Use Assessment
NSW Roads and Maritime Services
PO Box 576
Grafton NSW 2460

Our Reference: 0418291_Sancrox Quarry EIS

Attention: Mr Bill Butler

Dear Bill

RE: SANCROX QUARRY EXPANSION PROJECT (SSD 15_7293) EIS CONSULTATION

Environmental Resources Management Australia (ERM) has been engaged by Hanson Construction Materials Pty Ltd (Hanson) to prepare an Environmental Impact Statement (EIS) for the proposed expansion of the Sancrox Quarry, near Port Macquarie, NSW. The purpose of this letter is to inform the NSW Roads and Maritime Services that the EIS process for the Project is underway and provide the opportunity for additional comments to be provided.

Sancrox Quarry has been owned and operated by Hanson since 1998 and is located 8 kilometres (km) west of Port Macquarie, within the Port Macquarie Hastings Council (PMHC) local government area (*Figure 1*). The site compromises Lot 1 DP 704890, Lot 1 DP 720807, Lot 2 DP 574308 and Lot 353 DP 754434. The site also includes Crown lands enclosure permit 49229.

Hanson currently has ownership of approximately 145ha, of which approximately 11.6ha is currently used in the extraction, processing and storage of aggregates. The Sancrox Quarry Expansion Project will involve:

- extending the life of the quarry from the current 20 years to 30 years and expanding the area of extraction to the west of the existing pit;
- increasing the maximum annual rate of extraction from 455,000 tpa to 750,000 tpa;
- upgrading and relocating existing infrastructure (including processing plant, offices, weighbridge and workshop); and
- constructing a concrete batching plant and recycling facility, asphalt production plant and pug mill on site.

Environmental Resources Management Australia Pty Ltd
A.C.N. 002 773 248
A.B.N. 12 002 773 248

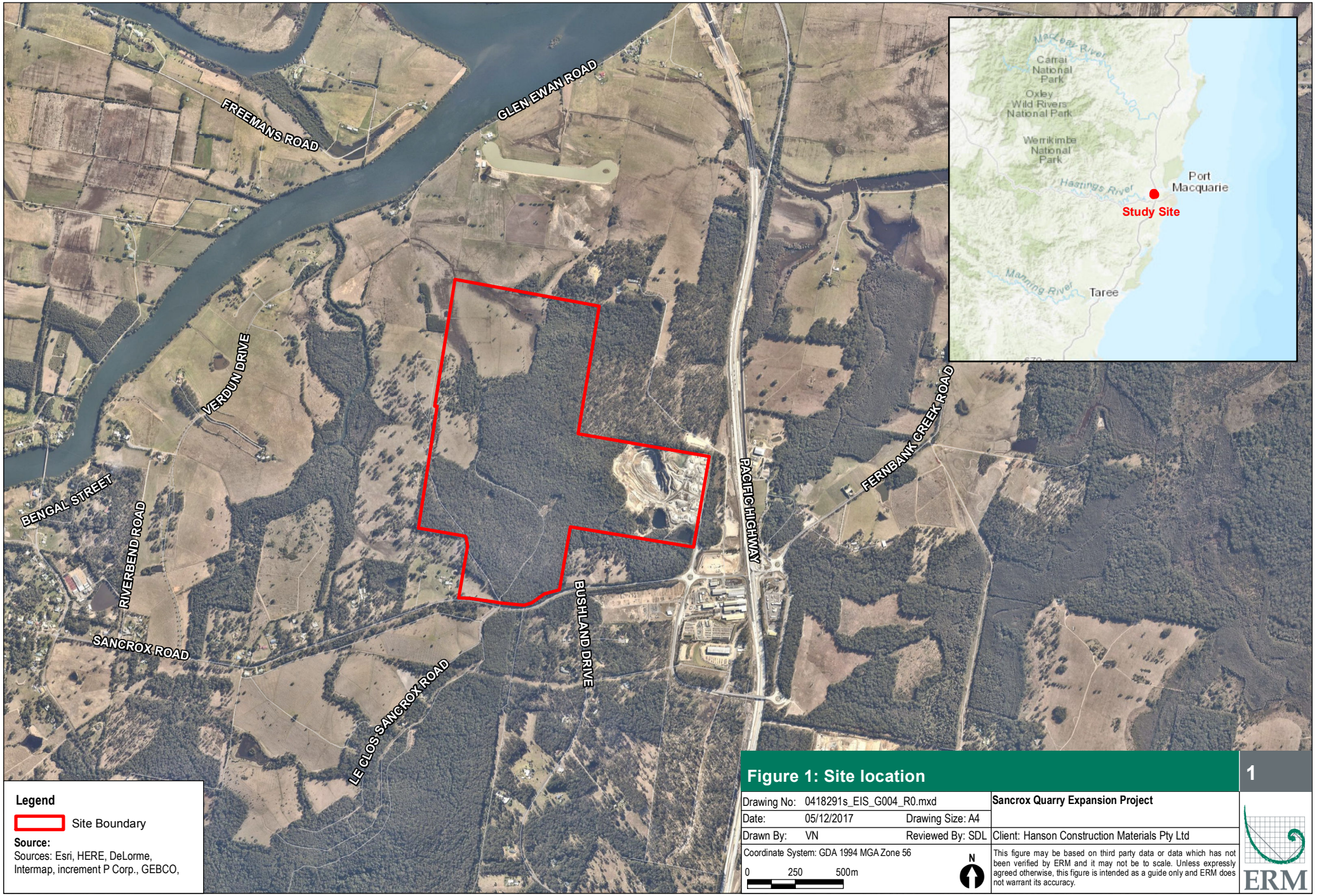
Offices worldwide

The Secretary's Environmental Assessment Requirements (SEARs) for the Project were re-issued on 18 September 2017 (refer to Attachment). We understand that the NSW Roads and Maritime Services were consulted by the NSW Department of Planning and Environment (DP&E) in the preparation of the SEARs. The EIS will be prepared in accordance with the SEARs and ERM has no questions or concerns relating to your area of environmental expertise. The EIS is scheduled to be on Public Exhibition around mid-2018.

Should you wish to provide any additional comments, written submissions can be made within 21 days of the date on this letter, and should be forwarded to matthew.errington@erm.com or Matthew Errington, ERM, Locked Bag 3012, Australia Square NSW 1215.

Yours sincerely,

Paul Douglass, Partner
for Environmental Resources Management Australia Pty Ltd


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
MacLeay River
Carrai National Park
Oxley Wild Rivers National Park
Werrikimba National Park
Hastings River
Port Macquarie
Study Site
Manning River
Taree
Legend
Site Boundary
Source:
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO,
Figure 1: Site location
1
Drawing No: 0418291s_EIS_G004_R0.mxd
Sancrox Quarry Expansion Project
Date: 05/12/2017
Drawing Size: A4
Drawn By: VN
Reviewed By: SDL
Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

Planning Services
Resource Assessments
Contact: Anthony Barnes
Phone: 8289 6709
Email: anthony.barnes@planning.nsw.gov.au

Matt Errington
Principal Environmental Consultant
Environmental Resources Management Australia
Locked Bag 3012 Australia Square
NSW 1215

Dear Mr Errington

Reissue of State Significant Development - Secretary's Requirements
Sancrox Quarry Extension Project (SSD 7293)

I have enclosed updated Secretary's requirements for the preparation of an Environmental Impact Statement (EIS) for the Sancrox Quarry Extension Project which replace the Secretary's requirements issued on 19 October 2015.

These requirements are based on the information you have previously provided, and reflect previous consultation with relevant government agencies.

Your attention is drawn to the environmental planning instruments (EPI), policies and guidelines to be addressed in your EIS (see Attachment 1). Please note that where these EPIs, guidelines and policies have changed or been updated, your EIS will need to address the latest available version.

The agencies' previous comments are attached for your information (see Attachment 2). You must have regard to these comments in the preparation of the EIS.

Please note that the Department may alter these requirements at any time, and that you must consult further with the Department if you do not lodge a development application and EIS for the project within the next two years.

You should establish whether the proposal requires a separate approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as soon as possible. If such an approval is required, please notify the Department immediately, as the Commonwealth approval process is likely to be integrated with the NSW approval process (under the bilateral agreement), and supplementary requirements will need to be issued.

Please contact the Department at least two weeks before you plan to submit the development application and EIS for the project. This will enable the Department to:

- confirm the applicable fee (see Division 1AA, Part 15 of the *Environmental Planning and Assessment Regulation 2000*); and
- determine the required number of copies of the EIS (hard copy and digital).

It is important for you to recognise that the Department will review the EIS for the project carefully before putting it on public exhibition. If it fails to adequately address these requirements, then you will be required to submit an amended EIS.

If you have any enquiries about these requirements, please contact Anthony Barnes on the details listed above.

Yours sincerely

Howard Reed

Howard Reed 18.9.17
Director
Resource Assessments
as the Secretary's delegate

Secretary's Environmental Assessment Requirements

State Significant Development

Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*
Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*

Application Number	SSD 7293
Proposal	The Sancrox Quarry Extension Project, which involves: • extending the approved extraction boundary by approximately 52 hectares, • extending the quarry life by ten years (from 20 to 30 years), • increasing the production limit from 455,000 tonnes per annum (tpa) to 750,000 tpa, • constructing and operating a concrete batching plant producing 20,000m^3 per annum (p/a), • constructing and operating a concrete recycling facility processing 20,000 tonnes p/a, • increasing truck movements and equipment loading from 7am–11pm weekdays, and 7am–1pm weekends and public holidays to 24 hours per day 7 days per week, • increasing quarry operations from 7am–5pm weekdays, and 7am–1pm Saturday to 24 hours per day 7 days per week, • transporting material off-site via public roads; and • Constructing and operating an asphalt plant producing 50,000 tonnes per annum.
Location	Sancrox Road Sancrox, Lot 2 DP 574308 Lot 353 DP 754434 Lot 1 DP 704890 Lot 1 DP 720807
Applicant	Hanson Construction Materials Pty Ltd (Hanson)
Date of Issue	18 September 2017
General Requirements	The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.* In particular, the EIS must include: • a stand-alone executive summary; • a full description of the development, including: – the resource to be extracted, including the amount, type and composition; – the site layout and extraction plan, including cross-sectional plans; – the production process and processing activities, including the in-flow and out-flow of materials and points of discharge to the environment; – surface infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate approvals process); – a waste (overburden, rejects, tailings etc) management strategy; – a water management strategy; – a rehabilitation strategy to apply during, and after completion of, extraction operations, and proposed final use of site; and – the likely interactions between the development and any existing, approved or proposed development in the vicinity of the site; • a strategic justification of the development focusing on site selection and the suitability of the proposed site; • a list of any approvals that must be obtained before the development may

	commence; • an assessment of the likely impacts of the development on the environment, focussing on the key issues identified below, including: – a description of the existing environment likely to be affected by the development, using sufficient baseline data; – an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice; – a description of the measures that would be implemented to avoid, minimise, mitigate and/or offset the likely impacts of the development, and an assessment of: o whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; o the likely effectiveness of these measures; and o whether contingency measures would be necessary to manage any residual risks; and – a description of the measures that would be implemented to monitor and report on the environmental performance of the development; • a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; • consideration of the development against all relevant environmental planning instruments (including Part 3 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007)*; • the reasons why the development should be approved, having regard to: - relevant matters for consideration under the *Environmental Planning and Assessment Act 1979*, including the objects of the Act; - the biophysical, economic and social impacts of the project, including the principles of ecologically sustainable development; - the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses; - feasible alternatives to the development (and its key components), including the consequences of not carrying out the development; • a signed declaration from the author of the EIS, certifying that the information contained within the document is neither false nor misleading. While not exhaustive, Attachment 1 contains a list of some of the environmental planning instruments, guidelines, policies, and plans that may be relevant to the environmental assessment of this development. In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*, the development application must be accompanied by a signed report from a suitably qualified expert that includes an accurate estimate of the capital investment value (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the development, including details of all the assumptions and components from which the capital investment value calculation is derived.
Key Issues	The EIS must address the following key issues: • **Noise & Blasting** – including: - a detailed assessment of the likely construction, operational and off-site transport noise impacts of the development in accordance with the *Interim Construction Noise Guideline*, *NSW Industrial Noise Policy* and the *NSW Road Noise Policy* respectively, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - if a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the *Interim Construction Noise Guideline*; - proposed blasting hours, frequency and methods; - a detailed assessment of the likely blasting impacts of the development (including noise, vibrations, overpressure, visual and odour) on people,

	animals, buildings, infrastructure and significant natural features, having regard to the relevant ANZEC guidelines; - reasonable and feasible mitigation measures to minimise noise emissions; and - monitoring and management measures, in particular real-time and attended noise monitoring; • **Air Quality** – including: - a detailed assessment of potential construction and operational impacts, in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW,* and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - an assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products; - reasonable and feasible mitigation measures to minimise dust and emissions; and - monitoring and management measures, in particular, real-time air quality monitoring; • **Water** – including: - a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures; - identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*; - demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP); - a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo; - an assessment of any likely flooding impacts of the development; - an assessment of the likely impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives; - an assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users; and - a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts; • **Biodiversity** – including: - accurate predictions of any vegetation clearing on site; - a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, and having regard to the *NSW Biodiversity Offsets Policy for Major Projects* and the *Framework for Biodiversity Assessment*; and - a strategy to offset any residual impacts of the development in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*, including evidence that the appropriate type and quantum of offsets will be available; • **Heritage** – including: - an assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including evidence of appropriate consultation with relevant Aboriginal communities/parties and documentation of the views of these stakeholders regarding the likely impact of the development on their cultural heritage; and - identification of historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items, having regard to the relevant policies and guidelines listed in

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Further consultation after 2 years	If you do not lodge a development application and EIS for the development within 2 years of the issue date of these requirements, you must consult further with the Secretary in relation to the preparation of the EIS.

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	NSW Guidelines for Controlled Activities on Waterfront Land (NOW)

Land	
	Soil and Landscape Issues in Environmental Impact Assessment (NOW)
	Agfact AC.25: Agricultural Land Classification (NSW Agriculture)
	Agricultural Issues for Extractive Industries (NSW Trade and Investment)
	State Environmental Planning Policy No. 55 – Remediation of Land
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC)
Traffic	
	Guide to Traffic Generating Development (RMS)
	Road Design Guide (RMS) & relevant Austroads Standards
Biodiversity	
	Biodiversity Offsets Scheme (OEH)
	Guidelines for Threatened Species Assessment (DP&E)
	NSW State Groundwater Dependent Ecosystem Policy (NOW)
	Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW)
	State Environmental Planning Policy No. 44 – Koala Habitat Protection
Heritage	
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
	Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DP&E)
	Aboriginal Cultural Heritage Consultation Requirements for Proponents (OEH)
	Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (OEH)
	Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH)
	NSW Heritage Manual (OEH)
	Statements of Heritage Impact (OEH)
	Port Macquarie-Hastings Local Environmental Plan 2011
Hazards	
	State Environmental Planning Policy No. 33 – Hazardous and Offensive Development
	Hazardous and Offensive Development Application Guidelines – Applying SEPP 33
	Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis
Waste	
	Waste Classification Guidelines (EPA)
Rehabilitation	
	Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Strategic Framework for Mine Closure (ANZMEC-MCA)
Social & Economic	
	Social impact assessment guideline for State significant mining, petroleum production and extractive industry development (DP&E)
Environmental Planning Instruments - General	
	State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007
	State Environmental Planning Policy (State and Regional Development) 2011
	State Environmental Planning Policy (Infrastructure) 2007
	State Environmental Planning Policy 55 – Remediation of Land
	Port Macquarie-Hastings Local Environmental Plan 2011

ATTACHMENT 2

Agency Correspondence

Stakeholders	Postal Address	Fact Sheet	Phone	Mobile	Email	Issues/Background	Notes	Responsible	Category	Current Status 27.5.15	Current Status 24.6.15
Local Residents											
Hilton Stubbs									Meet in person.	Ongoing negotiations around various fencing requirements for Hilton cows. Simon has plotted the requested fence and sent to JK. JK to visit with Hilton on 29.5.15 to further these discussions and to hand out the brochures. We see no issues at this time with Hilton as long as we make some accommodation for his cattle and keep the channels of communication clear through Brad, Simon and Hilton.	JK visited Hilton Stubbs on 5.6.15 and discussed current progression. Hilton reviewed the brochures and has no concerns other than fencing in stubbs land to control his cattle we have on the land. Simon Jones is continuing discussions (nearly every day) in regards to fencing options.
Jeff Freeman								JK	Meet in person.	Jk has requested Simon to get him a meeting for Friday (29.5.15) to hand out brochure and discuss the development. Brad and Dave have spoken with Mrs Freeman and she has no concerns at this stage.	JK and SJ visited the Freemans with great results. Jeff is keen on the new development and is encouraged with our communication. JK offered a new gate on the entry to the access road to his property. DB and BN to handle this asap. JK also offered some material for his driveway and road when required.
Dunn, James & Catherine						Several complaints received for water leaving Sancrox site. Complaints go back over 15 years. Current complaint made to council (Council notice received) being addressed using external expert. Complaints over the years for fly rock. None for several years. Refer Cassegrain and Expressway Spares for more info.	Meet in person.	Jeremy Keefe to liaise with James Dunn. Possible Noel Collyer input. JK and Brad Nelson to Liaise with Catherine Dunn.	Meet in person.	JK and BN met with James Dunn, Patrick Cassegrain and Catherine Dunn on 26.6.15 concerning the water issues ongoing. Comments were made by James Dunn that if the water is sorted then we will have no problems with the DA. If not sorted to their requirements/satisfaction then he will make several complaints against our development. A discussion was had about the development with no other comments made. Catherine Dunne expressed her pleasure with the way BN is conducting the quarry "best manger so far" and also jokingly offered JK a job at Expressway Spares because of the professional nature that we have introduced most recently. An Action Plan is underway between both parties to rectify the water issue. Risk from this neighbour remains high.	Ongoing discussions re water issue. James advised he is countering our report with his own investigation. BN is th3e point man on this relationship regarding water.
Residents/Business' within 2km											
TNT Express	Sancrox Rd		131 1150			No issues.	Meet in person.	BN	Meet in person.	BN to organise meeting by end of the week.	Not complete.
Local Businesses											
Billabong Koala Zoo	61 Billabong Drive Port Macquarie, NSW, 2444		6585 1060		info@billabongkoala.com.au	Have provided some materials (minimal) at a discounted rate. Previous manager was friends with the owner.	Meet in person.	JK	Meet in person.	JK had prelim meeting at the Zoo on Sunday 10th May and a further meeting is slated for week ending 5 June. Initial conversation with Director was positive and the feeling was it wouldn't effect them. Awaiting director to free up time for meeting.	JK has been unable to get a further meeting but will try in July.
Cassegrain Wines	764 Fernbank Creek Road , 2444		02 6583 7777			Cassegrain have made complaints regarding water in cooperation with Expressway Spares. There are historical reports of fly rock complaints. Cassegrain also made an adverse submission to the recent DA volume expansion limit in 2014	Catherine Dunn is a Cassegrain before marrying into the Dunn Family. A family relationship and I believe shareholder relationship exists between Cassegrain and Expressway Spares.	JK and BN	Meet in person.	Refer Expressway Spares.	JK to visit Cassegrain with Patrick Cassegrain in late June early July.
Expressway Spares	7 Sancrox Rd, Sancrox		02 6585 1000			Several complaints received for water leaving Sancrox site, over 15 years. Current complaint (Council notice received) being addressed using external expert. Complaints over the years for fly rock. None for several years. Expressway Spares intend to develop land adjacent to the quarry. Expressway Spares made an adverse submission to the recent DA volume expansion limit in 2014.	Hanson managers of Sancrox Quarry have been liaising with James Dunn regarding these issues. The relationship is strained over some issues. Expressway Spares are the owners of the adjoining land to the East and North of the quarry which is proposed to be developed as an industrial precinct within 5 years. Hanson has a VPA for this development already and details can be provided. Catherine Dunn is a director of the company and lives directly north of the quarry and has also made previous complaints regarding water runoff.	JK, BN and Possible NC	Meet in person.	JK and BN met with James Dunn, Patrick Cassegrain and Catherine Dunn on 26.6.15 concerning the water issues ongoing. Comments were made by James Dunn that if the water is sorted then we will have no problems with the DA. If not sorted to their requirements/satisfaction then he will make several complaints against our development. A discussion was had about the development with no other comments made. Catherine Dunne expressed her pleasure with the way BN is conducting the quarry "best manger so far" and also jokingly offered JK a job at Expressway Spares because of the professional nature that we have introduced most recently. An Action Plan is underway between both parties to rectify the water issue. Risk from this neighbour remains high.	Ongoing discussions re water issue. James advised he is countering our report with his own investigation. BN is the point man on this relationship regarding water.
Port Macquarie Airport	99 Boundary Street, Port Macquarie, NSW 2444		02 6581 8111			Supplied aggregate products for the expansion of the runway to Downer EDI in 2013.		RG	Fact Sheet.		
Chamber of Commerce - Lisa McPherson	Suite 5 Level 1 Garrison Building Cnr Hay and Clarence Streets		02 6583 4412		executive@portchamber.com.au	No real interaction to date.		JK	Fact Sheet and phone call.		No call made as yet. Will await submission.
Industry Groups											
Institute of Quarrying Australia						Some events have been attended by myself and previous manager Adam Philp. New manager Brad Nelson has some relationships but I believe is not a member.		JK and BN to join	Fact Sheet.		
Environmental Groups											
Fauna Wildlife Rescue	PO Box 218 Wauchope NSW 2446		(02) 65814141				7 km away	**RG**	Fact Sheet.		

Pappinbarra Landholders Conservation			02-6587-6033		bigmarksmail@yahoo.com	President: Kelly Miller. No interaction to date.		**RG**	Fact Sheet.		
Port Macquarie Landcare	Po Box 5287, Port Macquarie, NSW 2444		6583 6508	0432 141 605	info@landcareportmac.com.au	No interaction to date. Publish The Habitatler www.landcareportmac.com.au		**JK**	Fact Sheet and phone call.		No call made as yet. Will await submission.
Port Macquarie Council											
Clinton Tink (development assessment planner)			**(02) 6581 8538**		clinton.tink@pmhc.nsw.gov.au			JK	Meet in person.	Quarry visit set for Friday 29.5.15	Quarry visit with Clinton and Sandra was extremely successful. Both are impressed with the operation and are supportive of our development application. We discussed the potential buffer zone required and some fauna and flora issues. JK presented on an overhead projector our current and planned expansion area. Sandra and Clinton have committed to supporting our endeavour where we can and will be a valuable resource in the process.
Sandra Bush, Snr Strategic Planner	Port Macquarie-Hastings Council, PO Box 84, Port Macquarie NSW 2444		02 6581 8025		sandra.bush@pmhc.nsw.gov	Positive liaison with Jeremy Keefe; requested to be updated about additional land purchase so it does not impinge on expansion proposal.		JK	Meet in person.	Quarry visit set for Friday 29.5.15	
Community Associations											
Port Macquarie Lions Club			02 6584 9243		geraldbilling@ceinternet.com	Secretary: Gerald Billing. Supplied quarry and concrete as a donation to the Lions Club fitness stations in PMQ and Wauchope.		**JK**	Fact Sheet and phone call.		No call made as yet. Will await submission.
Rotary Club of Port Macquarie	PO Box 136, Port Macquarie NSW 2444		487690439			President: Debbie Loveday.		**RG**	Fact Sheet and phone call.		No call made as yet. Will await submission.

Meet in person
Phone Call and Fact Sheet
Fact sheet only

Planning Services
Resource Assessments
Name: Anthony Barnes
Phone: 8289 6709
Email: anthony.barnes@planning.nsw.gov.au

Belinda Pignone
Environment and Compliance Coordinator
Hanson Construction Materials Pty Ltd
Locked Bag 5260
Parramatta NSW 2124

Dear Ms Pignone

Sancrox Quarry Proposed Extension Project (SSD 7293)
Community Consultative Committee

I refer to your letter dated 12 February 2018 requesting the appointment of an independent chairperson for the Community Consultative Committee (CCC).

The Department has considered your request in accordance with the *Community Consultative Committee Guidelines, November 2016*. The Secretary has appointed Ms Lisa Andrews as the independent chairperson.

The Department notes that this is the establishment of a CCC as required by recently issued Secretary's Environmental Assessment Requirements. Consequently, the Department advises that the CCC's role is to provide input and advice regarding the Sancrox Quarry Extension Project only. Any CCC involvement with the existing Quarry's operations would only occur by agreement of all members of the CCC including the chair and your company.

You are encouraged to discuss the appointment of the CCC's community representatives with Ms Andrews at your earliest convenience, as the independent chairperson will need to oversee this process in accordance with Section 3 of the guidelines.

For any further enquiries, please contact Anthony Barnes.

Yours sincerely

Howard Reed 2·3·18
Howard Reed
Director
Resource Assessments
As nominee of the Secretary

Cc: Lisa Andrews

MINUTES OF SANCROX QUARRY

COMMUNITY CONSULTATIVE COMMITTEE MEETING

Meeting Date:	Friday 6th July 2018	
Commenced:	11:04am	
Venue:	Bayside 3, Rydges Hotel, 1 Hay Street, Port Macquarie	
Present:	Lisa Andrews (LA)	Independent Chairperson
	Andrew Driver (AD)	Eastern Region Development Manager
	Jeremy Keefe (JK)	Area Manager
	Simon Jones (SJ)	Sancrox Quarry Manager
	Belinda Pignone (BP)	Grad. Environmental Planning and Compliance Coordinator
	Maurice Driscoll (MD)	Community Representative
	Maureen Churnside (MC)	Community Representative
	Hilton King (HK)	Stakeholder Representative (Residents Action Network - RAN)
	John Cassegrain (JC)	Community Representative
	Geoff Freeman (GF)	Community Representative
	Sandra Bush (SB)	Port Macquarie-Hastings Council delegate
Apologies:	Anthony Thorne	Community Representative
	Jeff Gillespie	Community Representative

ITEM 1: **Opening & Welcome by Independent Chairperson**

LA welcomed all members and provided a briefing on why the CCC was established and the role of members, the community and proponent (Hanson) in ensuring an open forum of communication for the proposed expansion of the Sancrox Quarry.

Attendees were invited to introduce themselves and state their position on the committee.

ITEM 2: **Apologies** – Anthony Thorne & Jeff Gillespie.

ITEM 3: **Guideline overview (inaugural meeting)**

LA provided a briefing of the Community Consultative Committee Guidelines for State Significant Development, November 2016, including Code of Conduct, Pecuniary &

Non/Pecuniary Interests, Minutes procedure etc. There were no objections to Hanson providing a minute taker at the meetings.

ITEM 4: Declarations of Interest

LA declared that she is an approved Independent Chairperson with the Department of Planning & Environment and engaged by Hanson to establish the CCC and chair the meetings. Members submitted completed forms.

ITEM 5: Correspondence

- 2/3/18 - Email from Secretary - DPE appointing LA as chair of this CCC
- 21/6/18 - Email to DP&E with assessment report for consideration
- 26/6/18 - Email from DP&E with endorsement of committee members
- 26/6/18 - Emails to all successful committee members, enclosing Code of Conduct, Pecuniary/non-pecuniary interest forms and the Guidelines.
- 28/6/18 Email to members seeking an early inaugural meeting. Emails back and forth regarding availability.
- 29/6/18 - Meeting Notice & Agenda confirming date as 6/7/18.
- 4/7/18 - Email to members with the venue and agenda for this meeting
- 4/7/18 - Email from Port Macquarie Hastings Council advising that Sandra Bush, Senior Strategic Planner would be its delegate on the CCC.

ITEM 6: Presentation

<u>Background</u>

- AD provided a description of the current project overview
  - Operating hours
  - Hanson employee numbers (14)
  - Investigation of available resource in NSW – 10 year replenishment. DP&E grant approvals for 30 years
    - Hanson contacted DP&E last year to extend project life another 10 years
  - EIS process started in August 2017, nearly completed.
  - Noise, Air Quality, Transport/Traffic, Water (surface and GW), Biodiversity, Social and economic impacts.
  - Requirement to consult with community – new rules regarding CCC, requiring establishing CCC prior to submission of EIS
  - Hanson is engineering project to minimise impacts across all studies.
  - Current land holdings explained by AD
    - Current Quarry layout
    - Future Quarry layout
  - AD explained the imagery displayed and terminology
  - Clarification of resource accessibility/requirements under *State Environmental Planning Policy (State and Regional Development) 2011*
- HK – What are the current level of complaints from the existing quarry
  - SJ explained complaints over the last few years (minimal)
  - JK explained requirements of keeping complaints register under legislation

- GF advised that the land east of the project site has been zoned industrial. Working south of Sancrox Road and working north. This could impact on environmental levels within the area of Sancrox Quarry, most importantly dust.
- Has the quarry received complaints by any properties west/south of the site? JK/SJ clarified that no complaints have been received from those particular land holders.
    - The quarry is an important resource, Fernbank Road locality to the east/south of the winery has been identified as the next area for residential land use). This is for future demand - 30-40 years.
    - Highway/Express Way work infrastructure has impacted on how the local area is perceived.
        - Infrastructure is catalyst for urban growth.
- JK explained the importance of the quarry location and explained how the road upgrade has helped in transport management.

- Winery land has been rezoned as tourism.
- MD requested that environmental monitoring requirements be explained at future CCC meetings.
    - AD - Air Quality background levels are investigated with the modelled prediction of what the Quarry will be generating at full capacity added for a final level.
    - An OEH air quality monitoring station is required when formulating the modelling – the consultants forming the Air Quality Impact Assessment used Wyong in the study.
    - The use of this particular air quality monitoring station was queried by AD. Justification for its use is because it is more representative of where it sits in the environment and its neighbours.
        - However, background for Wyong is a little high (in terms of limits set out in legislation). Exceedances that have been triggered in the assessment are due to high background levels. Incremental levels are what the quarry will be contributing.
    - Further discussion on Hanson's environmental monitoring requirements will be included in for future CCC meetings.
    - Air quality monitoring will be a requirement to Australian Standard – real time monitoring will be necessary for compliance monitoring.
    - Noise will not have real time monitoring – attended and unattended noise monitoring will be compulsory. Attended noise monitoring is carried out by a technician/operator who notes when spikes happen.
    - MD – based on experience, he is aware that when a mine is established, there are potential land acquisition rights and asked if there was a need to initiate this process.
        - AD advised that there are policies in place that trigger when land acquisition is required. Hanson are engineering the project according, to avoid this trigger.
- HK – raised the issue of dust; people are concerned with dust settling on vegetation and waterways, impacting on oyster farms down the road. AD confirmed that this would be included in the EIS.
- MC asked what the type of product was that comes out of the quarry. SJ described the type of rock that is being quarried (conglomerates with some associated mudstones, shales and coal). 10% silica, is an issue that is monitored for OHS reasons.
    - Past complaint occurred during highway upgrade and crushing experience.
    - Dust suppression – watercart takes water from water holding dams.

- Water testing is completed when discharged. EPL conditions/requirements explained
- JK - Hanson received an infringement due to one x 2 month testing report being missed. Hanson takes great care that all water discharge is of the correct standard.
- HK – asked if a visual impact assessment will be undertaken to determine if there will be any visual impacts.
- MD – asked about the rehabilitation plan for the site.
    - AD – Rehabilitation is required, feedback welcomed to final landuse by community members.
        - GF stated that Council had looked at the site in 1996, doesn't lend itself to a waste storage facility due to groundwater impacts to local community.
    - Discussion of acid-sulfate risks – quarry shouldn't be impacted.

- SB - flyrock concerns had previously been brought up in the past.
    - SJ - blasting is completed by contractors – flyrock hasn't occurred in the last 5 years. All blasts recorded for safety.
        - AD – blast impact assessment with be contained in the EIS.
        - SJ – blasting conditions are highly regulated. Technology allows for hole integrity to be checked.
        - JK – regulations under the mine act, quite stringent and regulated by authority. SJ – exclusion zone taken from amount of explosive used in blast. Bigger quarries that do larger blasts have community sitting closer to the quarry than when compared to Sancrox.
    - MD – Requested the site map be included in the minutes. **Action.**
    - MD commented on the important of quarry safety.
        - JK - employee safety is of the highest importance. Employee safety is highly regulated due to legislation, however, it is also regulated within the company. Loss time injury requires contact with the General Manager and CEO of Hanson.
    - AD – pit plan modified from the image displayed. Along the planning process it was discovered that a flooding event could impact the pit so the pit has been reduced in the north-west corner of the pit design.
- AD – explained the use of the Hanson project website:
    - Ran through Project Approval for a SSD (Wagga Wagga as an example – link to be included with minutes)
    - SSD, 500000tpa or 5 million tonnes of resource
    - LA – explained what a VPA was and the differences between CCC or Council run VPAs.
- SB asked when ERM will finalise the EIS.
    - AD – in about 4 weeks. Requires adequacy checks, review from other government departments, and response to submissions (both from government departments and general feedback from the public). The EIS needs to satisfy SEARS before being placed on exhibition.
- MC asked if Hanson had considered alternate sites.
    - AD – explained the constraints associated in finding an alternative site.
- HK – When did the existing quarry start? 1983. Not many complaints received in that period. Hanson has owned the quarry since 1996.
    - JK – Workers have been with the quarry, local connection is still there. Social licence is considerable for this project.

- AD – within the EIS, Hanson is asking for permission of additional plants. Concrete batching plant, Asphalt plant and concrete recycling plant.
    - JK – Concrete plant will take Hanson out of the middle of town (Port Macquarie) and allows access to the highway. Concrete recycling plant, will not be bringing in demolition waste – waste by-product through Hanson concrete plant.
    - SJ – Council already practice concrete recycling.
    - JK/SJ – EPA highly regulates product that is received onto site. This includes soil.
    - JK – Asphalt plant, pug mill (stabilised road bases). Lime/flyash uses, regulations on stabilised bases.
    - SJ/JK – Asphalt approval allows for popup production at the quarry. There is rarely a permanent site established currently.

ITEM 7: General Business

- LA reiterated that this CCC is a conduit to the broader community. CCC members are encouraged to discuss the project with neighbours and residents and bring any questions/issues to the CCC for response.
- LA asked CCC members if they had any objection to their contact details being placed on the project website. Name & email address. No object raised.
- CCC members to take advantage of direct contact with the Quarry – any issues, please contact Hanson staff direct.
- Discussion on next CCC meeting – the next meeting to be held during the exhibition period. (Preferrably not on Wednesday and Thursday.)
- Same venue, however, arrangements will be made to provide parking under the venue to avoid any time constraints. (JK to provide details for the next CCC meeting).

ITEM 8: Next Meeting

Date to be confirmed once exhibition period is known. **Action: LA to advise**

Meeting closed at 12.30pm with LA thanking members for their attendance.

ACTION ITEMS:

ITEM	ISSUE	WHEN	RESPONSIBILITY
1	Provide copy of project map	With minutes	AD/LA
2	Future presentations to CCC (Dust – monitoring & suppression; Noise – monitoring and mitigation)	When available	AD
3	Link to project website	With minutes	LA
4	Advise CCC of next meeting date	When known	AD/LA

3: http://www.hanson.com.au/About/Regulatory-Information/Projects/Wagga-Wagga-Extension-Project
Website includes documentation of project approval, management plans, environmental monitoring, annual reviews.

Planning Services
Resource Assessments
Name: Genevieve Seed
Phone: 9274 6489
Email: genevieve.seed@planning.nsw.gov.au

Ms Lisa Andrews
Independent Chairperson
Sancrox Quarry CCC
PO Box 6017
Lake Munmorah NSW 2580

Dear Ms ~~Andrews~~ Lisa

Sancrox Quarry Expansion Project (SSD 7293)
Community Consultative Committee

I refer to your correspondence dated 21 June 2018 recommending the Secretary's endorsement of community representatives to be appointed to the Sancrox Quarry Community Consultative Committee (CCC).

I note that this CCC is a requirement of the Planning Secretary's Environmental Assessment Requirements (SEARs) for a proposed expansion to the existing quarry.

In accordance with the Department's *Community Consultative Committees Guidelines for State Significant Projects 2016,* please be advised that the following appointments have been endorsed:

- Mr Maurice Driscoll (local community representative);
- Ms Maureen Churnside (local community representative);
- Mr Hilton King (representative of the Residents Action Network (RAN) stakeholder group);
- Mr Jeff Gillespie (local community representative);
- Mr John Cassegrain (local community representative);
- Mr Anthony Thorne (representative of the Port Macquarie Chamber of Commerce stakeholder group); and
- Mr Geoff Freeman (local community representative).

I would appreciate if you would advise the successful candidates of their appointments and request that you return their completed Code of Conduct and Declaration of Pecuniary and Non-Pecuniary Interest forms at your earliest convenience.

Should you have any questions about this letter, please contact Genevieve Seed at the details above.

Yours sincerely

Howard Reed

Howard Reed 26.6.18
Director
Resource Assessments

Annex C

Biodiversity Assessment Report

SANCROX QUARRY EXTENSION PROJECT

State Significant Development (SSD 7293)
Biodiversity Assessment Report

Prepared for: Hanson Heidelberg Cement Group

SLR Ref: 630.11478.00100
Version No: -v2.1
June 2019

PREPARED BY

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Hanson Heidelberg Cement Group. Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
630.11478.00100-R01-v2.1-v2.1	17 June 2019	Jeremy Pepper, M Consterdine	J Pepper	J Pepper

EXECUTIVE SUMMARY

Project Description

Hanson Construction Materials Pty Ltd is seeking project approval for the expansion of the existing Sancrox hard rock quarry, located on Sancrox Road, Sancrox. The Sancrox Quarry Expansion Project will involve extending the life of the quarry to 30 years and increasing approved extraction limits of 175,000 m^3. The Project will be assessed as a State Significant Development (SSD 7293) as defined under *State Environmental Planning Policy (State and Regional Development) 2011*, and will require development consent under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979*. Under the *NSW Biodiversity Offsets Policy for Major Projects,* the SEARs require the proponent to apply the *Framework for Biodiversity Assessment* to assess impacts on biodiversity. A *Biodiversity Assessment Report* is required to describe the biodiversity values present on the development site and the impact of the Major Project on these values.

Existing Biodiversity Values

Field surveys conducted as part of the *Biodiversity Assessment Report* were in accordance with the relevant sections of the *Framework for Biodiversity Assessment*. The field assessment included targeted surveys for threatened orchid species, completed on the 16 October 2015, diurnal and nocturnal threatened fauna surveys from 30 November to 4 December 2015 and additional threatened species surveys completed between 14 and 15 December 2015.

Vegetation and Plant Communities

The Development Site contains native woody vegetation with areas of cleared land and artificial ponds for water retention. Presented below are the Plant Community Types identified on the development site during the field surveys.

- PCT 686 - Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion (0.55 ha);
- PCT 1215 - Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion (10.86 ha); and
- PCT 1265 - Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast (30.32 ha).

No significant state or regional biodiversity links have been mapped on the Development Site; however aerial imagery identified two local links that traverse the site that contribute to vegetation connectivity in the area. There is also a portion of a “sub-regional biodiversity corridor” mapped in the Greater Sancrox Structure Plan, which traverses south-north through the centre of the Development Site.

Flora and Fauna Habitats

During the field surveys habitat features, such as hollow-bearing trees, were recorded throughout the Development Site. No naturally occurring aquatic habitats were recorded as the site contains only ephemeral (unnamed) first and second order watercourses most of which drain into retention dams constructed as part of the infrastructure of the current quarry.

EXECUTIVE SUMMARY

Threatened Species Recorded

The following seven threatened species, all of which are native bat species and generate ecosystem credits, were recorded on site as a result of field surveys:

- Eastern Freetail-bat *Mormopterus norfolkensis* (Ecosystem credit);
- Eastern False Pipistrelle *Falsistrellus tasmaniensis (*Ecosystem credit);
- Greater Broad-nosed Bat *Scoteanax rueppellii* (Ecosystem credit);
- Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* (Ecosystem credit);
- Little Bent-wing Bat *Miniopterus australis* (Ecosystem credit);
- Eastern Bentwing-bat *Miniopterus schreibersii oceanensis* (Ecosystem credit); and
- Grey-headed Flying-fox *Pteropus poliocephalus* (Ecosystem credit).

According to the BioBanking Credit Calculator, 27 ecosystem credit species are predicted to occur on the site. Of the 27 species, 26 are deemed as being 'on site' due to the presence of one or more of the species habitat components (foraging, breeding or roosting habitat). The Credit Calculator predicts that 24 species credit species might be present on the site. Of those, indirect evidence for one species, the Koala (*Phascolarctos cinereus)* was recorded; however extensive searches of the Development Site recorded no Koalas or evidence of recent Koala activity. No threatened flora species, or other fauna species, were recorded on the Development Site.

Biodiversity Impacts

The direct impacts associated with the project include the clearing of 43.1 ha of native forest vegetation, 0.55 ha of which is identified as the threatened ecological community *Subtropical coastal floodplain forest* (NR117). Other impacts include the loss of hollow-bearing trees, which may provide potential breeding habitat and roost sites for a number of arboreal mammals, microchiropteran bats and bird species and the removal of foraging habitat for native fauna.

The clearing of 43.1 ha of native forest vegetation has been quantified in terms of biodiversity credits, with the proposed clearing resulting in the generation of 2,449 ecosystem credits. The type and number of ecosystem credits generated by the proposed vegetation removal is as follows:

- Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion (NR117) – 33 credits;
- Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion (NR247) – 490 credits; and
- Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast (NR263) – 1926 credits.

There are no species credits generated as a result of the impacts associated with the project.

EXECUTIVE SUMMARY

Impact Avoidance, Mitigation and Offsetting

A selection of best management practices and mitigation measures will be implemented, including a site-specific *Operational Environmental Management Plan* and a *Landscaping Strategy*, to minimise impacts on biodiversity values. Impact avoidance measures for the project have involved site selection and optimisation of the development footprint. There are limited opportunities to avoid native vegetation on the site; notwithstanding, around 29 % of the development footprint comprises cleared land or non-native vegetation.

The assessment has determined that a biodiversity offset is required in accordance with the *Framework for Biodiversity Assessment* and the *NSW Biodiversity Offsets Policy for Major Projects.* Offsets are generally secured prior to commencement of construction, although this can be deferred if a Voluntary Planning Agreement (under the *Environmental Planning and Assessment Act 1979*) is entered into prior to project approval. The offset will be secured either through purchasing and retirement of 2,449 ecosystem credits from the credit market (with some ecosystem credits to be generated by potential offset lands within the study area) or payment of an equivalent monetary value into the recently established Biodiversity Conservation Fund.

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APPENDICES

1 Introduction

1.1 Background

SLR Consulting Australia (SLR) has been engaged to prepare a BioBanking Assessment Report (BAR) to support an application by Hanson Construction Materials Pty Ltd seeking project approval for expansion of the existing Sancrox hard rock quarry. The Sancrox Quarry (including the proposed development site) is located approximately 8 kilometres (km) west of Port Macquarie, within the Port Macquarie local government area on the Mid North Coast of New South Wales (NSW) (**Figure 1**).

The Project will be assessed as a State Significant Development (SSD) as defined under *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP), and will require development consent under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). As such, an environmental impact statement (EIS) will be required to be prepared to support the project application under the SSD process. It is intended that this BAR informs the EIS and will be included as a technical document in the EIS.

The Secretary's Environmental Assessment Requirements (SEARs) for the EIS, as issued by the Secretary of the Department of Planning and Environment (DP&E), require the preparation of a Biodiversity Assessment Report (BAR) in accordance with the *Framework for Biodiversity Assessment* (FBA). A copy of the SEARs that apply to this BAR, including the DP&E summary of requirements and the detailed requirements of the NSW Office of Environment and Heritage (OEH), are provided in **Appendix A.** The relevant SEARs and a listing of where they are addressed in this BAR are summarised in **Section 1.4**.

This BAR has been updated in May 2019 to address comments from OEH as part of the adequacy review of the EIS.

1.2 Proposed Development Site

The general location and features of the site and study area are displayed in the Site Map, which is provided in **Figure 2**. In accordance with the FBA, the Site Map contains the following features:

- Boundary of the development site;
- Lot boundaries and labels (i.e. cadastre);
- IBRA region and subregion;
- Mitchell landscapes;
- Rivers and streams (no wetlands are present); and
- Extent of native vegetation.

The study area, including the quarry lands owned by Hanson, comprises approximately 145 hectares (ha) of which 6.5 ha is currently occupied by the quarry and its facilities. The site is identified as Lot 1 in DP 702807, Lot 1 in DP 704890, Lot 2 in DP 574308 and Lot 353 in DP 754434. There is also a parcel of Crown Land separating Lot 2 into a north and a south section. The site is zoned RU1 (Primary Production) under the *Hastings Local Environmental Plan 2011*.

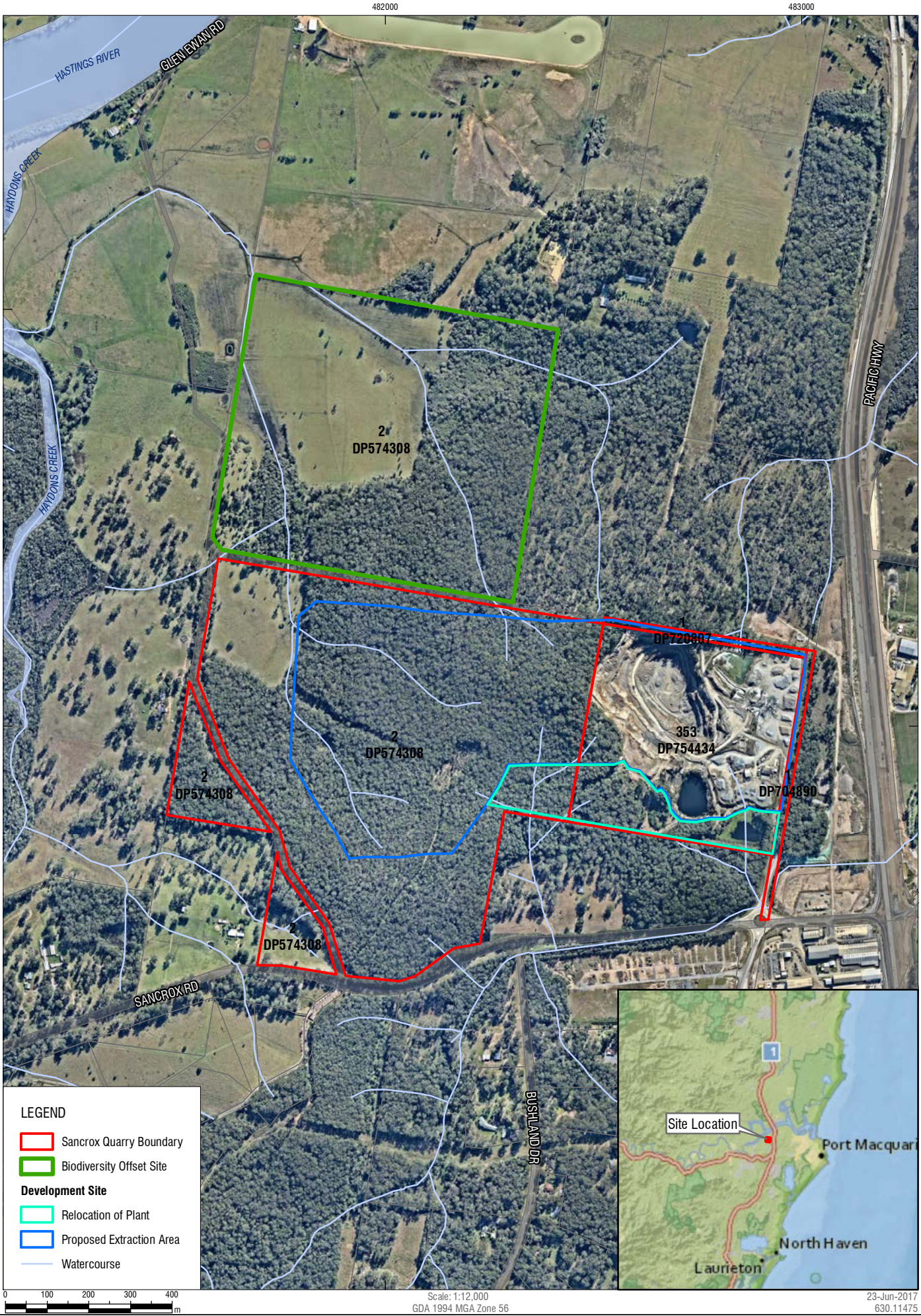
The site is located within the Port Macquarie-Hastings Local Government Area (LGA), Northern Rivers CMA and the NSW North Coast IBRA region and Macleay-Hastings sub-region. The Wauchope Coastal Foothills Mitchell landscape is mapped as occurring over the vast majority of the development site, with the Manning-Macleay Coastal Alluvial Plain landscape mapped as occurring across the northwestern parts of the study area (**Figure 2**).

There are no wetlands, rivers or streams traversing the development site, although a number of small ephemeral (and unnamed) first and second order watercourses are present, with two draining to the west and then north (beyond the site boundary) to Haydons Creek and then eventually the Hastings River. Other small tributaries drain south to the road drainage system of Sancrox Road or to the artificial dams located within the existing quarry area (**Figure 2**).

The vegetation within the study area and surrounding land is predominately native woody vegetation, interspersed with large expanses of cleared grassland (predominantly used for stock grazing), some areas of industrial use (i.e. the Sancrox industrial estate to the south) and major infrastructure of the Pacific Highway to the west (**Figure 2**). The southern parts of Lot 2 contain mostly white stringy bark-tallowwood-grey gum dry forest with patches of spotted grey gum grassy dry forest. The northern parts of Lot 2 contain stands of broad-leaved paperbark-mixed eucalypt swamp forest complex and stands of swamp mahogany-swamp forest. There are also small stands of flax-leaved paperbark-eucalyptus-prickly leaved tea tree forests among larger communities of white stringybark-tallowwood-grey gum dry forest.

The topography of the development site is varied, ranging between approximately 4 metres Australian Height Datum (AHD) and 62 metres AHD. The site area includes sections of steep slopes and ridgelines. The visual amenity is that of woodland with a small amount of disturbed land outside the area of current operations. There are two man-made ponds on the site as well as a drainage line that run from north to south.

There are patches of cleared grassland in the western and northwestern parts of Lot 2, which lie in the western margins of the study area and are currently subject to cattle grazing.



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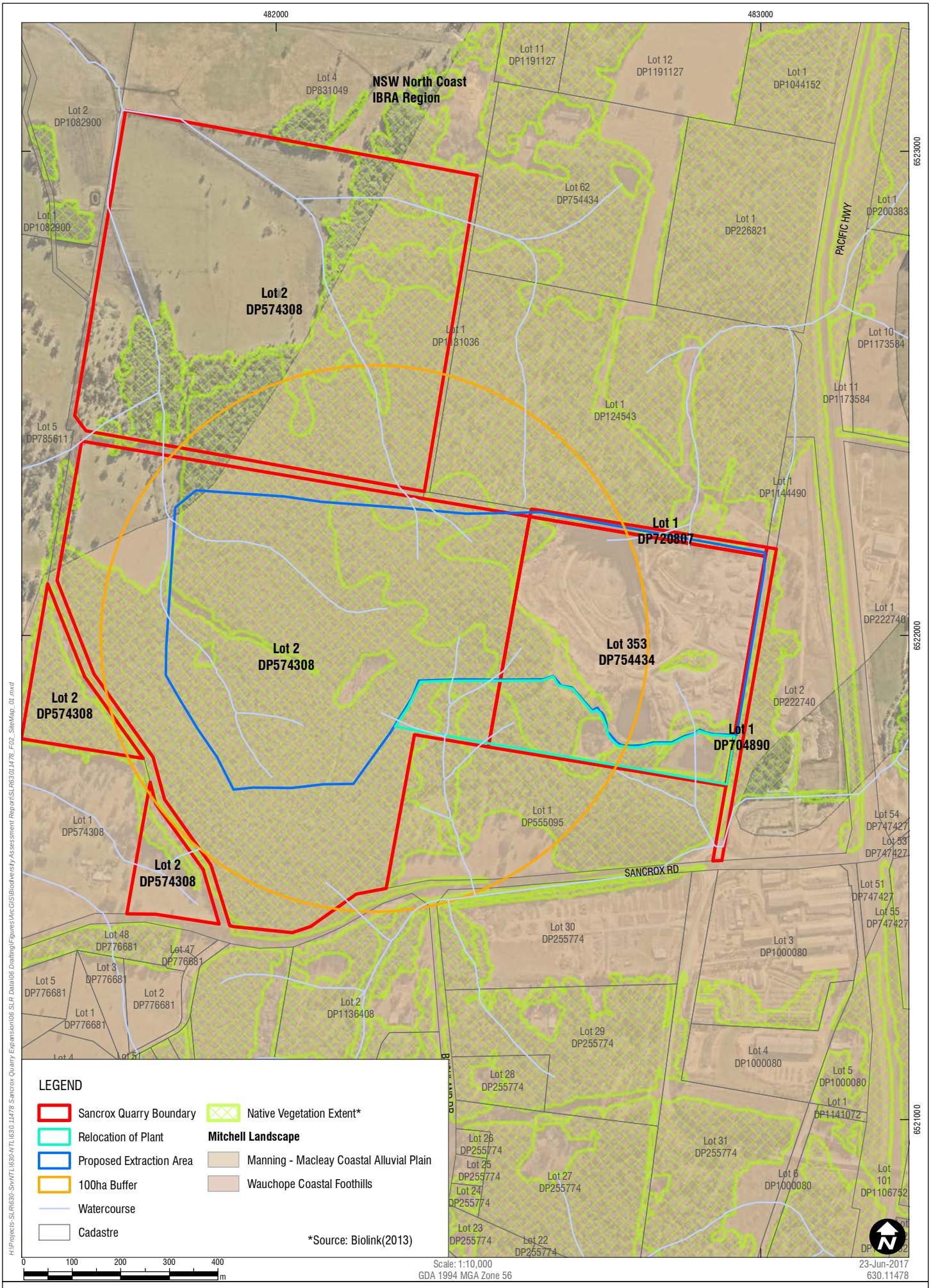
Study Area and Regional Location

FIGURE 1



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Site Map

FIGURE 2

1.3 Proposed Development

The information provided in this section is drawn from the *Preliminary Environmental Assessment* (Hanson 2015).

Hanson is seeking development consent under Part 4 of the EP&A Act to expand the quarry to extract and distribute construction materials for civil infrastructure, concrete and road construction projects. The proposed project will involve extending the life of the quarry to 30 years and increasing approved extraction limits of 175,000 m^3 (455,000 tonnes) per annum as per both DA1995/0193 and DA2004/609, to 750 000 tonnes per annum. Hanson is seeking project approval for 30 years.

The development will comprise expansion of the quarry footprint in a westerly direction into Lot 2, DP 574308 (**Figure 1**). This will include an upgrade and relocation of the existing infrastructure area including processing plant, offices, weighbridge, and workshop. Additionally the project includes the proposal for the construction of a concrete batching plant, concrete recycling facility, asphalt plant and pug mil. **Figure 3** shows the proposed extraction limit and infrastructure area.

Hanson is also seeking to enclose and purchase a parcel of Crown land, pursuant to the NSW *Roads Act 1993*, which splits Lot 2 (DP 574308), into northern and southern portions (**Figure 2**). This purchase will enable the methodical development of the quarry site.

1.3.1 Ancillary Infrastructure

The proposed project will involve an upgrade and relocation of the existing infrastructure area including processing plant, offices, weighbridge, and workshop. Additionally the project includes the proposal for the construction of a concrete batching plant, concrete recycling facility, asphalt plant and pug mil on site. The concrete plant will supply concrete within the local markets. The plant will produce approximately 20,000 m^3 of concrete each year. The plant infrastructure will be constructed on a concrete hard stand area and water runoff will be managed on site. The plant would consist of upright silo(s), incline conveyor belt, load bins, admixture bunded area, and batch room/amenities.

Other ancillary works include noise mounds, which are to be constructed along the southern and western margins of the site, and the establishment of an asset protection zone (APZ) around the administration buildings in the eastern parts of the site (within the existing quarry area) as depicted in **Figure 3**. The western noise mound lies outside of the proposed quarry footprint and would require the removal of around 1.26 hectares of native vegetation.

1.3.2 Operational Development Footprint

The layout of the proposed development is displayed in **Figure 3**. The proposed extraction limit is approximately 52.0 ha and the proposed infrastructure area is approximately 6.9 ha. Both areas include the current (and historically cleared and disturbed) quarry footprint.

Importantly, the proposed quarry footprint area assessed in this BAR was adjusted after the assessment, to avoid a mapped flood risk area. As a result, the quarry pit area was reduced by around three hectares in the northwestern corner of the pit. The current quarry layout, as presented in the current version of the EIS, is presented in **Appendix L.**

Conversely, since the original BAR assessment was completed, the proposed development footprint now includes noise attenuation structures (mounds or bunds) and the proposed western noise mound will require an additional 1.26 hectares of vegetation removal. On balance, the reduced pit payout combined with the western noise mound included will involve a reduction of the original footprint by 1.94 hectares. However, for simplicity, the proponent has agreed to retain the original footprint areas for the purposes of calculating impacts in this current version of the BAR. Accordingly, the depiction of the quarry footprint and the vegetation zones described in this version of the BAR remain unchanged from the original version submitted with the EIS for adequacy review.

In addition to extraction, the proposed development will also include the following operational activities:

- Blasting: 8 am – 5 pm Monday to Friday;
- Truck movements and equipment loading: 24 hours 7 days;
- Quarry operations (incl. production and maintenance): 24 hours a day, 7 days a week;
- Concrete batching plant - 20,000 m^3 per year;
- Concrete recycling plant - 20, 000 tonnes per year; and
- Constructing and operating an asphalt plant producing 50,000 tonnes per annum.

Further details on the Project are provided in the accompanying EIS.

1.4 Scope and Aims of this Report (SEARs)

Under the *NSW Biodiversity Offsets Policy for Major Projects* (NSW Government & OEH 2014), the SEARs require a proponent to apply the Framework for Biodiversity Assessment (FBA) to assess impacts on biodiversity. The FBA is also applied to identify reasonable measures and strategies that can be taken to avoid and minimise impacts on biodiversity. A Biodiversity Assessment Report (BAR) is required to describe the biodiversity values present on the development site and the impact of the Major Project on these values. Additionally, a Biodiversity Offset Strategy (BOS) is required to outline how the proponent intends to offset the impacts of the Major Project. These reports form part of the EIS.

The Department of Planning and Environment provided the SEARs for the Sancrox Quarry Extension Project (SSD 7293) on 19 October 2015. Biodiversity was identified as an issue in the SEARs and was "*to be assessed and documented in accordance with the Framework for Biodiversity Assessment…*" As the two year validity period on the original SEARs lapsed, revised SEARs were issued in September 2017. An excerpt of the revised SEARs is provided in **Appendix A** of this report.

Table 1 lists the revised SEARs that are relevant to biodiversity. Of particular note is the requirement (as stated in the revised agency letter from OEH) for the biodiversity assessment to be prepared according to the Biodiversity Assessment Method (BAM), pursuant to the NSW *Biodiversity Conservation Act 2016* (BC Act), which came into effect on 25 August 2017 (**Table 1**). However, the transitional arrangements for the BC Act allow for biodiversity assessments for State Significant Developments to be prepared under the former legislation for which SEARs were issued prior to 25 August 2017. Accordingly, this Biodiversity Assessment Report has been prepared according to the FBA, pursuant to the (former) *Threatened Species Conservation Act 1995* (as amended).

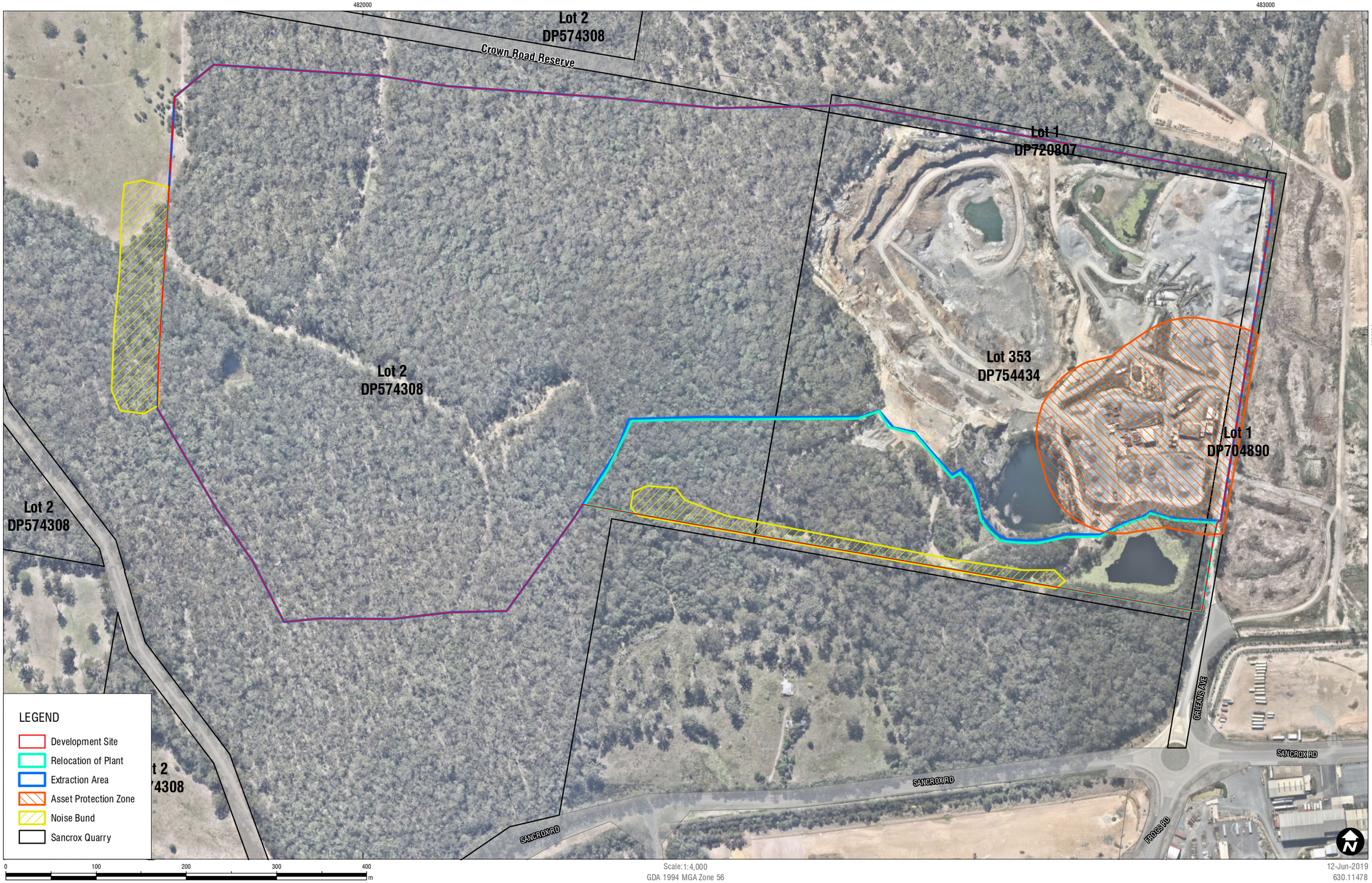
Table 1 Revised SEARs relating to Biodiversity

SEARs	Location in BAR
Key Issue – Biodiversity to include:	
Accurate predictions of any vegetation clearing on site.	Chapters 5 and 6
a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, and having regard to the *NSW Biodiversity Offsets Policy for Major Projects* and the *Framework for Biodiversity Assessment*.	Chapters 5 and 6
A strategy to offset any residual impacts of the development in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*, including evidence that the appropriate type and quantum of offsets be available.	Chapter 7
OEH requirements (SEARs letter, Attachment B)	
The EIS is to include relevant local planning undertaken by the Port Macquarie – Hastings Council for the Greater Sancrox Area, in the context of the landscape to assess existing, and future habitat connectivity, especially in regards to alignment of subregional corridors, and local habitat linkages in accordance with s4.2.1.3(d) of the BAM.	Section 2.8
The species listed below as 1(a) and (b) are to be included, as part of the 'potential' serious and irreversible impacts, on other threatened entities as part of s10.2.1.5 of the *Biodiversity Assessment Method 2017* (BAM), not listed in the *Guidance and criteria to assist the decision maker to determine a serious and irreversible.* Should one of these entities be identified during survey, the proponent is required to provide additional information in accordance with section 10.2 of the BAM • *Dendrobium melaleucaphilum*- Spider Orchid • *Phaius australis* - Southern Swamp Orchid	Chapters 4 to 6

Consideration of the *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act) is also provided (see **Section 8**). Matters of National Environmental Significance (MNES) are protected under the EPBC Act and the FBA requires proponents to identify and assess the impacts on all nationally listed threatened species and threatened ecological communities that may be on the development site. Other MNES are not considered by the FBA.

The aims of the Report are as follows:

- Address the requirements of the SEARs;
- Address the requirements of the FBA;
- Describe the existing flora and fauna and other diversity values of the development site;
- Identify threatened biota of potential relevance to the site;
- Describe and quantify impacts on biodiversity values in accordance with the FBA; and
- Identify suitable measures to avoid, minimise and offset impacts on biodiversity associated with the Project.



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Aerial Image of the Development Site

Figure 3

1.5 Information Sources

The key information sources utilised in the assessment include:

- the *OEH Atlas of NSW Wildlife* for previous records of threatened species from the locality;
- the Protected Matters Search Tool, located on the Department of the Environment website (DE 2014b) for matters of national environment significance (as listed under the EPBC Act) predicted to occur within the locality;
- the *Threatened Species Profile Database*, for detailed information on threatened species of relevance to the site and the locality;
- GIS data on Interim Biogeographic Regionalisation for Australia (IBRA) regions and Mitchell Landscapes;
- the BioBanking Credit Calculator, for lists of predicted ecosystem credit species and species credit species and for the Project credit requirements;
- regional vegetation mapping, including GIS data that was utilised to prepare base vegetation maps and design field surveys;
- data collected during field surveys; and
- officers of the Office of Environment and Heritage (OEH), NSW Offsets Policy Team who provided assistance on particular matters relating to the FBA and the Credit Calculator.

Key documents that were reviewed and applied to inform this BAR include:

- Greater Sancrox Structure Plan 2014-2034 (PMHC 2015);
- Greater Sancrox Ecological Assessment (Biolink 2011); and
- Vegetation of the Port Macquarie Hastings LGA (Biolink 2013).

Other references and published literature are listed in the References section.

1.6 Methods Summary

This BAR was prepared according to the steps and processes detailed in the FBA, with the key steps being:

- Desktop review – database searches to identify listed threatened biota (species, populations and communities) of potential relevance to the study area; initial GIS mapping; survey design;
- Field survey of the study area (see **Appendix B** for details);
- GIS mapping and data compilation;
- Using GIS and field survey results to complete the 'landscape assessment';
- Identification of vegetation zones and use of BioBanking plot/transect data and GIS mapping to assess 'site value';
- Applying the proposed development footprint in GIS to calculate vegetation removal;
- application of the Credit Calculator, including identification of candidate threatened species and impact credit calculations; and
- Preparation of the BAR and BOS.

Appendix B provides details of the field surveys, including methods, survey effort and weather conditions. The field surveys conducted as part of this BAR are as follows:

- Targeted orchid survey on the 16 October 2015, timed to coincide with the known flowering period of the threatened orchid *Dendrobium melaleucaphilum*; details regarding the survey methods and results for the targeted orchid survey are provided in **Section 6.4**.
- five-day, four-night survey for threatened fauna species conducted by two SLR ecologists from 30 November to 4 December, 2015;
- two-day survey by two SLR ecologists to conduct plot/transect surveys according to the BioBanking methodology set out in the FBA;
- a one-night one day survey conducted by one SLR ecologist between 14 and 15 December 2015, to address minimum recommended survey effort (when combined with the five-day four-night survey) for a selection of threatened species previously recorded in the locality.

The purpose of the field surveys was to inspect the areas proposed for development and to collect the necessary floristic and habitat details for completion of the FBA assessment (including plot and transect data for site value score and targeted threatened species surveys). The survey design, including the location, number and set out of plot/transects, was completed according to the FBA. Copies of plot/transect field sheets are provided in **Appendix C**.

Application of the BioBanking Credit Calculator was completed by Jeremy Pepper, Principal Ecologist, accredited under s.142B(1)(c) of the *Threatened Species Conservation Act 1995* (TSC Act) (assessor #0107).

1.7 SLR Project Team – Staff Qualifications

The roles and qualifications of all staff responsible for preparation of this report are listed in **Table 2**.

Table 2 Staff Roles and Qualifications

Staff Name	Project Role	Qualifications
Jeremy Pepper	Project Manager Threatened orchid surveys FBA field work (plot/transects) Report co-author Credit Calculations Accredited BioBanking Assessor	Bachelor of Science (Hons Class 1) University of NSW 1996 Certificate II Bushland Regeneration, TAFE NSW Cert III Horticulture (Arboriculture), TAFE NSW BioBanking accredited assessor (#0107)
Gary Leonard	Flora and vegetation survey FBA plots/transects Plant identification Reporting	Masters of Science (in progress) Diploma of Education National Diploma of Horticulture Horticulture Certificate
Matt Doherty	Report drafting and research	Bachelor of Environmental Science and Management, University of Newcastle 2016
Matt Consterdine	Ecologist Threatened species surveys Reporting	Bachelor of Environmental Science & Management, University of Newcastle, 2011
Louise Hibbert	CAD/GIS Draftsperson	Dip Architectural Technology, 2007 Cert IV Civil Construction Design, 2012

Staff Name	Project Role	Qualifications
Stacy Mail	Threatened species surveys	Bachelor of Engineering (Civil) Diploma of Land Management

1.8 Definitions

Definitions used in this report are listed in **Table 3**.

Table 3 Common definitions and abbreviations used in the BAR

Term	Definition
BC Act	NSW *Biodiversity Conservation Act 2016*
Development Site	The area proposed for the quarry expansion and associated infrastructure and ancillary works, as shown in **Figure 3**
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
Locality	All land within 10 kilometres (km) of the Development Site.
Study Area	Area of land containing the Development Site and surrounding land that was subject to field surveys and desktop review
Threatened biota	Any threatened species, population or ecological community listed under the schedules of the BC Act (or former TSC Act). Threatened species and ecological communities listed under the EPBC Act.
TSC Act	NSW *Threatened Species Conservation Act 1995* (now repealed)
Matter of NES	Matter of national environmental significance listed under the EPBC Act
TEC	Threatened ecological community listed under BC Act, TSC Act and/or EPBC Act
EEC	Endangered ecological community listed under BC Act, TSC Act and/or EPBC Act

2 Landscape Features

This chapter describes the landscape features of the study area and surrounds, in accordance with Section 4 of the FBA.

2.1 Overview

Relevant landscape features pertaining to the study area have been identified according to Chapter 4 of the FBA, including:

- IBRA regions and subregions;
- Mitchell landscapes;
- Native vegetation extent and any 'cleared areas' (noting any differences between mapped vegetation and aerial imagery);
- Rivers and streams; and
- Wetlands.

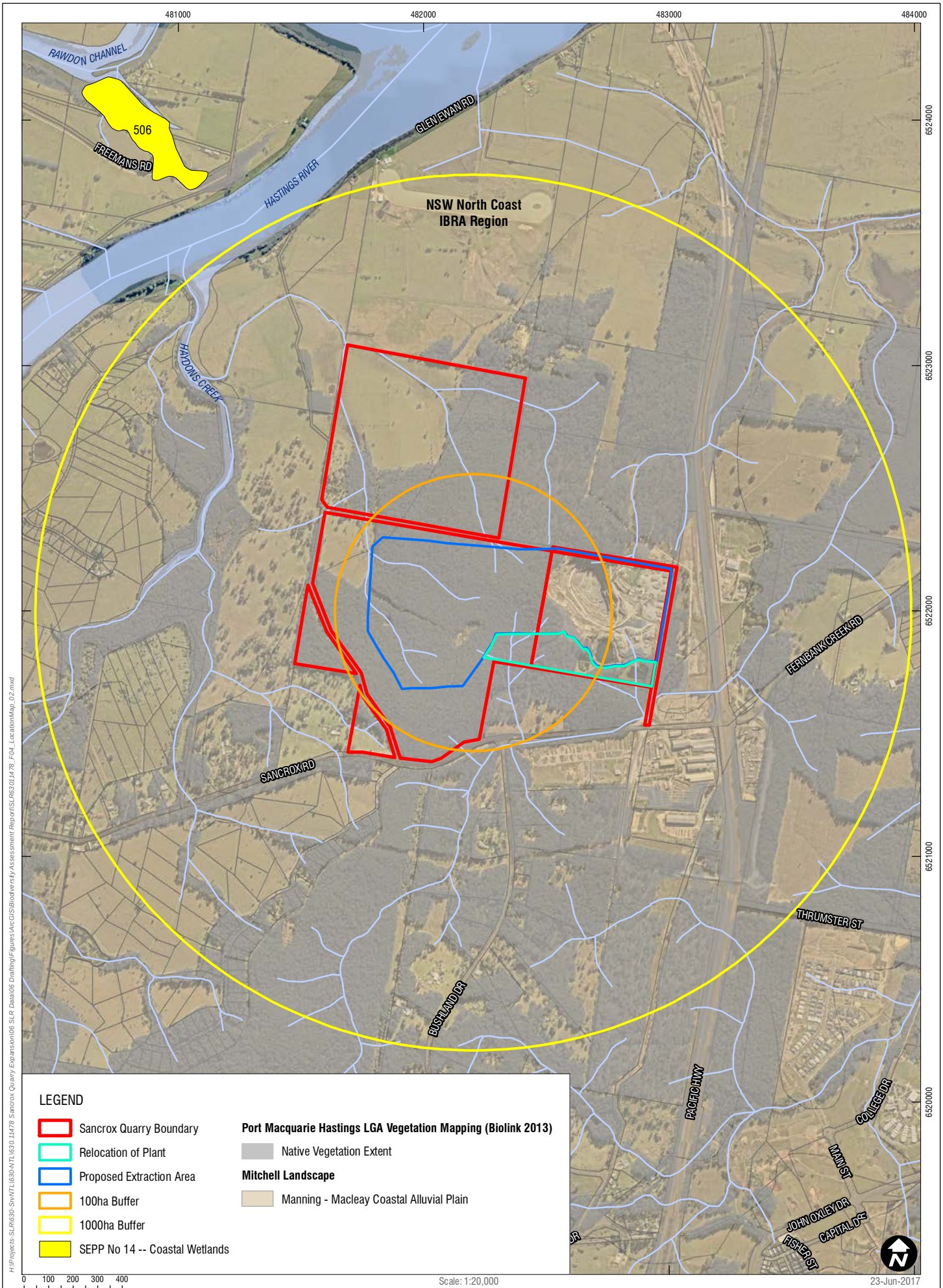
Relevant landscape features within the inner and outer assessment circles are displayed in the Site Map (**Figure 2**) and Location Map (**Figure 4**), as per Section 4 of the FBA.

No landscape features are specifically identified in the SEARs, although the SEARs (OEH) refer to existing and future habitat connectivity, biodiversity linkages and corridors, in the context of local planning undertaken by Port Macquarie Hastings Council. In this regard, biodiversity corridors and the Greater Sancrox Structure Plan are both discussed in **Section 2.8**.

Relevant landscape features are described in the following sections.

2.2 IBRA Bioregions and Subregions

The study area lies in the middle of the North Coast bioregion. The North Coast bioregion is adjacent to the New England Tablelands and Nandewar bioregions to the west and the Sydney Basin bioregion to the south (OEH 2016). The North Coast Bioregion lies on the east coast of New South Wales (NSW), with a small portion just inside the Queensland border, and covers an area of approximately 5,924,130 hectares, 96 % of which lies in NSW (IBRA). The North Coast Bioregion extends from Nelson Bay just north of Newcastle subregion north to Tweed Heads. Within its boundaries lie the towns of Maitland, Forster, Taree, Murrurundi, Port Macquarie, Kempsey, Coffs Harbour, Yamba, Grafton, Ballina, Byron Bay and Tweed Heads. The bioregion contains the Tweed, Richmond, Clarence, Coffs Harbour, Bellinger, Nambucca, Macleay, Hastings and Manning River catchments (OEH 2011).



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Location Map

FIGURE 4

The study area lies within Macleay-Hastings IBRA subregion, which is characterised by Silurian and Devonian slates, Carboniferous mudstones and Permian sandstones and shales. Soils are mainly red-brown structured loams on basalt; however there are a range of other, poorly known soils that relate to the subregions geology. Vegetation comprises of wet sclerophyll forest with White Mahogany, Small-fruited Grey Gum, Sydney Blue Gum, Blackbutt, Tallowwood and Brush Box. The open flat areas of the subregion are dominated by White Gum, Blackbutt, Forest Red Gum and Grey Box, while the coastal areas contain banksia, paperbark, Smooth-barked Apple and Blackbutt. The Barrington areas has a dense covering of Antarctic Beech and the Comboyne Plateau area has mixed patches of cool temperate and warm temperate rainforests. Stands of these main vegetation types are present within vegetation communities of the study area.

2.3 Mitchell Landscapes

The study area lies within two Mitchell landscapes:

- Manning - Macleay Coastal Alluvial Plains, which covers the north-western corner of the Development Site in Lot 2 south (DP 574308) as well as the western half of the proposed offset site in Lot 2 north (DP 574308).
- Wauchope Coastal Foothills, which occur throughout the majority of the Development Site in Lot 2 south (DP 574308), excluding the small portion in the north-west, as well as the eastern half of the proposed offset site in Lot 2 north (DP 574308).

The distribution of Mitchell Landscapes across the study area is shown in the Location Map (**Figure 4)**.

Manning-Macleay Coastal Alluvial Plains are described by DECCW (2002) as “Wide valleys, channels, floodplains, swamps and terraces of the Manning and Macleay rivers and other coastal streams on Quaternary alluvium with a general elevation of 0 to 50 m and a local relief of 15 m. Soils are described as dark, organic loams and silty clay on the floodplains, gradational brown loams and yellow yellow-brown texture contrast soil on terraces with organic silty mud in swamps.” The Manning - Macleay Coastal Alluvial Plains landscape is 57 % cleared.

Wauchope Coastal Foothills are described by DECCW (2002) as “hills and ranges of the coastal fall with some dendritic drainage on faulted carboniferous lithic sandstone, tuff and some limestone with a general elevation of 50 m to 460 m and a local relief of 200 m. Soils are described as having a red and yellow texture contrast throughout the area.” Common native plant species are Blackbutt, White Mahogany, Spotted Gum, Forest Red Gum, Grey Gum and Red Bloodwood (DECCW, 2002). The Wauchope Coastal Foothills landscape is 44 % cleared. As the Mitchell landscape occupying the majority of the Development Site, the percentage cleared value for Wauchope Coastal Foothills was applied to calculate the patch size score, in accordance with Appendix 4 of the FBA.

2.4 Soils

The study area has been mapped by NSW Office of Environment and Heritage (OEH) as Australian Soil Classification (ASC) type Kurosol. Kurosols are soils that have a strong texture contrast between the topsoil and subsoil horizons and contain strongly acidic subsoil and have moderate to moderately low inherent fertility. There are three Soil Landscape Units within the study area: Kundabung, Euroka and Cooperabung.

The study area has been assessed by OEH as Land and Soil Capability Classes 5 and 6 (OEH, 2012)

- Class 5 Moderately Low Capability Land: high limitations for high-impact agricultural land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.
- Class 6 Low Capability Land: very high limitations for high-impact agricultural land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation.

2.5 Native Vegetation extent

The extent of native vegetation within the study area and within the locality has been obtained using broad scale vegetation mapping data for the Port Macquarie-Hastings LGA (Phillips *et al.* 2013). The extent of native vegetation within the outer assessment circle, by vegetation class, is listed in **Table 4**

Around 45 % (447 ha) of the outer assessment circle comprises native vegetation, with the remaining 55 % (550 ha) comprising either cleared land or land that has not been mapped or assigned to a vegetation type.

Table 4 Native vegetation extent (by class) within outer (1,000 ha) circle

Class	Sum of Area	Proportion (%)
Estuarine seagrass	1.31	0
Coastal Floodplain Wetlands	58.57	13
Coastal Swamp Forests	45.51	10
Hunter - Macleay Dry Sclerophyll Forests	11.88	3
Mangrove Swamps	0.43	0
North Coast Dry Sclerophyll Forests	324.00	72
North Coast Wet Sclerophyll Forests	0.58	0
Northern Hinterland Wet Sclerophyll Forests	6.27	1
Unassigned	4.18	1
Grand Total	**452.73**	**100**
Total Native Vegetation Extent (1000 ha)	447.25	99

Conversely, areas not mapped as native vegetation, including 'cleared areas' and exotic vegetation, within the outer assessment circle account for 552.75 ha. Cleared areas within the Sancrox locality include:

- Built up areas and industrial land uses around the Sancrox industrial estate, immediately south of the site;
- Cleared farmland; and
- Infrastructure, including the Pacific Highway, and local roads, Main Northern Rail Line and the open water of the major rivers and streams (notably Hasting River, just west and north of the site).

2.6 Topography

A review of topographical mapping indicates that the highest elevation of the Development Site is 62 m and the lowest elevation is 4 m, giving a local relief of 58 m. The high point of the site occurs a small rounded knoll immediately west of the existing quarry pit and slopes steeply to the west and north, then gradually becomes a gentle slope towards the western and northern boundaries of the site. The slopes in the southern direction are steep and varied as there are several high areas in the southern part of the site.

There is a second area of high elevation, around 34 m, in the southern parts of the proposed Development Site, which has been identified as an area of disturbed land that can be described as an open valley. In the southern parts of the subject site there is another high point, at 40 m, which has steep slopes towards the east, west, north and south. This area is outside of the proposed Development Site. Contour intervals vary between 4 m and 62 m throughout the site and are closely spaced within the Development Site.

2.7 Waterbodies

2.7.1 Rivers and Streams

The Development Site lies within the catchment of the Hastings River, which flows towards the coast in a north-easterly direction beyond the northern boundary of the Development Site (**Figure 4**). At its closest point, the river flows approximately 2 kilometres to the north-east of the site.

There are no notable surface water bodies or tributaries within the study area. The nearest waterway, Haydons Creek, which is a fifth order stream, flows approximately 1.5 kilometres to the west of the study area boundary at its closest point. Haydon Creek is fed by small first order tributaries which are located in the southern parts of the Development Site (**Figure 2**). There are two first order streams in the northern part of the Development Site in Lot 2 DP 577308. These two streams feed into second order stream that flows through the proposed offset site and join to make a third order stream in the north-east of the site. This third order stream then flows west into Haydons Creeks. Haydons Creek then continues to flow north into the Hastings River.

As a fifth order stream, Haydons Creek is defined in the FBA as a "regionally significant biodiversity link", to which a 20 m riparian buffer applies. At its closest point this buffer will be approximately 1.2 kilometres from the site boundary.

The Hastings River is categorised as a seventh order stream, which is defined in the FBA as a "State significant biodiversity link", to which a 50 m riparian buffer applies. At its closest point, the Development Site will be approximately 1.3 kilometres from the riparian buffer zone of the Hastings River. (It is worth noting that the boundary of the Hastings River riparian buffer zone at its closest point is adjacent to the boundary of the proposed offset site – see **Section 7**).

There is evidence that a drainage line runs north-south through the site, feeding into a small stream that runs east from the site boundary.

2.7.2 Wetlands and estuarine areas

There are two water bodies within the study area. These two water bodies have been identified as small ponds of water created by areas of the quarry filling with rainwater and water from the drainage line on the site. There are no significant wetlands and estuarine areas on the subject site and an EPBC Act protected matters search revealed that there are no RAMSAR wetlands within 10 kilometres of the subject site.

The nearest wetlands, as identified by the Port Macquarie Hastings LGA Vegetation Mapping (Biolink 2013), are shown to occur approximately 2.45 kilometres to the north-west of the development site on the west bank of the Hastings River. The wetland is not a protected wetland under the RAMSAR convention.

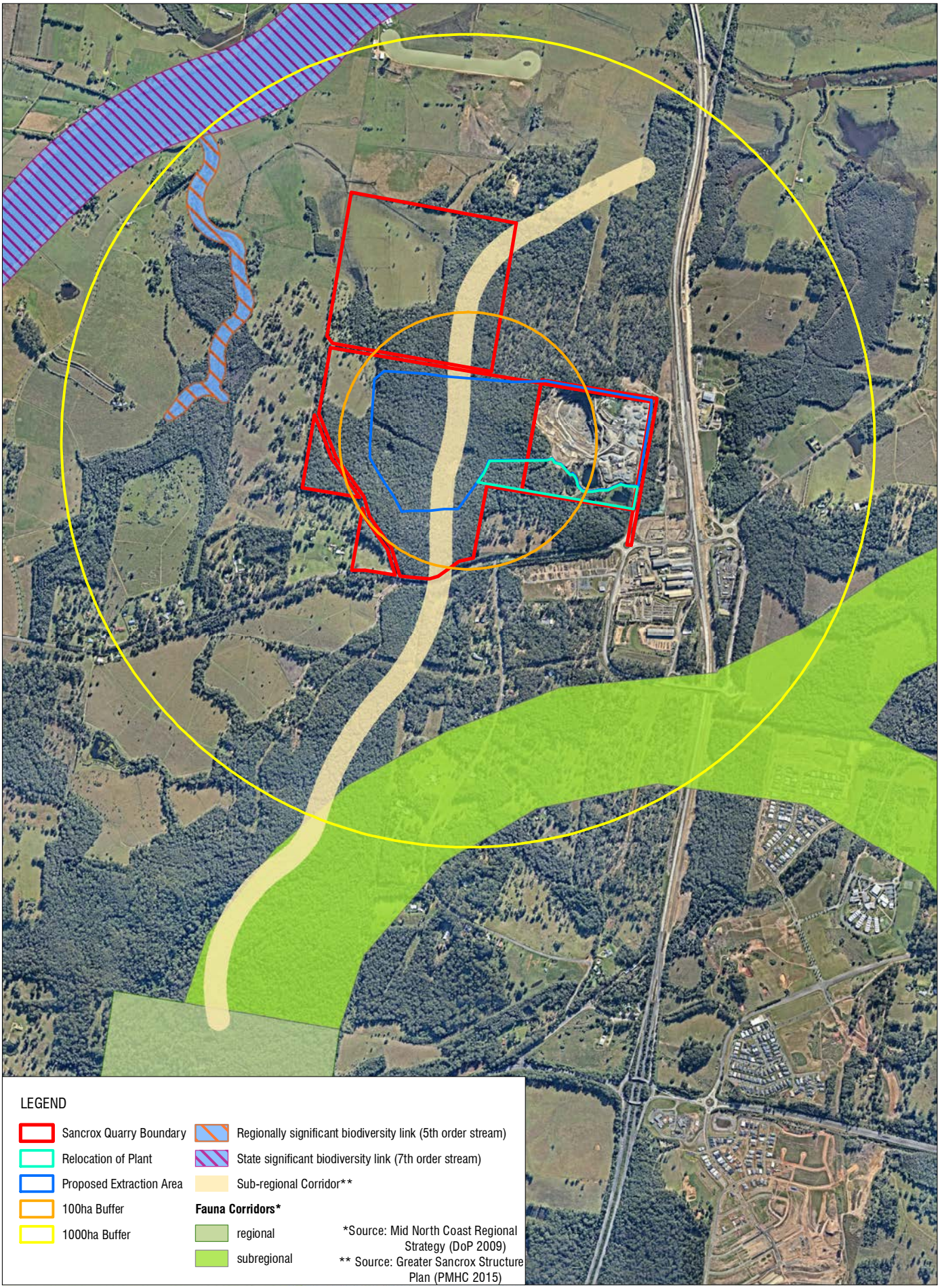
2.8 Biodiversity corridors and links

Published GIS data on State, regional and local biodiversity corridors links was obtained and reviewed as part of the preparation of this BAR. The key biodiversity corridors and links mapped within or near to the study area are mapped in **Figure 5** and include:

- a portion of a "sub-regional biodiversity corridor" mapped in the Greater Sancrox Structure Plan (see **Appendix D**), which traverses south-north through the centre of the Development Site. The corridor extends several kilometres south of the site; to the north of the site, it extends through the proposed offset site and before turning east and ending abruptly near the Pacific Highway; and
- a portion of a sub-regional "fauna corridor", mapped in the Mid North Coast Strategy, traverses just south of the Development Site before turning east. This corridor transforms into a "regional biodiversity corridor" further south of the Development Site. The subregional fauna corridor is approximately 1.5 kilometres from the Development Site.

The Mid-North Coast Regional Strategy (DOP 2009) states that fauna habitat corridors are of "high conservation importance" and as such urban development near these corridors should be limited.

In addition, the *Urban Growth Management Strategy 2017-2036* (PMHC 2017) classifies the area as a 'medium biodiversity asset/constraint' and identifies that the site could provide a 'major conceptual habitat link'. The strategy states the areas categorised as medium contain biodiversity assets that have the potential to be offset using the appropriate planning measures. The strategy maps **"**high priority koala habitat" within and surrounding the study area and there is a small portion of "medium-high priority biodiversity area" within the proposed Development Site. A large portion of the offset site has also been identified as 'key habitat' in the Strategy.



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Sancrox Quarry Expansion BAR

Sancrox Quarry Expansion

Biodiversity Corridors

FIGURE 5

2.9 Landscape Value

Landscape value score was calculated according to Chapter 4 of the FBA. A 100 ha inner assessment circle was drawn in GIS, with the centroid on the Development Site using available aerial imagery as a base. Using a 1:10 ratio, a 1,000 ha outer assessment circle was also drawn. The inner and outer assessment circles are plotted in the Location Map (**Figure 4**).

2.9.1 Native Woody Vegetation cover

Native vegetation extent was mapped and the area calculated within the inner (100 ha) and outer (1,000 ha) landscape assessment circles using regional vegetation mapping of the Port Macquarie-Hastings LGA (Phillips *et al.* 2013). The extent of native vegetation within the landscape assessment circles is shown in **Figure 4**. The existing native vegetation cover within both assessment circles is listed in **Table 5**. Native vegetation comprises around 84 % of the inner assessment circle and 45 % of the outer assessment circle.

Table 5 Percent vegetation cover in the landscape

Circle Size (ha)	Existing Veg. Cover (ha %)	Future Veg. Cover (ha %)
100	84.48 ha (84 %)	44.28 ha (44 %)
1000	452.74 ha (45 %)	411.01 ha (41 %)

The future extent of native vegetation cover within the inner and outer assessment circles was calculated by deducting the vegetation that would be removed as part of the proposed development from the existing extent of native vegetation. Approximately 44 ha (44 %) native vegetation will remain within the inner assessment circle after clearing for the proposed development and around 411 ha (41 %) of native vegetation will remain in the outer assessment circle after development (**Table 5**). The above listed scores for percentage native vegetation cover in the inner and outer assessment circles were entered into the BioBanking Credit Calculator.

Based on the above results, the score for percentage native vegetation cover in the Credit Calculator is 2.95

2.9.2 Connectivity

No State or regional biodiversity links occur within the Development Site, as discussed in **Section 2.8**. A 'site based assessment of connectivity' is therefore required, according to the approach set out in Appendix 4 of the FBA.

Connectivity score was calculated according to the method outlined in Appendix 4 of FBA. Using aerial imagery, connecting links of contiguous canopy vegetation across the study area were mapped. Inspection of aerial imagery reveals that two main links traverse the site, with native forest vegetation extending from south of the site through to north of the site. Beyond the northern boundary of the site, both links narrow to just one or two trees amongst cleared agricultural landscapes. The linkage width class for each link was therefore assigned to 'Very narrow (0-5m wide). Removal of the native canopy vegetation within these theoretical links as a result of the proposed development would render the future linkage width class as also 'very narrow'. Hence the number of linkage width classes crossed as a result of the impact of the proposed development is zero (i.e. no change in linkage width class). The connecting links mapped across the site as part of this exercise are provided in **Appendix E**.

Similarly the condition of vegetation with the two vegetated links is assessed as likely to be within benchmark. Hence linkage condition class (of woody vegetation) within the over-storey (canopy) and mid-storey or groundcover is estimated to be > 50% of lower benchmark before and after the proposed development. Hence no linkage conditions classes are crossed (i.e. no change in linkage condition class).

As no linkage width classes and no linkage conditions classes are crossed, the score for connectivity in the Credit Calculator is zero.

2.9.3 Patch Size

Patch size of native woody vegetation was estimated using GIS and available spatial data for vegetation of the Port Macquarie-Hastings LGA by Phillips *et al.* (2013). The native woody vegetation in moderate to good condition on the site extends off the site to surrounding areas forming a large patch that is estimated to be 1255 ha (see **Figure 4**).

The percentage cleared value for Wauchope Coastal Foothills Mitchell landscape, which occupies the majority of the Development Site (see **Figure 4**), is 54 %. The 'patch size class' for a Mitchell landscape with a percentage cleared value of 30-70% and a patch size of > 200 ha is categorised as 'Extra large' and attracts a patch size score of 12.

2.9.4 Landscape Value Score

Landscape value is calculated in the Credit Calculator based on the sum of the three landscape assessment components in the FBA: (i) native vegetation extent (ii) connectivity score and (iii) patch size. For the Sancrox SSD project the landscape score in the Credit Calculator is composed of the following scores:

- Native vegetation extent - 2.95;
- Connectivity score - 0; and
- Patch size score – 12,

giving an overall landscape value score of 15.

3 Native Vegetation

This chapter describes the native vegetation on the study area in accordance with Section 5 of the FBA.

3.1 Study Area Characteristics

The study area is a mosaic of forested areas, low-lying swampy terrain, cleared grazing land and areas of disturbance and infrastructure. The study area incorporates the existing quarry, with surrounding areas of cleared and disturbed terrain, open water in detention dams, roads and the buildings and infrastructure of the quarry administration centre. West of the existing pit, where the quarry expansion is proposed, lies a tract of bushland that extends over an elevated hill rising to 62 m above sea level. Further west, open grassland is interspersed with scattered trees across low lying terrain that drains to the northwest. Several hundred metres further northwest lies the Hastings River, which eventually drains to the coast at Port Macquarie several kilometres east of the study area. The cleared grassy areas in the western parts of the study area are used for cattle grazing.

Similarly in the northwestern parts of the study area (including the northern parts of Lot 2, which is proposed to set aside as a biodiversity offset) the land has been cleared and supports cattle grazing over grasslands. Adjoining these cleared grassy areas to the east are stands of swamp forest and paperbark swamp forest. Further details on the nature and condition of the proposed offset site are provided in **Section 7**.

3.2 Regional (Broad-scale) Vegetation Mapping

The following regional vegetation mapping resources are available for the study area and were reviewed as part of the preparation of this BAR:

- Vegetation of the Port Macquarie-Hastings LGA (Phillips *et al.* 2013);
- Mapping of the Northern Rivers catchment (NRCMA 2011); and
- 'CRAFTI' data prepared as part of the Comprehensive Regional Assessments (CRA) (NPWS 2012).

The Council data (Phillips *et al.* 2013), being smaller scale than the other data sets, was found to be the most accurate and precise when viewed at the scale of the study area. Accordingly, the Council mapping was adopted as a 'base map' to guide the field survey design, and was verified and, where necessary, modified during field surveys. An excerpt of the Council mapping for the study area is provided in **Table 6**.

The Council vegetation types mapped within the study area and their mapped extent (in hectares) are listed in **Table 6**.

Table 6 Vegetation mapped within the site – LGA mapping*

Code	Council Vegetation Type	Area
PMVT_073	Flax-leaved Paperbark - Mixed Eucalypt Coastal Floodplain Wetlands Forest Complex	0.6
PMVC_035	Spotted Gum Grassy Dry Forest	11.0
PMVC_037	White Stringybark - Tallowwood - Grey Gum Dry Forest	31.0

* Source: Phillips *et al.* 2013.

Profiles for each of the three vegetation types listed in are provided in **Appendix F**. A brief description of each is provided below:

3.2.1 Flax-leaved Paperbark – Mixed Eucalypt Coastal Floodplain Wetlands Forest Complex

Phillips *et al*. (2013) describe this community as "A tall to very tall emergent woodland of mixed *Eucalyptus* spp. including Flooded Gum *Eucalyptus grandis*, Tallowwood *Eucalyptus microcorys*, Grey Gum *Eucalyptus propinqua*, Grey Ironbark *Eucalyptus siderophloia* and Forest Red Gum *Eucalyptus tereticornis*." The community occurs along drainage lines and is characterised by the presence of a relatively dense mid-stratum of *Melaleuca* species and a more open canopy stratum.

3.2.2 Spotted Gum Grassy Dry Forest

Phillips *et al*. (2013) describe this community as "A tall to extremely tall open forest dominated by Spotted Gum *Corymbia citriodora* [sic]. Common associates include Grey Ironbark *Eucalyptus siderophloia*, Broad-leaved White Mahogany *Eucalyptus carnea*, Tallowwood *Eucalyptus microcorys* and Grey Gum *Eucalyptus propinqua* with scattered Pink Bloodwood *Corymbia intermedia*, White Stringybark *Eucalyptus globoidea* and the occasional Blackbutt *Eucalyptus pilularis*." The community is restricted to the Cooperabung and Beechwood erosional soil landscapes at Red Hill and Sancrox.

3.2.3 White Stringybark – Tallowwood – Grey Gum Dry Forest

Phillips *et al*. (2013) describe this community as "A tall to very tall open forest dominated by White Stringybark *Eucalyptus globoidea* growing in association with Tallowwood *Eucalyptus microcorys*. Common associates include Broad-leaved White Mahogany *Eucalyptus carnea*, which occurs occasionally as a sub-dominant, Grey Gum *Eucalyptus propinqua* and Turpentine *Syncarpia glomulifera*, less commonly Red Bloodwood *Corymbia gummifera* and Grey Ironbark *Eucalyptus siderophloia*." The community occurs in the coastal hinterland between Sancrox and Heron's Creek.

3.3 Vegetation Classes

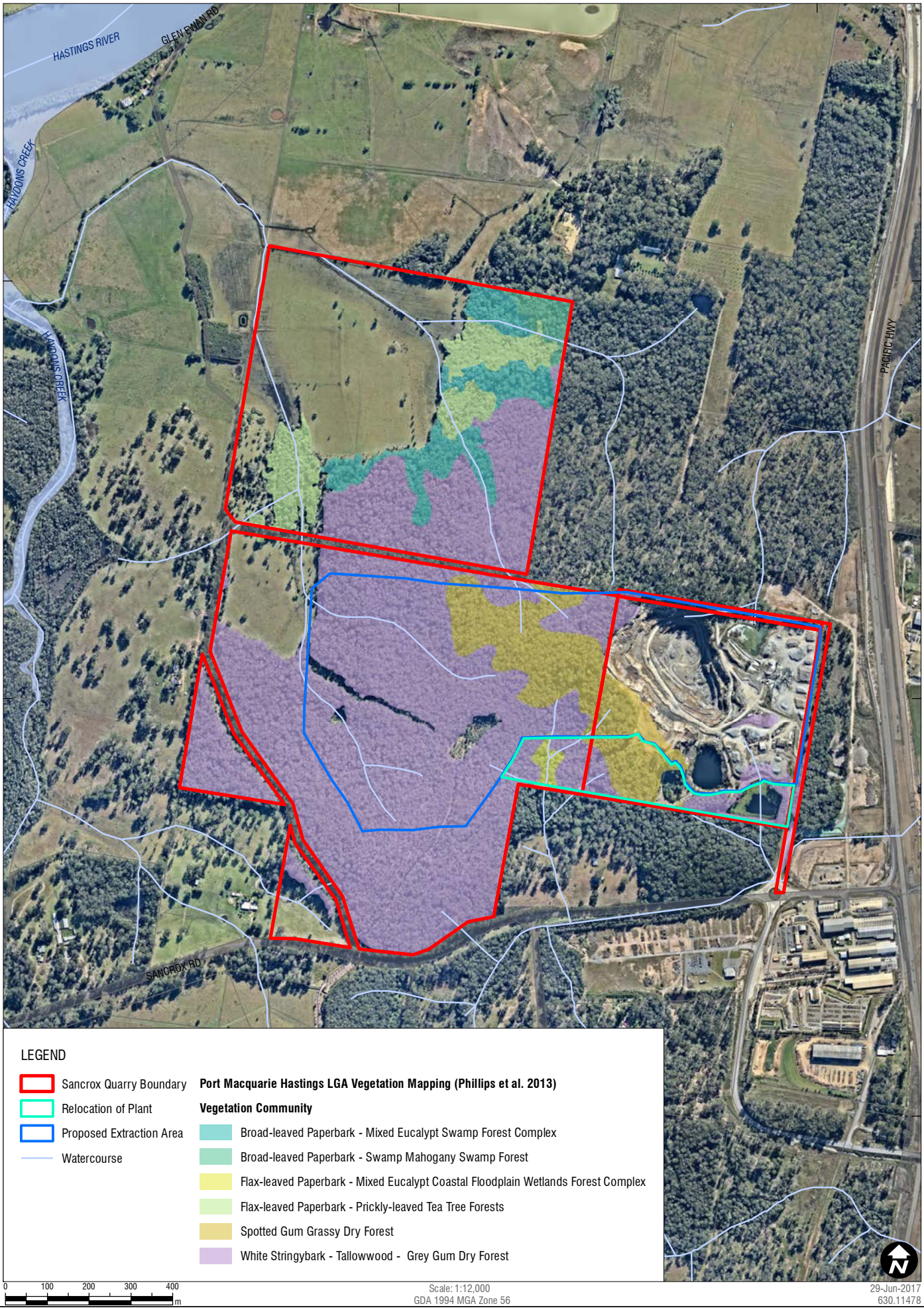
According to broad-scale mapping of Port Macquarie-Hastings LGA (Phillips *et al.* 2013), the vegetation within the study area comprises two vegetation classes occurring within two vegetation formations, as listed in **Table 7**.

Table 7 Vegetation Formations and Classes Mapped in the Study Area

Vegetation Formation	Vegetation Class	Area (ha)
Forested Wetlands	Coastal Floodplain Wetlands	1.2
Dry Sclerophyll Forests (shrub/grass)	Hunter-Macleay Dry Sclerophyll Forests	11.0
Dry Sclerophyll Forests (grassy)	Hunter-Macleay Dry Sclerophyll Forests	31.0
	Total	**43.2**

Coastal Floodplain Wetlands is a vegetation class that is described as a mosaic of open forests with an open graminoid understorey and closed sedgeland. Open forests dominated by eucalypts may exceed 40 m tall; while denser forests dominated by *Casuarina* and *Melaleuca* typically grow up to 20 m tall. On levees and elevated terraces, the canopy is dominated by *Angophora floribunda* (rough-barked apple) whereas low-lying flats with saline soils contain an abundance of *Casuarina glauca* (swamp oak). This vegetation class includes a variety of small trees including *Livistona australis* (cabbage palm), *Melaleuca linariifolia* and *M. styphelioides* (prickly-leaved tea-tree). This vegetation is typically found in Coastal floodplains with fertile alluvial soil, periodically inundated. Levees and elevated river flats (up to 250 m above sea level) support predominantly eucalypt forests, but these give way to Casuarina forests on more frequently inundated low-lying flats, particularly where soils are subsaline. The assemblages of the vegetation class are poorly documented; however, floristic attributes are similar to that of Coastal Swamp Forest and Coastal Freshwater Lagoons (OEH, 2017a).

Hunter-Macleay Dry Sclerophyll Forests are dry open eucalypt forest to 30 m tall, with a mixed sclerophyll and mesophyll shrub stratum and semi-continuous grassy groundcover. This vegetation class is dominated by large Eucalypt species including *Corymbia maculata* (spotted gum), *Eucalyptus crebra* (narrow-leaved ironbark), *E. moluccana* (grey box), *E. propinqua* (grey gum), *E. siderophloia* (grey ironbark) and *Syncarpia glomulifera* (turpentine). Hunter-Macleay Dry Sclerophyll Forests may also have *Angophora costata* (Sydney red gum) and *Eucalyptus punctata* (grey gum) though these species are mainly identified in the eastern Hunter valley. The community is associated with foothills and undulating terrain in rain shadow valleys below 400 m elevation in the eastern parts of coastal rainshadow valleys, well-drained loams derived from shales and foothills and undulating terrain below 400 m on loamy soils derived from shales. They are associated with the major coastal river valleys along the New South Wales coast, and occur in local areas that are transitional between Coastal Valley Grassy Woodlands and Northern Hinterland Wet Sclerophyll Forests. They are associated with the major coastal river valleys along the New South Wales coast, and occur in local areas that are transitional between Coastal Valley Grassy Woodlands and Northern Hinterland Wet Sclerophyll Forests. This vegetation class varies floristically in response to latitude and the influence of clay content within the soil (OEH, 2017b).



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Regional Vegetation Mapping for Port Macquarie-Hastings LGA

FIGURE 6

3.4 Plant Community Types (PCTs)

3.4.1 Overview

Plant community types (PCTs) were mapped across the study area during the field survey, using vegetation mapping of the Port Macquarie-Hastings LGA (Phillips *et al.* 2013) as a base map. The three broad vegetation types mapped within the study area, as noted in **Section 3.2**, were recorded within the site:

- Flax-leaved Paperbark - Mixed Eucalypt Coastal Floodplain Wetlands Forest Complex;
- Spotted Gum Grassy Dry Forest; and
- White Stringybark - Tallowwood - Grey Gum Dry Forest.

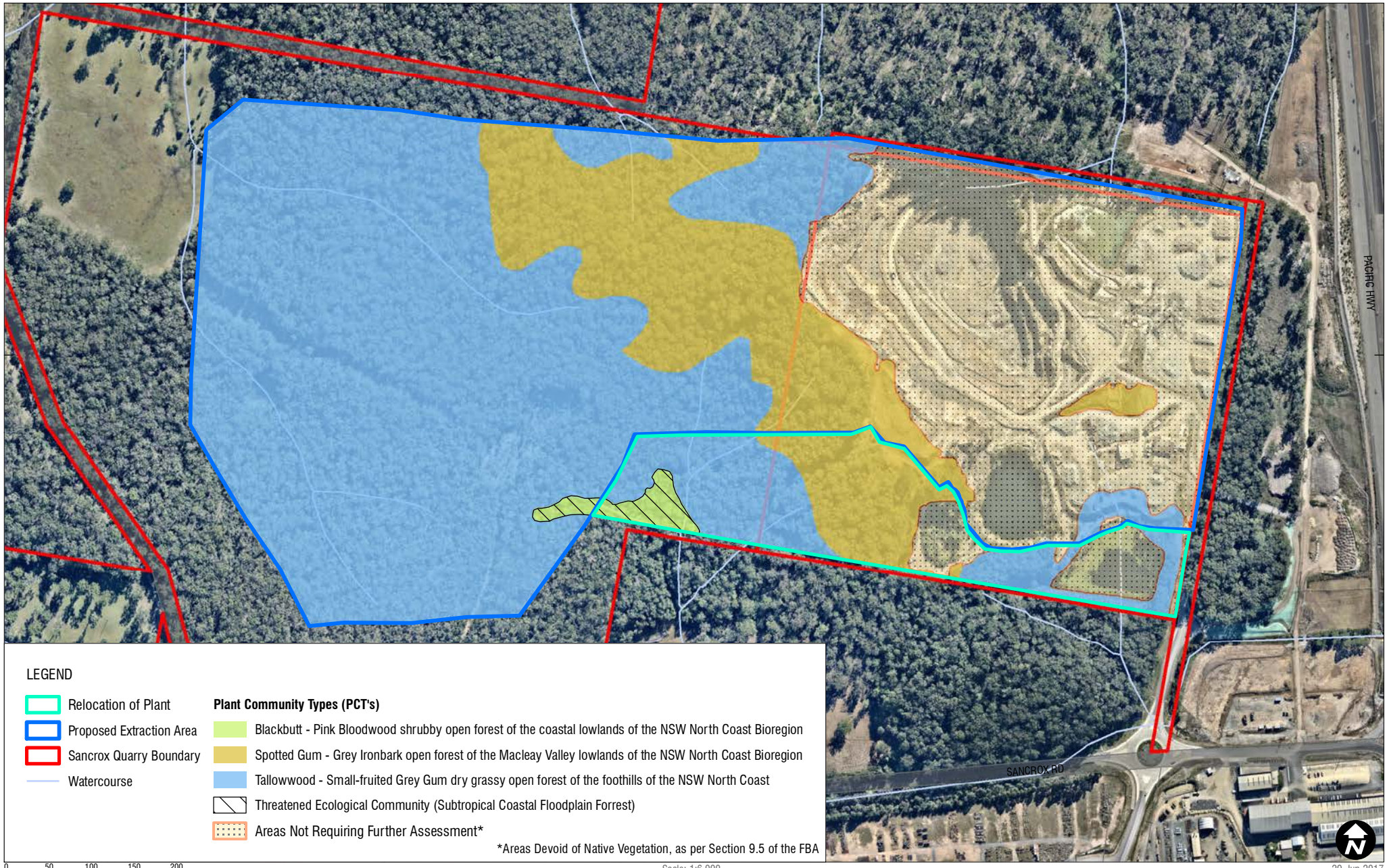
Using the online NSW Vegetation Information System (VIS) database, these communities were converted into PCTs, as per **Table 8**.

Table 8 Conversion of Council mapping units to PCTs

Council Vegetation Type*	PCT	PCT Name
Flax-leaved Paperbark - Mixed Eucalypt Coastal Floodplain Wetlands Forest Complex	686	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion
Spotted Gum Grassy Dry Forest	1215	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
White Stringybark - Tallowwood - Grey Gum Dry Forest	1262	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast

Source: Phillips *et al.* 2013

The PCTs mapped within the study area are listed in **Table 9**. The distribution of these plant community types within the study area is shown in **Figure 7**. The floristics and structure of these communities, as they occur on the site, is described below. Profiles of each PCT obtained from the VIS database are provided in **Appendix G.**



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Plant Community Types Mapped Within the Development Site

FIGURE 7

Table 9 Plant Community Types (PCTs) mapped within the study area

PCT Code	PCT Name*	TEC	% Cleared [2]	Area (ha)
686	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	Yes	35 %	0.6
1215	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	No	35 %	11.0
1262	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	No	30 %	31.0
	Total Native Vegetation			**42.6**

Table 10 lists the vegetation formation and vegetation class associated with each PCT mapped within the study area.

Table 10 Formations, Classes and PCTs mapped within the study area

Vegetation Formation	Vegetation Class	PCT Name	Area (ha)
Forested Wetlands	Coastal Floodplain Wetlands	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	0.6
Dry Sclerophyll Forests	Hunter - Macleay Dry Sclerophyll Forests	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	11.0
Dry Sclerophyll Forests	North Coast Dry Sclerophyll Forests	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	31.0
		Total Native Vegetation	**42.6**

One of the PCTs recorded within the study area, PCT 686, represents an example of the threatened ecological community *Subtropical coastal floodplain forest of the NSW North Coast bioregion*, which is listed as endangered on the BC Act. Threatened ecological communities are discussed further at **Section 3.7**.

3.4.2 Blackbutt – Pink Bloodwood Shrubby Open Forest (PCT 686)

Location:

Small patch along southern boundary, central portion of subject site in sandy soil with high moisture content. OEH (2017) note the distribution of the community as "In low lying areas on the coast from Kendall north to Coffs Harbour".

Area: 0.6 ha

Structure:

An open-forest with dense mid-storey and ground cover.

Trees from 15 to 25 m. Foliage projective cover (FPC) is 15 to 35 %.

Shrubs and small trees from 2 to 8 m; FPC generally to 20 % to 35 % in some patches.

Groundcover 0.1 to 1 m. FPC up to 50 %.

Floristics:

Trees:

- Eucalyptus pilularis (Blackbutt)
- Corymbia intermedia (Pink Bloodwood)
- Eucalyptus resinifera subsp. resinifera (Red Mahogany)

Shrubs and small Trees

- Glochidion ferdinandi var. ferdinandi (Smooth Cheesetree)
- Melaleuca linariifolia (Snow-in-Summer)
- Callistemon salignus (Pink Tips)
- Breynia oblongifolia (Coffee Bush)
- Polyscias sambucifolia (Elderberry Panax)

Vines and Groundcovers

- Eustrephus latifolius (Wombat Berry)
- Geitonoplesium cymosum (Climbing Lily)
- Hibbertia dentata and H. scandens (Trailing Guinea Flower and Climbing Guinea Flower)
- Gahnia sieberiana (Red-fruited Saw-sedge)
- Lomandra longifolia (Spiny-headed Mat-rush)
- Pratia purpurascens (Whiteroot)
- Pteridium esculentum (Bracken Fern)
- Viola hederacea (Native Violet)
- Imperata cylindrica var. major (Blady Grass)

A total of 36 indigenous species and one exotic species (one individual of *Cinnamomum camphora*) were recorded in the BioBanking plot. Although *Corymbia intermedia* was recorded, *Eucalyptus pilularis* was absent from the plot, but occurrence of this species is common further upslope. *Lophostemon confertus* was recorded as having higher FPC (4 %), compared with *Corymbia intermedia* (3 %). Other Eucalypt species which were recorded include *Eucalyptus carnea*, *E. microcorys* and *E. propinqua*.

Mesic mid-storey species include *Maclura cochinchinensis*, *Myrsine variabilis*, *Jagera pseudorhus* and *Glochidion ferdinandi* var. *ferdinandi*. Common groundcover species include *Lomandra longifolia*, *Hypolepis muelleri*, *Gahnia clarkei* and *Carex appressa*.

This plant community type aligns with the threatened ecological community *Subtropical coastal floodplain forest of the NSW North Coast bioregion*, which is listed as an endangered ecological community in Part 3 of Schedule 1 of the BC Act.

The community is not listed under the EPBC Act.

3.4.3 Spotted Gum-Grey Ironbark Open Forest (PCT 1215)

Location:

This vegetation type occurs across the middle of the subject site on upper slopes, to the west of the quarry, in sandy well-drained soils.

Area: 11 ha.

Structure:

A tall open-forest with mostly grassy groundcover.

Trees from 15 to 25 m. FPC 15 to 35 %.

Shrubs and small trees from 2 to 12 m; FPC generally to 15 % to 35 % in some patches.

Groundcover 0.1 to 0.5 m. FPC up to 60%.

Floristics:

Trees:

- Corymbia maculata (Spotted Gum)
- Eucalyptus acmenoides (White Mahogany)
- Eucalyptus siderophloia (Northern Grey Ironbark)
- Lophostemon confertus (Brushbox)

Small Trees and Shrubs:

- Allocasuarina torulosa (Forest Oak)
- Allocasuarina littoralis (Black Oak)
- Acacia melanoxylon (Blackwood)
- Acacia implexa (Hickory)

Vines and Groundcovers:

- *Themeda triandra* (Kangaroo Grass)
- *Imperata cylindrica* var. *major* (Blady Grass)
- *Lomandra longifolia* (Spiny-headed Mat-rush)
- *Billardiera scandens* (Apple Berry)

- *Glycine* spp. (Love Creeper)

A total of 35 indigenous species and no exotic species were recorded in the BioBanking plot. The canopy species include: *Eucalyptus siderophloia* (5), *Corymbia maculata* (4), *Corymbia intermedia* (3) and *Eucalyptus globoidea* (3). Common mid-storey species include *Allocasuarina torulosa*, *Polyscias sambucifolia* and *Breynia oblongifolia*. Common groundcover species include *Themeda triandra*, *Entolasia marginata*, *Lomandra hystrix* and *Dichelachne micrantha*.

This plant community type does not constitute a TEC under the BC Act or EPBC Act.

3.4.4 Tallowwood – Small fruited Grey Gum dry grassy open forest (PCT 1262)

Location:

This vegetation type occurs across a large proportion of the subject site, especially in the western parts. This vegetation occurs mostly on coastal foothills.

Area: 31 ha

Structure:

An open-forest with mostly grassy groundcover.

Trees from 12 to 20 m. FPC 15 to 30%.

Small trees and shrubs from 2 to 12 m; FPC generally to 10%.

Groundcover 0.1 to 1 m; FPC up to 70%.

Floristics:

Trees:

- *Eucalyptus globoidea* (White Stringybark)
- *Eucalyptus microcorys* (Tallowwood)
- *Eucalyptus siderophloia* (Northern Grey Ironbark)
- *Eucalyptus propinqua* (Small-fruited Grey Gum)
- *Syncarpia glomulifera* subsp. *glomulifera* (Turpentine)

Small Trees and Shrubs:

- Allocasuarina torulosa (Forest Oak)
- Allocasuarina littoralis (Black Oak)
- Persoonia linearis (Narrow-leaved Geebung)
- Dodonaea triquetra (Hop-bush)

Vines and Groundcovers:

- *Themeda triandra* (Kangaroo Grass)
- *Imperata cylindrica* var. *major* (Blady Grass)
- *Lomandra longifolia* (Spiny-headed Mat-rush)
- *Pteridium esculentum* (Bracken Fern)
- *Hardenbergia violacea* (Purple Coral Pea).

A total of 32 indigenous species and one exotic species (several specimens of *Cinnamomum camphora*) were recorded. The canopy species include *Eucalyptus siderophloia* (3), *Corymbia gummifera* (3) and *Eucalyptus globoidea* (3). Common mid-storey species include *Allocasuarina littoralis*, *Melaleuca linariifolia*, *Callistemon salignus*, *Alphitonia excelsa* and *Glochidion ferdinandi* var. *ferdinandi*. Common groundcover species include *Imperata cylindrica* var. *major*, *Carex appressa*, *Centella asiatica*, *Microlaena stipoides* var. *stipoides* and *Dichondra repens.*

This plant community type does not constitute a TEC under the BC Act or EPBC Act.

3.5 Site Specific Vegetation Mapping – Differences to Regional Mapping

Vegetation types and vegetation mapping as described by Phillips *et al.* (2013) were adapted in the initial desk-top assessment and then validated by field work. For the purposes of this assessment, the vegetation descriptions used by Phillips *et al.* (2013) were then converted to the nearest approximation of descriptions of the NSW Plant Community Types that are stated to occur within the Northern Rivers Catchment Management Area (CMA).

3.5.1 Biometric vegetation classification

The NSW Plant Community Type classification was developed in 2011 "…to establish an unambiguous master community-level classification for use in vegetation mapping programs, regulatory decisions, and as a standard typology for other planning and data gathering programs…." In 2011 the PCT classification consolidated two existing community-level classifications:

1. The NSW Vegetation Classification and Assessment database (Benson 2006 & 2008; Benson *et al.* 2006 & 2010);
2. The Biometric Vegetation Types database used in NSW regulatory processes including property vegetation planning, Bio-certification and BioBanking.

Since 2011, several quantitatively derived regional classification data sets have been into the PCT classification. These include Greater Hunter and Sydney Metropolitan area. Work is underway to integrate the new Northern Rivers vegetation classification.

3.5.2 Mapping of Port Macquarie-Hastings LGA

Phillips *et al.* (2013) state that "…Vegetation mapping was undertaken in two stages and involved polygon capture down to a minimum patch size of 0.25 ha (0.1 ha for littoral rainforest) using task-specific software and a combination of satellite, aerial and digital imagery. Excluding National Park and State Forest estate, approximately 115,922 ha of remnant vegetation was captured for purposes of the mapping project. Once captured, polygons were internally partitioned by hand. Field survey involved a combination of formal 0.04 ha floristic plots sampled in accord with Modules 1 and 2 of the NSW Government's Native Vegetation Type Standard. Less detailed but similarly quantitative "rapid" assessments were also undertaken in other areas, supported by foot-, vehicle- and air-based traverses for ground-truthing purposes. Available data from other studies was (sic) also employed to assist the mapping process…..Disregarding geographical constraints, approximately 70% of the mapped vegetation communities conform to those similarly recognised by the NSW Northern Rivers Catchment Management Area's Vegetation Classification System, the remainder constituting novel ecological entities for the Northern Rivers CMA that have hitherto not been detailed…..".

The vegetation mapping prepared by SLR for this report differs only slightly from the regional-scale mapping by Phillips *et al.* (2013), in the context of locations and extent of vegetation types. For example, field work for this report determined that the patch of Flax-leaved Paperbark-Mixed Eucalypt Coastal Floodplain Wetlands Forest Complex extended further west, along a drainage depression, in comparison with the mapping of Phillips *et al.* (2013). This vegetation type was matched with the Plant Community Type Blackbutt- Pink Bloodwood Shrubby Open Forest (PCT 686). No other approximal PCT is included in the selection of PCTs for the Northern Rivers CMA and the one sample quadrat which was required for this small patch of vegetation (as well as the adjacent vegetation) was found to comply structurally and floristically with both the descriptions for Flax-leaved Paperbark-Mixed Eucalypt Coastal Floodplain Wetlands Forest Complex and Blackbutt – Pink Bloodwood shrubby open forest.

Four quadrats and general surveys of the vegetation type which has the greatest spatial representation over the site is described by Phillips *et al.* (2013) as White Stringybark–Tallowwood–Grey Gum Dry Forest. The structural and floristic characteristics of the surveyed patches of vegetation validated this description. This vegetation type was matched with the Plant Community Type Tallowwood - Small-fruited Grey Gum dry grassy open forest (PCT 1262) and was found, after data analysis, to comply with the description of the PCT.

Three quadrats and general surveys of the vegetation type occurring along the upper slopes and ridge line in the central portion of the site were carried out. This vegetation type is described as Spotted Gum Grassy Forest by Phillips *et al.* (2013). This is a distinctive plant community within the Port Macquarie-Hastings LGA and is only conserved at Bundjalung National Park, within the North Coast region (see Griffith 1993; Hager and Benson 1994). The Plant Community Type Tallowwood - Small-fruited Grey Gum dry grassy open forest is the most appropriate classification for the vegetation patch on the subject site.

With due consideration to the above listed factors, SLR has modified the regional vegetation mapping for the study area and has mapped native vegetation patches, where present, to create a site specific vegetation map for the study area (see **Figure 7)**. The PCTs recorded and mapped within the study area are described in **Section 3.4**.

3.6 Vegetation Zones

According to the FBA (OEH 2014), vegetation zones are areas of vegetation of the same type and same condition class. Vegetation zones are categorised into either 'low' or 'moderate to good' condition. To qualify as low condition the native vegetation (being woody vegetation) within a vegetation zone must have:

- a value of less than 25 % of the lower benchmark value in the canopy; and
- groundcover that is either less than 50 % indigenous (or native) or over 90 % cleared.

PCTs mapped within the study area have been further divided into the following vegetation zones:

- Veg Zone 1 - NR117_Moderate/Good Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion;
- Veg Zone 2 - NR247_Moderate/Good Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion;
- Veg Zone 3 - NR263_Moderate/Good Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast;
- Veg Zone 4 - NR263_Moderate/Good_Poor Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast; and
- Veg Zone 5 - NR247_Moderate/Good_Poor Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion.

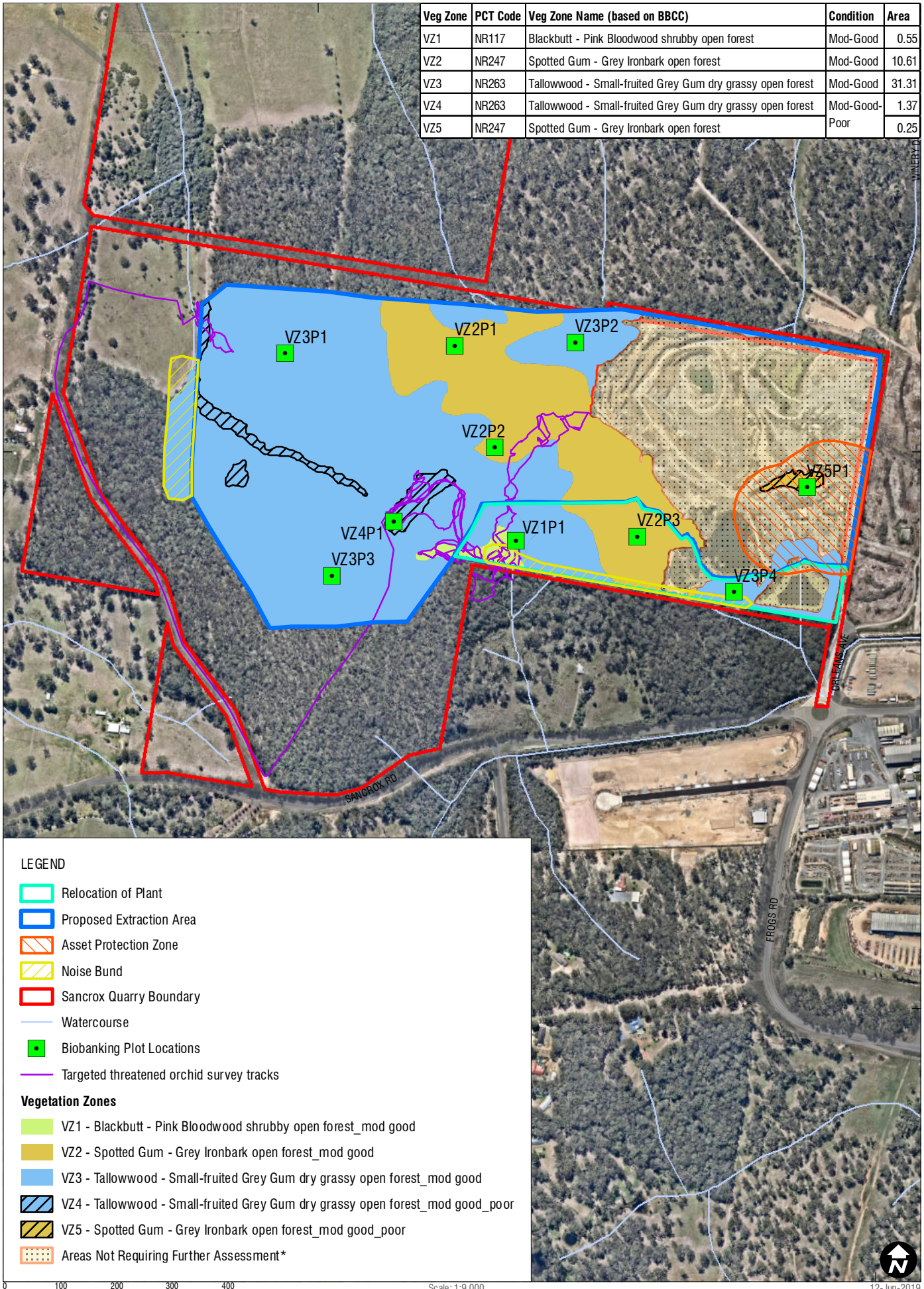
The distribution of these vegetation zones within the development site, as well as the location of plot/transects, is shown in **Figure 8**. The vegetation zones, their mapped extent within the study area and plots completed within each zone are listed in **Table 11**.

Table 11 Vegetation Zones mapped within the Development Site

No.	Vegetation Zone name	Vegetation type name	Area (ha)	Min plots#	Plots done
1	NR117_Moderate/Good	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	0.55	1	1
2	NR247_Moderate/Good	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	10.61	3	3
3	NR263_Moderate/Good	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	30.32	4	4
4	NR263_Moderate/Good_Poor	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	1.37	1	1
5	NR247_Moderate/Good_Poor	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	0.25	1	1
		Total	**43.1**	**10**	**10**

Minimum number of plots required in the FBA.; ## Includes 1.26 ha of clearing for the proposed western noise mound.

Veg Zone	PCT Code	Veg Zone Name (based on BBCC)	Condition	Area
VZ1	NR117	Blackbutt - Pink Bloodwood shrubby open forest	Mod-Good	0.55
VZ2	NR247	Spotted Gum - Grey Ironbark open forest	Mod-Good	10.61
VZ3	NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest	Mod-Good	31.31
VZ4	NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest	Mod-Good-Poor	1.37
VZ5	NR247	Spotted Gum - Grey Ironbark open forest		0.25



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GDA 1994 MGA Zone 56

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*Areas Devoid of Native Vegetation, as per Section 9.5 of the FBA

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Vegetation Zones and Plot Locations Within the Development Site

FIGURE 8

3.7 Threatened Ecological Communities

3.7.1 Desktop Results

According to the NSW Wildlife Atlas (10 km search), nine threatened ecological communities (TECs) have been recorded within the locality, including;

- Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions
- Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion
- Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions.

Of the above listed communities, one was recorded within the study area: Subtropical coastal floodplain forest. No evidence for any other TECs was recorded within the Development Site. With reference to the above TECs:

- There is no estuarine habitat within the study area; hence no saltmarsh vegetation;
- There are no stands of rainforest vegetation within the study area;
- The detention ponds or dams that lie within the active quarry site, in the southeastern corner of the Development Site, are not natural wetlands and do not support the requisite flora assemblages that characterise the Freshwater Wetlands on Coastal Floodplains TEC;
- There are no stands of Swamp Oak on floodplain or estuarine margins;
- There are stands of Swamp Mahogany swamp forest and paperbark swamp forest in the proposed offset site, as discussed in **Section 7**; however no such vegetation occurs within the Development Site; and
- The site is located at some distance from the coast; hence there are no seacliffs or headlands that could support the Themeda grassland on seacliffs and coastal headlands TEC.

3.7.2 Subtropical coastal floodplain forest

The small patch of Blackbutt–Pink Bloodwood Shrubby Open-forest (PCT 686) in the southern parts of the site represents an example of the threatened ecological community *Subtropical coastal floodplain forest of the NSW North Coast bioregion*, which is listed as endangered under Schedule 1 (Part 3) the BC Act. This community is not listed under the EPBC Act. Within the Development Site, this community occurs as a small (0.5 ha) patch associated with a low lying area along an ephemeral drainage lines that drains the southern slope of the site, and extends beyond the southern boundary of the site, as displayed in **Figure 7**.

According to the profile for this community (OEH 2012), Subtropical coastal floodplain forest has a tall open tree layer of eucalypts, angophoras, melaleucas and bloodwoods, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality.

While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include *Eucalyptus tereticornis* (forest red gum), *E. siderophloia* (grey ironbark) and *Corymbia intermedia* (pink bloodwood).

Other trees may be scattered throughout at low abundance or locally common at few sites, particularly where there is an influence from lithic substrates upslope. These include *Eucalyptus moluccana* (grey box), *E. propinqua* (grey gum), *E. seeana* (narrow-leaved red gum), *Angophora subvelutina* (broad-leaved apple), *E. robusta* (swamp mahogany), *Eucalyptus resinifera* subsp. *hemilampra* (red mahogany), and *E. acmenoides* (white mahogany), and rainforest trees such as *Ficus* spp. (figs) and *Cupaniopsis* spp. (tuckeroos).

The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic grasses, vines and forbs.

4 Threatened Species

This chapter describes the threatened species predicted to occur within the study area, based on the field survey results, the outputs of desktop assessment and the outputs of the BioBanking Credit Calculator, in accordance with Section 6 of the FBA.

4.1 Overview

Several sources of information have been employed to create a list of candidate threatened species and populations relevant to the study area. The Credit Calculator outputs of ecosystem credit species and species credit species are used as the basis for the consideration of threatened species in this BAR. In addition to this, the NSW Wildlife Atlas 10 km search tool was used to search for previous records of threatened species (as listed under the *Biodiversity Conservation Act 2016* - BC Act) from the locality.

Overall, an assemblage of 81 threatened species or populations are deemed as potential relevance to the study area. This assemblage consists of 14 plants, 35 birds, 24 mammals, four amphibians, three reptiles and one endangered population. The habitat requirements and ecology of the threatened species predicted to occur within the study area are described in the likelihood of occurrence table presented in **Appendix H** this report. The likelihood of occurrence rating is based on the results of field surveys, and particularly on the extent, nature and condition of habitat types and habitat features within the study area.

Of the 81 threatened biota potentially relevant to the site at Sancrox, seven were recorded within the study area during the current field surveys (see **Figure 9**). These species and the field survey results are discussed in **Sections 4.3** and **4.4**.

Additionally, the SEARs identify the following threatened species as requiring "further consideration":

- Biconvex Paperbark *Melaleuca biconvexa*;
- Spider Orchid *Dendrobium melaleucaphilum*; and
- Southern Swamp Orchid *Phaius australis*.

These species were not recorded during the current investigation, despite targeted searches for the two orchid species during their known flowering periods. These species are discussed further in **Section 6.4**.

This chapter describes the threatened species of potential relevance to the site and hence that were targeted during field surveys, in terms of (i) ecosystem credits (**Section 4.3**) and (ii) species credits (**Section 4.4**).

4.2 Summary of Threatened Species Recorded on Site

Threatened species recorded on the Development Site, including their respective habitat components and credit type, are listed in **Table 12**.

Table 12 Threatened species recorded on the site

Species	BC Act	Credit Type	Habitat Component Development Site
Eastern Freetail-bat *Mormopterus norfolkensis*	Vulnerable	Ecosystem	Foraging and roosting habitat available. Recorded on site (AnaBat detector).
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	Vulnerable	Ecosystem	Foraging and roosting habitat available. Recorded on site (AnaBat detector).
Greater Broad-nosed Bat *Scoteanax rueppellii*	Vulnerable	Ecosystem	Foraging and roosting habitat available. Recorded on site (AnaBat detector)
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	Vulnerable	Ecosystem	Foraging habitat available, roosting habitat (hollow-bearing trees) scarce. Recorded on site via AnaBat Detector, with low confidence level.
Little Bent-wing Bat *Miniopterus australis*	Vulnerable	Ecosystem (foraging habitat) Species (breeding)	Foraging habitat available on site. Roosting habitat and breeding caves absent. Recorded on site via AnaBat Detector.
Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*	Vulnerable	Ecosystem (foraging habitat) Species (breeding)	Foraging habitat available on site. Roosting habitat and breeding caves absent. Recorded on site via AnaBat Detector.
Grey-headed Flying-fox *Pteropus poliocephalus*	Vulnerable	Ecosystem (foraging habitat) Species (breeding)	Foraging habitat available on site. No breeding habitat, including camp sites, on or near site. Recorded via visual observation and call recognition.

A total of seven threatened fauna species were recorded on the site at Sancrox during the survey (31st November to 14th December 2015) including:

- Six microchiropteran bats; and
- one megachiropteran bat (Grey-headed Flying Fox)

A number of threatened microchiropteran bat species, listed under the BC Act, were recorded via ultrasonic detection (using AnaBat recorders), namely the Eastern Falsistrelle, Little Bent-wing Bat, Greater Broad-nosed Bat, East-coast Freetail Bat and Yellow-bellied Sheathtail-bat (possible ID), Eastern Bent-wing Bat (Probable ID). No microchiropteran bats were recorded in harp traps.

The threatened Grey-headed Flying-fox was also recorded during spotlighting surveys. This species is listed under both the BC Act and the EPBC Act.

Despite comprehensive searches for Koalas using visual searches and the Spot Assessment Technique (10 plots in total), no direct evidence (via sightings or aural calls) of this species was recorded on the site. Further details are provided in **Section 4.4**.

No threatened ground mammals (including Rufous Bettong, Spotted-tailed Quoll, Eastern Chestnut Mouse, and Common Planigale) were recorded via the use of cage trapping, Elliot trapping, camera monitoring or spotlighting.

No threatened arboreal mammals (including Squirrel Glider, Yellow-bellied Glider or Brush-tailed Phascogale) were recorded via glider-tube trapping, arboreal hair tube trapping or spotlighting.

No threatened amphibians were recorded during spotlighting or call playback at waterbodies in the bushland or within the quarry. All waterbodies on the site contain Mosquito Fish *Gambusia holbrooki*, which are a tadpole predator and would further decrease the likelihood of any threatened amphibians occurring.

The only reptiles observed were the Lace Monitor and Eastern Water Dragon. There are no threatened reptiles known to occur in the locality.

No threatened woodland birds or raptors were observed during avifauna surveys. No threatened forest owls were observed during spotlighting or call-playback surveys.

The following sections detail the threatened species of relevance to the Development Site, in terms of ecosystem credit species and species credit species.

4.3 Ecosystem Credit Species

According to the FBA, threatened species that attract ecosystem credits are predicted to occur in a given area based on the presence of "habitat surrogates"[1]. Where such habitat surrogates occur, these species have a "high likelihood of being present on the site" and therefore a threatened species survey is not required.

By contrast, targeted surveys are required for species that attract species credits, as discussed in **Section 4.4**.

4.3.1 Generated by credit calculator

A total of 27 ecosystem credit species have been predicted to occur within the study area according to the Credit Calculator (**Table 13**). Species prediction is based on the presence of certain habitat surrogates, including vegetation zones that have been mapped within the study area and on landscape values. According to Section 6.3 of the FBA, an ecosystem credit species is deemed as 'on site' if one or more of its habitat components are present on site. The three habitat components used for this assessment include foraging habitat, breeding habitat and roost/shelter habitat.

Table 13 lists the ecosystem credit species predicted to occur within the study area (including records from field surveys) and provides reasoning for the predicted presence or absence of the species within the study area (including habitat component). Species recorded on site are listed in bold type.

[1] IBRA subregion, PCT, percent vegetation cover and vegetation condition.

Table 13 Threatened species predicted to occur by the Credit Calculator (ecosystem credit species)

Species	BC Act	LoO*	On Site **	Habitat Component Development Site
Square-tailed Kite *Lophoictinia isura*	Vulnerable	M	Yes	Foraging habitat availability in woodland areas; large home ranges. Low quality nesting habitat (preferred near to watercourses).
Brown Treecreeper *Climacteris picumnus victoriae*	Vulnerable	L	Yes	Potential foraging and nesting habitat availability, although prefers habitats inland of Great Dividing Range.
Bush Stone-curlew *Burhinus grallarius*	Endangered	L	Yes	Moderate habitat available on site, dense shrubs for nesting predominantly absent. No records within 10 km of site (Atlas of NSW Wildlife)
Swift Parrot *Lathamus discolour*	Endangered	L	Yes	Potential foraging habitat: winter flowering eucalypts (e.g. Spotted Gum) on site. Breed in Tasmania.
Little Lorikeet *Glossopsitta pusilla*	Vulnerable	M	Yes	Potential foraging and nesting habitat on site. Large home range.
Little Eagle *Hieraaetus morphnoides*	Vulnerable	M	Yes	Potential foraging and nesting habitat available on site; large home range.
Diamond Firetail *Stagonopleura guttata*	Vulnerable	L	Yes	Foraging and nesting habitat available on site, dense shrubs for nesting predominantly absent. No records within 10 km of site (Atlas of NSW Wildlife)
Scarlet Robin *Petroica boodang*	Vulnerable	M	Yes	Potential foraging and nesting habitat available on site. Large home-ranges. No records within 10 km of site (Atlas of NSW Wildlife)
Glossy Black-Cockatoo *Calyptorhynchus lathami*	Vulnerable	L	Yes	Scattered foraging habitat available within pockets of *Allocasuarina* trees; Hollow-bearing trees for nesting are rare.
Wompoo Fruit-Dove *Ptilinopus magnificus*	Vulnerable	L	Yes	Potential foraging and nesting habitat, prefers rainforest or moist eucalypt forest. Unlikely to occur apart from possible wide-ranging foraging activity. No records within of site (Atlas of NSW Wildlife)
Barred Cuckoo-shrike *Coracina lineata*	Vulnerable	M	Yes	Potential foraging and nesting habitat. No records within of site (Atlas of NSW Wildlife)
Hooded Robin *Melanodryas cucullata cucullata*	Vulnerable	L	Yes	Potential foraging and nesting habitat although prefers structurally diverse forests or woodland. No records within of site (Atlas of NSW Wildlife)
Varied Sittella *Daphoenositta chrysoptera*	Vulnerable	H	Yes	Foraging and nesting habitat available in woodland areas; nearby records to site (within 2 km).
Masked Owl *Tyto novaehollandiae*	Vulnerable	M	Yes	Foraging and breeding habitat available, although large hollow nesting habitat scarce, nearby records to site (within 2 km).

Species	BC Act	LoO*	On Site **	Habitat Component Development Site
Powerful Owl *Ninox strenua*	Vulnerable	L	Yes	Foraging and breeding habitat available, large hollow nesting habitat scarce, large home range.
Sooty Owl *Tyto tenebricosa*	Vulnerable	L	Yes	Foraging and breeding habitat available, large hollow nesting habitat scarce; prefers rainforest or moister forest types.
Barking Owl *Ninox connivens*	Vulnerable	M	Yes	Foraging habitat available. Large hollow nesting habitat scarce. No records within of site (Atlas of NSW Wildlife)
Red-legged Pademelon *Thylogale stigmatica*	Vulnerable	L	Yes	Marginal foraging and breeding habitat availability, although dense understorey vegetation is predominantly absent on site. Prefers rainforest and moist vegetation types.
Long-nosed Potoroo *Potorous tridactylus*	Vulnerable	L	Yes	Foraging and breeding habitat availability, although dense understorey vegetation is predominantly absent on site.
Spotted-tailed Quoll *Dasyurus maculatus*	Vulnerable	L	Yes	Potential foraging habitat availability, den opportunities scarce. Large home ranges
Yellow-bellied Glider *Petaurus australis*	Vulnerable	L	Yes	Potential foraging habitat availability. Large hollow bearing trees scarce.
Eastern Freetail-bat *Mormopterus norfolkensis*	**Vulnerable**	**P**	**Yes**	**Foraging and roosting habitat available, recorded on site (Anabat detector)**
Golden-tipped Bat *Kerivoula papuensis*	Vulnerable	M	Yes	Foraging habitat availability; prefers rainforest or forest adjacent to rainforest. Roosts mainly in rainforest gullies - unlikely to occur apart from possible foraging activity.
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	**Vulnerable**	**P**	**Yes**	**Foraging and roosting habitat available, recorded on site (Anabat detector))**
Greater Broad-nosed Bat *Scoteanax rueppellii*	**Vulnerable**	**P**	**Yes**	**Foraging and roosting habitat available, recorded on site (Anabat detector)**
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	**Vulnerable**	**H**	**Yes**	**Possible recording on site (AnaBat Detector). Data likely to be confused with calls with those of other bat species). Foraging habitat available, roosting habitat (hollow-bearing trees) scarce.**
Hoary Wattled Bat *Chalinolobus nigrogriseus*	Vulnerable	H	No	Foraging and roosting habitat available.

* Likelihood of occurrence – see **Appendix H** for likelihood definitions.

** Species marked 'Yes' have been ticked as 'On site' in the Credit Calculator.

4.3.2 Wildlife Atlas (10 km search)

A range of other ecosystem credit threatened species has been identified in the 10 km search results from the NSW Wildlife Atlas. Although not identified as 'predicted threatened species' in the Credit Calculator, these species were targeted during surveys conducted in December 2015. **Table 14** provides the listings and survey findings for each species.

The relevance of each species to the proposal is based on their individual habitat requirements, which are provided in the Likelihood of Occurrence (LoO) table in **Appendix H** of this report. The process of assessing habitat for such species was undertaken in accordance with the steps in Section 6.3 of the FBA. Species recorded on site are listed in bold type.

Table 14 Additional Ecosystem Credit Species generated by Wildlife Atlas

Species	TSC	LoO**	Relevance
Blue-billed Duck *Oxyura australis*	Vulnerable	L	Moderate habitat availability in large quarry dams (in disturbed quarry area), prefers dense aquatic vegetation. No habitat in proposed expansion area.
Common Blossom-bat *Syconycteris australis*	Vulnerable	L	Low habitat availability, prefers littoral rainforest for roosting and feeds in heath or paperbark swamps. Occasionally occurs in wet sclerophyll forests.
Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*	**Vulnerable**	**P**	**Foraging habitat available on site. Roosting habitat predominately absent. Breeding caves absent.**
Eastern Cave Bat *Vespadelus troughtoni*	Vulnerable	L	Foraging habitat available on site. Roosting and breeding habitat (caves) is absent.
Eastern Grass Owl *Tyto longimembris*	Vulnerable	L	Low habitat availability, prefers areas with tall grass, including tussocks, grassy plains, swampy areas or sedges on floodplains
Grey-headed Flying-fox *Pteropus poliocephalus*	**Vulnerable**	**P**	**Foraging habitat available on site.** **No breeding habitat, including camp sites, on or near site.**
Southern Myotis *Myotis macropus*	Vulnerable	M	Foraging habitat available on site particularly near larger waterbodies in quarry area. Roosting habitat such as caves, mine shafts or hollow-bearing trees is rare or absent.
Spotted Harrier *Circus assimilis*	Vulnerable	L	Habitat available on site, largely vagrant - unlikely to occur apart from possible foraging activity. Found most commonly in native grassland.
Rose-crowned Fruit-Dove *Ptilinopus regina*	Vulnerable	L	Low habitat availability, prefers rainforest and occasionally moist eucalypt forest; unlikely to occur.

* Based on 'probable' or 'possible' confidence level in identification of Anabat recordings. Some possibility of confusion of data with those of other bat species.

** Likelihood of occurrence – see Appendix H for likelihood definitions.

4.3.3 Predicted Ecosystem Credit Species

The relevant steps in Section 6 of the FBA have been applied to identify the ecosystem credit species present on the site, or which have a high likelihood of occurrence on the site. The likelihood of occurrence has been identified for all of the potential ecosystem credit species by conducting habitat and vegetation type assessments across the site. The results for this are provided in the comprehensive likelihood of occurrence table in **Appendix H**. Furthermore, detailed ecological surveys for species with moderate or high likelihood of occurrence were undertaken on the site in December 2015.

A total of 27 threatened species, including 17 birds and nine mammals (five microchiropteran bats), which attract ecosystem credits, have been predicted to occur within the site in the Credit Calculator. Of these, four threatened micro-bats were recorded during field surveys:

- Eastern False Pipistrelle;
- Eastern Freetail-bat;
- Greater Broad-nosed bat;
- Yellow-bellied Sheathtail Bat;

Whilst not listed as 'predicted threatened species' in the Credit Calculator, an additional two threatened micro-bats and one megachiropteran bat were recorded on site:

- Eastern Bentwing-bat;
- Little Bentwing-bat; and
- Grey-headed Flying-fox.

The Eastern False Pipistrelle, Eastern Freetail-bat, Greater Broad-nosed bat and Yellow-bellied Sheathtail Bat attract ecosystem credits; whereas the Eastern Bentwing-bat, Little Bentwing-bat and Grey-headed Flying Fox attract ecosystem credits for foraging habitat and species credits for impacts on their breeding habitat (see **Section 4.4**).

The ecosystem credit bat species recorded on the site are described below, including credit type (within Northern Rivers CMA), conservation status, habitat requirements and conservation biology. The locations of records within the study area (which are all linked to Anabat detector locations) are shown in **Figure 9**. Data on credit type and other ecology of each species is sourced from the Threatened Species Profile Database.

Eastern False Pipistrelle *Falsistrellus tasmaniensis*

Credit type: Ecosystem

NSW Status - Vulnerable (BC Act); Commonwealth status – not listed (EPBC Act)

The Eastern False Pipistrelle inhabits sclerophyll forests in south eastern Australia from southern Queensland to Tasmania with a preference for moist forest types and tall trees (>20m). It roosts predominantly in hollow-bearing trees although can use caves or buildings. Foraging distances can be large with one record of a 12 km commute from roost.

This species breeds during Spring months and young are usually born in December or January. Hibernation occurs during winter months. The best time of year for identification of this species is mid-spring to mid-autumn.

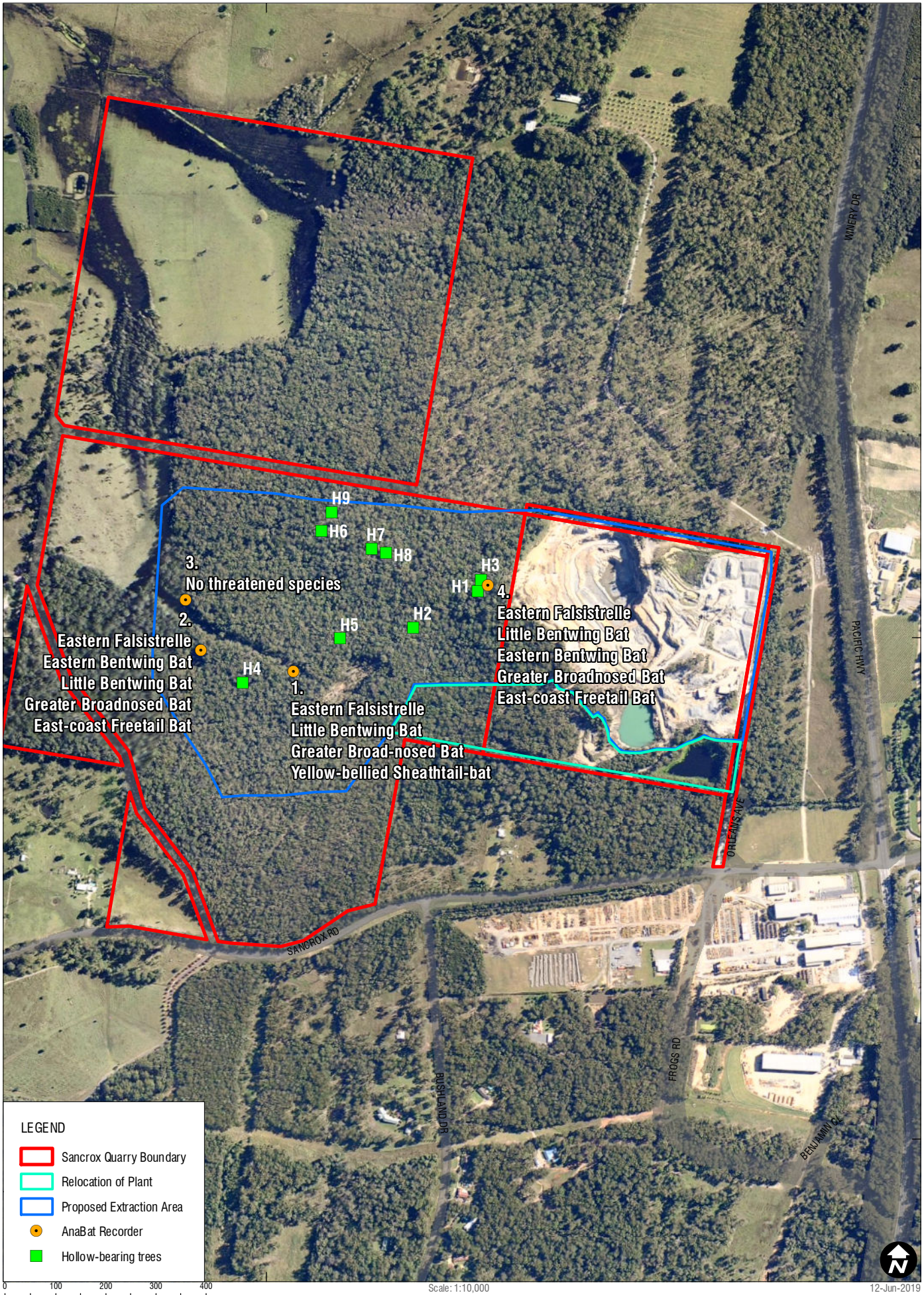
Within the Northern Rivers CMA, the Eastern False Pipistrelle can only tolerate up to 10 % loss of foraging habitat and up to 10 % loss of hollow-bearing trees.

Eastern Freetail-bat *Mormopterus norfolkensis*

Credit type: Ecosystem

NSW Status - Vulnerable (BC Act); Commonwealth status – not listed (EPBC Act)

The Eastern Freetail-bat is found dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. This species nests in hollow-bearing trees although will also roost under bark or in man-made structures. The site contains limited hollow-bearing trees that might provide roosting habitat for this species. Forest and woodland foraging habitat is abundant.



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Fauna survey locations, habitat trees and threatened bat records

FIGURE 9

Within the Northern Rivers CMA, the Eastern Freetail-bat can only tolerate temporary loss of up to 10 % foraging habitat and no more than 10 % hollow bearing trees.

Greater Broad-nosed Bat *Scoteanax rueppellii*

Credit type: Ecosystem

NSW Status - Vulnerable (BC Act); Commonwealth status – not listed (EPBC Act)

The Greater Broad-nosed Bat utilises habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Its distribution includes slopes of the Great-dividing range and coastal regions from north-eastern Victoria to the Atherton Tableland in Queensland. This species predominantly roosts in tree hollows, which are available on the site in small amounts. Woodland foraging habitat for this species is abundant on the site however preferred creek line and riparian vegetation is largely absent.

Within the Northern Rivers CMA, the Greater Broad-nosed Bat can only tolerate temporary loss of 10 % of foraging habitat and 10 % loss of hollow-bearing trees. Loss of riparian habitat cannot be tolerated.

Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*

Credit type: Ecosystem

NSW Status - Vulnerable (BC Act); Commonwealth status – not listed (EPBC Act)

The Yellow-bellied Sheathtail Bat was also recorded as a 'Possible Identification', meaning the calls recorded by Anabat are *likely* to be confused with calls with those of other bat species. The site does contain suitable foraging habitat for this species although roosting habitat such as hollow-bearing trees are scarce. This species is regarded as present and is included in the offset calculation for the proposal on the site.

This species occurs in many habitat types and occupies very large ranges. Like all microchiropteran bats, this species is most active in warmer months between October and March. It forages throughout most habitats over its large range, even in treeless areas. Individuals roosts in tree hollows and in treeless areas, and is also known to roost in mammal burrows. Breeding has been recorded from December to mid-March. Some of the hollow-bearing trees recorded within the site could provide roosting habitat for this species.

The Yellow-bellied Sheathtail-bat can only tolerate temporary loss of 10 % of foraging habitat and 10 % of hollow-bearing trees within the Northern Rivers CMA.

Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*

Credit types: Ecosystem (foraging habitat) and Species (land containing caves or similar structures)

NSW Status - Vulnerable (BC Act); Commonwealth status – not listed (EPBC Act)

The Eastern Bent-wing Bat is an ecosystem credit species that was not predicted to occur in the Credit Calculator but was recorded using AnaBat detectors (with 'Probable' confidence level) within the Development Site (see **Figure 9**). Probable confidence level means that the calls recorded by AnaBat have some possibility of confusion of calls with those of other bat species.

This species occurs in a variety of forest formations along the east and north-west coasts of Australia. Roosting occurs predominantly in caves and occasionally in derelict mines, storm-water tunnels, buildings and other man-made structures. Populations use maternity caves in spring and summer and during other months disperse up to 300 km from these caves.

Foraging habitat, in the form of forest, woodland and adjoining open areas, is present within the site. Roosting and breeding habitat (i.e. caves, disused mines shafts, some buildings) is absent from the site.

Within the Northern Rivers CMA, the Eastern Bentwing-bat attracts ecosystem credits for foraging habitat and species credits for breeding habitat (land containing caves or similar structures). As no caves or similar structures were recorded within the study area, no species credits are generated for the impacts of the development on the Eastern Bentwing-bat. Impacts on the Eastern Bentwing Bat as a result of the proposed development are therefore quantified via loss of foraging habitat represented as ecosystem credits.

Within the Northern Rivers CMA, the Eastern Bentwing-bat cannot tolerate loss of natural breeding or roosting habitat and can tolerate no more than 10 % loss of foraging habitat within 500 m of breeding habitat (caves in Karst). There can be no capping of loss of foraging habitat elsewhere.

Grey-headed Flying-fox *Pteropus poliocephalus*

Credit types: Ecosystem (foraging habitat) and Species (land within 40 m of rainforest, coastal scrub, riparian or estuarine communities)

NSW Status - Vulnerable (BC Act); Commonwealth status – Vulnerable (EPBC Act)

The Grey-headed Flying-fox is an ecosystem credit species that was not predicted to occur in the Credit Calculator but was recorded during field surveys within the Development Site. This species occurs in a variety of woodland formations including subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young. There is no roosting camp on or adjacent to the site. The forest and woodland habitats that extend across the site provide foraging resources for this species during flowering season when individuals search for nectar and pollen in native trees, in particular *Eucalyptus, Melaleuca* and *Banksia*, and fruits of rainforest trees and vines.

Within the Northern Rivers CMA, the Grey-headed Flying-fox attracts ecosystem credits for foraging habitat and species credits for breeding and roosting habitat (i.e. “land within 40 m of rainforest, coastal scrub, riparian or estuarine communities”). The forested parts of the Development Site represent foraging habitat for Grey-headed Flying-fox and accordingly, impacts on the foraging habitat for this species have been included as ecosystem credits. However, the site does not contain or lie within 40 m of rainforest, coastal scrub, riparian or estuarine communities. Hence no species credits are generated for the impacts of the development on the Grey-headed Flying-fox.

Within the Northern Rivers CMA, the Grey-headed Flying-fox cannot sustain loss of breeding habitat. It can tolerate up to 10 % loss of foraging habitat providing that "replanting" or "supplementary planting" is undertaken in offset sites.

Little Bentwing-bat *Miniopterus australis*

Credit types: Ecosystem (foraging habitat) and Species (breeding/roosting habitat)

NSW Status - Vulnerable (BC Act); Commonwealth status – not listed (EPBC Act)

The Little Bentwing-bat was not listed as a predicted threatened species in the Credit Calculator, but was nonetheless recorded using ultrasonic call detection (i.e. AnaBat detector).

The Little Bentwing-bat inhabits moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub in south eastern Australia from Cape York in Queensland to Wollongong in New South Wales. This species often uses caves, abandoned mines or buildings as roosting habitat however does also utilise tree hollows which are available (although limited) on the site. Like the Eastern Bentwing-bat, this species uses maternity caves during summer months to rear young.

Within the Northern Rivers CMA, the Little Bentwing Bat attracts both ecosystem credits and species credits. Ecosystem credits are linked to foraging habitat, whilst species credits are only applicable where breeding habitat (i.e. caves) occurs.

Whilst foraging habitat is widespread across the site, maternity caves or other similar resources for breeding and roosting for Little Bentwing Bat are not present. For this reason, preparation of a species polygon (according to Section 6.5 of the FBA) and creation of species credits is not required for the Little Bentwing-bat.

Within the Northern Rivers CMA, the Little Bentwing-bat can only tolerate 5% loss of tree hollows, and up to 10% loss of foraging habitat. No loss of breeding habitat can be tolerated.

4.4 Species Credit Species

4.4.1 Candidate species – Generated by credit calculator

A total of 24 candidate 'species credit species' have been determined relevant to the study area according to the Credit Calculator (**Table 15**). This prediction is based, *inter alia*, on previous records and the 'Geographic/Habitat Features' identified in the Credit Calculator. Species recorded on site are listed in bold type.

Table 15 Species credit species – Credit Calculator output and field survey records

Species	BC Act	LoO*	On Site	Habitat present on site
Biconvex Paperbark *Melaleuca biconvexa*	Vulnerable	L	No	Potential habitat availability in low-lying areas containing paperbark in southern patch and in western area of site. Not recorded during surveys.
Common Planigale *Planigale maculata*	Vulnerable	L	No	Potential habitat availability in woodland areas. Low occurrence of tree hollows may be a deterrent.
Eastern Chestnut Mouse *Pseudomys gracilicaudatus*	Vulnerable	L	No	Low habitat availability, prefers heathland mainly in dense, wet heath and swamps

Species	BC Act	LoO*	On Site	Habitat present on site
Eastern Pygmy Possum *Cercartetus nanus*	Vulnerable	L	No	Possible habitat availability in woodland areas although lack of understorey and sparsity of trees may be a deterrent.
Giant Barred Frog *Mixophyes iteratus*	Endangered	L	No	Low habitat availability, prefers freshwater streams
Green-thighed frog *Litoria brevipalmata*	Vulnerable	L	No	Potential habitat availability in soaks and depressions on the site (following heavy rain). Can occur in drier sclerophyll forest (in disturbed quarry area).
Groves Paperbark *Melaleuca grovenia*	Vulnerable	L	No	Low habitat availability, prefers heath and shrub land, often in exposed sites, in low coastal hills, escarpment ranges and tablelands on outcropping granite, rhyolite and sandstone.
Koala *Phascolarctos cinereus*	**Vulnerable**	**M**	**Yes**	**One group of old scats observed on ridgetop of site, numerous possible koala scratches (old) observed on Grey Gum trunks across the site. Potential koala habitat (SEPP 44) present on site. No breeding population (core koala habitat) present.**
Leafless Tongue Orchid *Cryptostylis hunteriana*	Vulnerable	M	No	Marginal potential habitat occurs on site in very restricted locations in paperbark swamp forest margins.
Milky Silkpod *Parsonsia dorrigoensis*	Vulnerable	L	No	Low habitat availability, prefers subtropical and warm-temperature rainforest, on rainforest margins, and in moist eucalypt forest.
Pale-headed Snake *Hoplocephalus bitorquatus*	Vulnerable	L	No	Possible habitat available. Low occurrence of tree hollows may be a deterrent.
Rainforest Cassia *Senna acclinis*	Endangered	L	No	Low habitat availability, prefers margins of subtropical, littoral and dry rainforests.
Red-backed Button-quail *Turnix maculosus*	Vulnerable	L	No	Low habitat availability, prefers grasslands, heath and crops.
Regent Honeyeater *Anthochaera phrygia*	Critically Endangered	L	No	Low breeding habitat potential onsite due to small number of mature trees, open canopy, and lack of preferred woodland tree species. Possible foraging habitat in winter.
Rufous Bettong *Aepyprymnus rufescens*	Vulnerable	M	No	Potential habitat in woodland areas, native grasses in ground layer unlikely tall or dense enough for favourable habitat.
Rusty Plum *Niemeyera whitei*	Vulnerable	L	No	Low habitat availability, prefers gullies of warm temperate or littoral rainforests and the adjacent understorey of moist eucalypt forest.
Scant Pomaderris *Pomaderris queenslandica*	Endangered	L	No	Possible habitat availability, vegetation communities that occur on site are not typical species assemblages in which it is known to occur.

Species	BC Act	LoO*	On Site	Habitat present on site
Slender Marsdenia *Marsdenia longiloba*	Endangered	L	No	Low habitat availability, prefers subtropical and warm temperate rainforest, lowland moist or open eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops.
Squirrel Glider *Petaurus norfolcensis*	Vulnerable	M	No	Potential habitat in woodland areas. Lack of understorey for foraging and tree hollows for shelter would likely be a deterrent.
Stephens Banded Snake *Hoplocephalus bitorquatus*	Vulnerable	L	No	Low habitat availability, prefers rainforest and moist eucalypt forests and rocky areas.
Three-toed Snake-tooth Skink *Coeranoscincus reticulatis*	Vulnerable	L	No	Low habitat availability, prefers rainforest and occasionally moist eucalypt forest, on loamy or sandy soils.
White-eared Monarch *Carterornis leucotis*	Vulnerable	L	No	Low habitat availability, prefers dry and littoral rainforest or rainforest margins.
White-flowered Wax Plant *Cynanchum elegans*	Endangered	N	No	No habitat on site; prefers rainforest and littoral rainforest
Willawarrin Double tail *Diuris disposita*	Endangered	N	No	Outside distribution range

* Likelihood of occurrence – see **Appendix H** for likelihood definitions.

Additional species credit species relevant to the study area which have not been generated by the credit calculator but appear in database searches are listed below in **Section 4.4.2**.

4.4.2 Candidate Species – Wildlife Atlas (10 km search)

Additional candidate threatened species of potential relevance to the site have been identified through obtaining previous records within 10 km of the site in the 'BioNET' *Atlas of NSW Wildlife*. Targeted surveys for these species were included as part of the December 2015 field survey program and their potential relevance to the site has been documented in the 'likelihood of occurrence' assessments for the site in **Appendix H**. These species are discussed below in **Table 16.**

Of these species, one, the Little Bentwing-bat *Miniopterus australis*, was recorded on the site.

Table 16 Species credit species – derived from NSW Wildlife Atlas (BioNet) 10 km search

Species	BC Act	LoO*	Explanation (for presence/absence)
Australasian Bittern *Botaurus poiciloptilus*	Endangered	M	Moderate habitat availability in large quarry dams (in disturbed quarry area), prefers dense aquatic vegetation. No habitat in proposed expansion area.
Black Bittern *Ixobrychus flavicollis*	Vulnerable	M	Moderate habitat availability in large quarry dams (in disturbed quarry area), prefers dense aquatic vegetation. No habitat in proposed expansion area.

Species	BC Act	LoO*	Explanation (for presence/absence)
Brush-tailed Phascogale *Phascogale tapoatafa*	Vulnerable	M	Moderate habitat available. Foraging habitat abundant throughout woodland containing rough bark trees. Hollows-bearing trees for nesting are relatively scarce.
Comb-crested Jacana *Irediparra gallinacea*	Vulnerable	L	Moderate habitat availability in large quarry dams (in disturbed quarry area), prefers dense, floating aquatic vegetation. No habitat in proposed expansion area.
Black-necked Stork *Ephippiorhynchus asiaticus*	Endangered	L	Low habitat availability, prefers floodplain wetlands. Could potentially occur in quarry dams containing aquatic vegetation.
Dwarf Heath Casuarina *Allocasuarina defungens*	Endangered	N	Low habitat availability, prefers tall heath on sand, but can also occur on clay soils and sandstone.
Eastern Osprey *Pandion cristatus*	Vulnerable	L	No habitat available on the site.
Lesser Sand-plover *Charadrius mongolus*	Vulnerable	N	No habitat available on the site.
Little Bentwing-bat *Miniopterus australis*	**Vulnerable**	**P**	**Foraging habitat available on site. Roosting habitat predominately absent (possible in quarry rock faces or abandoned buildings in quarry area). Breeding caves absent.**
Little Tern *Sternula albifrons*	Endangered	N	No habitat available on the site.
Maundia triglochinoides	Vulnerable	L	Low habitat availability, prefers swamps, lagoons, dams, channels, creeks or shallow freshwater 30 - 60 cm deep on heavy clay with low nutrients. Potential low quality habitat in ponds within quarry area. Not recorded.
Narrow-leaved Black Peppermint *Eucalyptus nicholii*	Vulnerable	N	No habitat available on site. Outside distribution range. Not recorded.
Pied Oystercatcher *Haematopus longirostris*	Endangered	N	No habitat available on the site.
Sooty Oystercatcher *Haematopus fuliginosus*	Vulnerable	N	No habitat available on the site.
Southern Swamp Orchid *Phaius australis*	Endangered	L	Site lies outside of distributional range (i.e. south of Evans Head). Potential habitat in low-lying western area of site. Not recorded during targeted orchid surveys.
Spider Orchid *Dendrobium melaleucaphilum*	Endangered	L	Habitat available in western area of site.

Species	BC Act	LoO*	Explanation (for presence/absence)
Terek Sandpiper *Xenus cinereus*	Vulnerable	N	No habitat available on the site.
Wallum Froglet *Crinia tinnula*	Vulnerable	L	No habitat availability on site. Prefers habitats associated with acidic swamps on coastal sand plains or sedgelands and wet heathland. Occasionally in swamp sclerophyll forests, which are located in proposed Offset Site.

* Likelihood of occurrence – see **Appendix H** for likelihood definitions.

4.4.3 Candidate Species Credit Species – present on site

According to Section 6.5 (Step 3) of the FBA, an assessor must establish whether a candidate threatened species is present on a development site or is likely to use the habitat available on the site.

Four fauna species credit species were recorded during the December 2015 field survey: Koala, Eastern Bentwing-bat, Grey-headed Flying-fox and the Little Bentwing-bat. According to the Threatened Species Profile Database, the Eastern Bentwing-bat, Little Bentwing-bat and Grey-headed Flying-fox attract both ecosystem credits and species credits within the Northern Rivers CMA. Species credits for these species are linked to the presence of breeding habitat, which in the case of the Eastern Bentwing-bat and Little Bentwing-bat is "land containing caves or similar structures" and for the Grey-headed Flying Fox, is "land within 40 m of rainforest, coastal scrub, riparian or estuarine communities". Neither of these habitat types or features is present on the site at Sancrox. By following the steps for identifying species credit species in Section 6.5 of the FBA, these three species were excluded from the species credit entries in the Credit Calculator for this project based upon the absence of breeding habitat on the site. For this reason, and for the purpose of this assessment, each was assessed as an ecosystem credit species (see **Section 4.3**).

By contrast, the Koala is a species credit species. A description of the occurrence of the Koala on the Development Site is provided below.

No threatened plants have been recorded on the site. However, targeted searches for threatened orchids were conducted in October 2015 and revealed a specimen of an epiphytic orchid that was thought to potentially be the Spider Orchid *Dendrobium melaleucaphilum*. Flowering of this specimen during 2016 revealed that the specimen was not *D. melaleucaphilum.* This species is listed in the SEARs as a species for which impacts require "further consideration". Accordingly, a description of the surveys and results for this threatened orchid species are provided in **Section 6.4.2**.

Koala *Phascolarctos cinereus*

Vulnerable (NSW BC Act and EPBC Act)

The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. It occupies a wide range of eucalypt forest habitats, usually where preferred browse species of eucalypt occur.

The Koala was observed on the site via indirect evidence including old scats and possible tree scratches. Despite comprehensive searches for Koalas using visual searches and the Spot Assessment Technique (10 plots in total – see **Appendix B**), no direct evidence (via sightings or aural recognition of male calls) of this species was recorded on the site. Indirect evidence of Koala activity was recorded in the form of some old tree-trunk scratches (although not definitive) and scats collected at one of the plots. The results of the SPOT assessment indicate that Koala activity on the site is low.

With regard to *State Environmental Planning Policy No. 44 Koala Habitat Protection* (SEPP 44), the bushland on the site contains two 'feed trees' as listed under Schedule 2 of the Policy: Tallowwood *Eucalyptus microcorys* and Small-fruited Grey Gum *E. propinqua*. These trees were found to constitute more than 15 % of the total canopy composition across the site, and accordingly the majority of the forested parts of the site would constitute 'potential Koala habitat' according to Clause 7 of SEPP 44. However, no evidence of a breeding population was recorded on the site during the survey. As such, the Development Site does not constitute 'core Koala habitat', as defined under Clause 8 of the Policy.

Within the Northern Rivers CMA, the Koala population cannot tolerate clearing of Core Habitat within the meaning of SEPP 44 (i.e. within an approved koala PoM) or greater than 5% of foraging habitat (provided clearing does not result in any increase in fragmentation of existing habitat that affects species dispersal).

The ecological assessment completed for the *Greater Sancrox Structure Plan* (Biolink 2011) identified two small areas of high koala activity, of which both are located within the development site (see **Appendix D**). By using a Grid Based Spot Assessment Technique (RG-bSAT) combined with a radial search, the boundary for koala activity was able to be refined. Although no Koalas were sighted on the site, the recording of scats provided enough data to model the distribution of core Koala habitat (Biolink 2011). Two populations of less than 10 to 15 individuals utilise the areas and are restricted to these areas by the Pacific Highway to the east and extensive clearing to the west and north (PMHC 2015)

Ecotone (2013), similarly, did not record any sightings or other direct evidence of koala activity on the site; however, they recorded the presence of Koala scats and scratches on tree bark and concluded that the site was 'Core Koala Habitat', as defined under SEPP 44. Ecotone (2013) state that indirect evidence for Koalas was not recent and was likely to be several months old. On this basis, it is possible that Koalas still utilise the habitats within the site for dispersal between other areas of habitat in the locality. However, whilst the site constitutes potential habitat (due to the presence of listed feed tree species), it would not qualify as Core Koala Habitat, as defined under SEPP 44, as there is no evidence of a resident breeding population.

In light of the above results, there is requirement for preparation of a species polygon for the Koala according to Section 6.5 of the FBA.

5 Impact Avoidance and Minimisation

This chapter describes the impacts of the proposed development, in accordance with Section 8 of the FBA.

5.1 Impact Avoidance Measures

5.1.1 Site Selection

The proponent proposes to extend the life of the existing Sancrox quarry, rather than the opening of a new quarry in a nearby location. The use of the existing site allows for efficient use of existing quarry infrastructure, such as haul roads and shipping facilities; whereas developing an alternative site would require the purchase of additional land, exploration and construction of new quarry infrastructure.

Finding other resources of the same quality and reliability as what currently exists on the subject site is difficult as exploration of the surrounding area has identified only isolated pockets of good quality, consistent resource material located close enough to Port Macquarie as to be financially viable.

Selection of an alternative site for the Project would involve the acquisition of a new and/or 'greenfield' site which, apart from being more expensive than expanding the existing quarry, could potentially cause greater environmental impacts than the current proposal.

5.1.2 Optimising the proposed layout

The location and position of the existing resource within the study area (and current landholding) is such that expansion of the current quarry pit in a westerly direction requires clearing of existing native vegetation that cannot be avoided. The proposed quarry pit layout has been designed, as far as possible, to incorporate land already devoid of vegetation so as to limit the clearing of native vegetation where possible. As a result, 29 % of the development footprint includes cleared areas and areas of non-native vegetation.

Extending the proposed quarry footprint in other directions would not be viable as exploration investigations have only identified pockets of Metamorphic and volcanic rocks. The inconsistency of these pockets and the unknown suitability in hard rock applications make extending the quarry into areas containing these rock types unreliable.

5.2 Final Development Footprint Areas

The development footprint is defined as "*the area of land that is directly impacted on by a proposed Major Project that is under the EP&A Act, including access roads, and areas used to store construction materials*".

The development footprint includes clearing for the quarry expansion area, and the area designated for relocation of plant and access roads. The final development footprint is shown in **Figure 8** Total impact areas for the various features of the proposed development are included in **Table 17**.

The development footprint is approximately 60.6 ha, comprising 43.1 hectares (71 %) of native vegetation and 17.5 ha (29 %) of areas devoid of native vegetation (i.e. areas not requiring further assessment) (**Table 17**). The proposed quarry expansion will occur over the entire development footprint.

Table 17 Development Footprint Areas

Feature	Clearing Area (ha)	Total Native Vegetation in Footprint
Expansion Area	53.7	38.0
Relocation of Plant (Administration and Infrastructure)	6.9	5.1
Total Development Footprint Area	**60.6**	**43.1**

As noted in **Section 1.3**, the BAR assesses the original proposed quarry footprint area (prior to decreasing the footprint to avoid the mapped flood risk area), and as such the proposed vegetation clearing estimates presented herein are representative of the larger originally proposed quarry footprint. The reduction in the quarry footprint will ultimately reduce vegetation clearing (by around 3.2 hectares). Conversely, construction of a proposed noise mound on the western margin of the quarry pit would require clearing of 1.26 hectares of native vegetation. Taking into consideration the western noise mound, the revised pit layout would allow a reduction of 1.97 hectares of vegetation clearing than that listed in **Table 17**, and as a result would reduce the offset credits; however, the proponent has agreed to retain the original vegetation clearing areas (and corresponding vegetation zones) and associated offset credit amounts in the Biodiversity Offset Strategy presented in **Section 7** of this BAR.

5.3 Direct Impacts

5.3.1 Overview

According to the FBA, direct impacts on biodiversity values are described as "*an impact on biodiversity values that is a direct result of vegetation clearance from a development. It is predictable, usually occurs at or near to the development site and can be readily identified during the planning, design, construction, and operational phases of a development*."

The final development footprint will involve the following direct impacts:

- clearing of 43.1 ha of native forest vegetation, which includes 0.55 ha of the threatened ecological community *Subtropical coastal floodplain forest* (NR117);
- loss of hollow-bearing trees, some of which may provide potential roost sites and breeding habitat for a selection of bird, arboreal mammal, reptile and microchiropteran bat species; and
- removal of foraging habitat for locally occurring native fauna, in particular for threatened microchiropteran bats species, ground mammals, arboreal mammals and a range of bird species.

5.3.2 Impacts on vegetation zones

All native vegetation within the development footprint, which comprises the proposed expansion area and the area designated for relocation of plant, will be removed. Maps showing impacts on native plant communities are therefore equivalent to the PCTs shown in **Figure 7**. Impacts on native vegetation zones are shown in **Figure 8** and described in **Table 18**. The total area of vegetation removal required for construction and operation of the proposal is 43.1 ha, which represents 71 % of the development footprint. These areas of native vegetation will be replaced with permanent infrastructure for the proposed quarry and therefore impacts on native vegetation (and associated habitats) would be permanent (and unavoidable).

Table 18 Native Vegetation Impacts (clearing areas for vegetation zones)

Biometric Code	Vegetation Type Name	Condition	Clearing Area (ha)
NR117	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion#	Mod/Good	0.55
NR247	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	Mod/Good	10.61
NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	Mod/Good	30.32
NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	Mod/Good_Poor	1.37
NR247	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	Mod/Good_Poor	0.25
		Total	**43.1**

NR117 is a form of the threatened ecological community *Subtropical coastal floodplain forest*, which is listed as endangered under Schedule 1 of the BC Act.

5.4 Indirect Impacts

According to the FBA, indirect impacts on biodiversity values are described as follows:

> *"when development related activities affect threatened species, threatened species habitat, populations or ecological communities in a manner other than direct impact. Compared to direct impacts, indirect impacts often: occur over a wider area than just the site of the development; have a lower intensity of impact in the extent to which they occur compared to direct impacts; occur off site; have a lower predictability of when the impact occurs;* [and] *have unclear boundaries of responsibility."*

Indirect impacts in relation to the proposed development include:

- Potential for sedimentation and run-off to occur during construction and operation of the quarry and associated infrastructure. These are to be managed using appropriate sediment and erosion control measures and in accordance with an engineered stormwater management system (see EIS).
- There is some potential for animal strike (particularly macropods and birds) by increased traffic across the site. The speed limit will be reduced to 40 km/hr along the access road and at these speeds animal strikes are unlikely.
- Deposition of dust on vegetation adjoining the quarry, leading to reduced plant health and foraging quality for local native fauna.
- An increased presence of weeds is a possibility across the site. Weed management is to be integrated into the construction and operational management measures. Vehicle wash down is proposed and implementation of property maintenance will reduce the likelihood of weeds entering retained or adjacent areas of native vegetation.
- Rubbish and pollution may enter the site from staff or during the general day-to-day operation of the facility. To reduce the likelihood of waste entering the environment, all waste materials from the facility are proposed to be collected and transported off site for disposal or distribution. Skip bins will be provided and regularly maintained for other general waste.

5.5 On-site Mitigation Measures

A selection of best management practices and mitigation measures will be implemented as part of the proposed development to prevent, minimise and/or manage the potential for adverse impacts upon the local environment and surrounding populace.

A site-specific Operational Environmental Management Plan (EMP) for the proposed quarry to ensure that the commitments made within this EIS, along with relevant statutory obligations and the conditions of development consent (including Environment Protection Licence (EPL) requirements), are fully implemented and complied with.

A Landscaping Strategy will be prepared and implemented to screen the development from neighbouring landholders and generally improve the visual and environmental amenity of the development site.

On-site mitigation measures to reduce direct and indirect impacts include before, during and after construction measures as outlined in **Table 19** below.

Table 19 Mitigation measures to be implements before, during and after construction

Action	Outcome	Timing	Responsibility
Before Construction			
Pre-clearing surveys	Fauna residing within or occupying the expansion area are safely and ethically salvaged and relocated	Prior to tree felling or other related works	Project Ecologist
Protection of native vegetation	Delineate quarry expansion limit (to ensure no native vegetation outside expansion area is cleared)	Prior to and for the duration of any works	Construction contractor
Erosion and sediment control measures	Install and maintain erosion and sediment control measures in accordance with the requirements of the 'Blue Book' (Landcom 2004).	Prior to and for the duration of any works	Construction contractor
During Construction			
Fauna management	Supervision of tree felling to rescue and recover any fauna (as necessary)	During clearing	Project Ecologist
Weed Management	Vehicle wash-down Site weed control program Prepare weed control plan	Prior to and for the duration of any works	Project Ecologist
Rubbish management	Rubbish (such as food scraps and building waste) are to be properly managed during construction and must not be stockpiled on areas of native vegetation	Ongoing	Construction team
Exposed soil surface management	Revegetation – using re-use of topsoil layers and seeding of pasture grasses and legumes (see EIS)	Immediately following soil disturbances	Construction team

Action	Outcome	Timing	Responsibility
Traffic management	Speed limits of 40 km/hr to be imposed within site, reducing the likelihood of animal strikes. Educate workers on possibility of animal strike through construction management program	Ongoing	Construction team
Revegetation	Design and implement planting plan for corridor of native vegetation east and west of proposed quarry pit, to maintain north-south corridor link of canopy trees, as per sub-regional corridor in Greater Sancrox Structure Plan	During construction	Proponent (with Project Ecologist)
Post- Construction			
Traffic management	Speed limits of 40 km/hr are proposed, reducing the likelihood of animal strikes	Ongoing	Site operator
Weed management	Limit spread of weeds along with landscape maintenance program	Ongoing, half-yearly minimum	Site operator
Increased artificial light	Each luminaire will be aimed downwards and only switched on during loading-unloading and servicing activities outside of daylight hours and during heavy fog.	Ongoing	Site operator
Waste management	Appropriate systems will be implemented to ensure that each waste stream generated by the development is effectively managed and/or disposed of off-site (see detail in EIS). There will not be any on-site stockpiling or disposal of waste materials.	Ongoing	Site operator
Revegetation	Maintain and monitor plantings within proposed native vegetation corridors east and west of quarry pit	Post-construction; operational life of quarry	Proponent (with Project Ecologist)
Surface water and run-off	An engineered surface water drainage and management strategy is to be prepared and implemented. Techniques currently proposed to manage stormwater include bunding walls, swales, underground water capture systems and dams (see EIS)	Ongoing	Site operator

6 Impact Summary

This chapter describes the impact of the proposed development in terms of biodiversity credits, in accordance with Section 9 of the FBA.

6.1 Areas Not Requiring Further Assessment

Areas that do not require further assessment are those that do not contain native vegetation, as per Section 9.5 of the FBA (unless otherwise required by the SEARs). Of the development site, around 17.74 ha (29%) does not contain native plant communities. These areas, which do not require further assessment (and hence do not require offsets), are shown in **Figure 7** and **Figure 8**.

6.2 Entities Not Requiring Offsets

Impacts for which the assessor is not required to determine an offset (FBA, Section 9.4) comprise:

- Vegetation clearing within a vegetation zone that has a site value score of less than 17 and the PCT is not a TEC;
- Impacts on PCTs that are not threatened species habitat and are not TECs;
- Threatened species habitat within a vegetation zone that has a site value score of <17; and
- Species or populations that are not threatened and do not form part of a TEC.

As listed in , all of the vegetation zones mapped and assessed have current site value scores of over 17 and all zones represent potential threatened species habitat (subject to the findings outlined in Chapter 4). Hence, the only entities not requiring offsets are areas of native vegetation not subject to clearing as part of the proposed development.

6.3 Impacts Requiring Offsetting

According to Section 9.3 of the FBA, impacts on native vegetation that require an offset include:

- Impacts on EECs and CEECs, unless specifically nominated in the SEARs as an impact requiring further consideration; and
- impacts on PCTs associated with threatened species habitat and in a vegetation zone that has a site value score of >= 17.

6.3.1 PCTs Requiring Offset

All vegetation zones mapped with the site have current site value scores of over 17 (see **Section 6.5.1**) and represent habitat for at least one threatened species; hence any clearing in these vegetation zones would require an offset. Accordingly, the PCTs within which clearing will occur and which require an offset are:

- Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion;
- Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion; and
- Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast.

The PCTs requiring offset and the corresponding number of ecosystem credits required are listed in **Table 20**. Mapping showing the areas of PCTs and vegetation zones requiring offsetting is presented in **Figure 7** and **Figure 8**, respectively.

Table 20 PCTs requiring offset and credits required

PCT Code	PCT Name#	TEC	Clearing Area (ha)	Credits Required
686	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion (NR117)	Yes	0.55	33
1215	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion (NR247)	No	10.86	490
1262	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast (NR263)	No	30.32	1926
	Total:		**41.73**	**2449**

\# Based on online NSW Vegetation Information System (VIS) Database

\## Threatened ecological community, as listed under the BC Act

The Credit Report for development impacts is provided in **Appendix I.**

6.3.2 Species Polygons Requiring Offset

As discussed in Chapter 4 of this report, no individuals or populations of threatened species that generate species credits were recorded within the Development Site. In addition, with regard to species that attract both ecosystem credits and species credits that were candidate species recorded on the site, and the species credit component is associated with breeding habitat for those species (i.e. Grey-headed Flying Fox, Little Bentwing-bat and Eastern Bentwing-bat), no such breeding habitat is present on the site for those species. Hence, the creation of species polygons for such species is not required for this assessment.

Hence there are no species credit polygons that require offset as part of the proposed development.

6.4 Impacts Requiring Further Consideration

In the attachments to the SEARs (see **Appendix A**), OEH identify impacts that require further consideration. OEH states "Impacts on the following species, populations and ecological communities will require further consideration and provision of the information specified in s.9.2 of the Framework for Biodiversity Assessment:

- Biconvex Paperbark *Melaleuca biconvexa*;
- Spider Orchid *Dendrobium melaleucaphilum*; and
- Southern Swamp Orchid *Phaius australis*."

No evidence for these threatened plant species was recorded during field surveys conducted for this BAR. It is noted that targeted searches for threatened plants were conducted across the site on several occasions during 2015 and 2016, including during the known flowering period of the two orchid species and no individuals of these species were recorded. Track logs for the targeted orchid survey meanders are depicted in **Figure 8** and the methods and results of the targeted orchid survey are discussed in the report attached in **Appendix J.**

Section 9.2 of the FBA sets out the information to be included in the BAR on threatened species requiring further assessment. Regardless of the lack of evidence for the above listed species, a brief description of the surveys conducted for these species and their ecology, habitat and distribution is provided below.

6.4.1 Biconvex Paperbark *Melaleuca biconvexa*

The *Melaleuca biconvexa* is a small to medium size shrub that grows up to 10 m tall, occasionally growing as tall as 20 m. It is only found in a limited extent with populations scattered throughout coastal NSW. Swamp, swamp margins and creek edges are essential habitat for *Melaleuca biconvexa* as it generally grows on low lying alluvial soils on sheltered aspects.

The bark of *Melaleuca biconvexa* is typical of the Myrtaceae family. The leaves of the species are distinctive as they are small, 18 mm long and 4 mm wide, and emerge in pair at right angles from the branch. Each leaf has a central vein with the leaf blade curving upwards on either side of the vein.

The species flowers over a four week period in September and October, producing white flowers in dense clusters. The fruits of the species are typically urn shaped and approximately three to five mm in diameter.

BioNet search results have identified numerous records of *Melaleuca biconvexa* approximately four kilometres to the south of the site. No individuals of *Melaleuca biconvexa* have been recorded during any of the surveys conducted on the site to date, despite targeted searches in areas of suitable habitat. Given that this species is not cryptic and can be readily identified via leaf morphology at any time of year, there is a low likelihood that this species occurs on the site.

6.4.2 Spider Orchard *Dendrobium melaleucaphilum*

This section summarises targeted surveys and assessments for threatened orchid species carried out across the Development Site by SLR in October 2015. A copy of the report that documents the methods and results of the survey (SLR 2016) is provided in **Appendix J.**

D. melaleucaphilum (Family Orchidaceae) is an orchid which grows on other plants (i.e. epiphytic) and sometimes on rocks (i.e. epilithic) and occurs in coastal districts and nearby ranges, extending from Queensland to its southern distributional limit in the lower Blue Mountains in New South Wales (NSW). In NSW, it is currently known from seven recent collections (OEH 2012). Stems are spreading to drooping, thin and wiry in the basal half, succulent, swollen and square in cross section in the upper half, tapering towards the tip, rooting only at the base. This species grows frequently as an arboreal epiphyte of *Melaleuca styphelioides*, less commonly on rainforest trees or on rocks. Flowering occurs between July and October. It is listed as 'endangered' under the BC Act, but is not listed under the EPBC Act.

In terms of identification and morphology, *D. melaleucaphilum* is very similar to the closely related *D. tetragonum*, which has dorsal sepals 19 – 30 mm long and labellum only up to 10 mm long. *D. melaleucaphilum* was previously known as the 'large-flowered paperbark form' of *D. tetragonum* (PlantNET 2015a). Hence, these two species cannot, strictly speaking, be distinguished unless in flower.

One orchid specimen with similar characteristics to the Spider Orchid *Dendrobium melaleucaphilum* was recorded growing on the trunk of a Prickly-leaved Paperbark *Melaleuca styphelioides* on the western limit of the proposed quarry expansion area (see **Photo 1**). The identity of the *Dendrobium* was initially uncertain, as the specimen recorded was not in flower at the time of the survey. However, photographic evidence of the orchid collected during flowering in August and September 2016 revealed that the specimen was *Dendrobium gracilicaule* or possibly a hybrid *Dendrobium gracilicaule* x *D. tarberi* (see **Photo 2**). *Dendrobium gracilicaule* or its hybrid forms are not listed as a threatened species in the BC Act or EPBC Act. Hence, no threatened orchids have been recorded on the site as part of the current investigation.

Photo 1 Specimen of *Dendrobium gracilicaule* x *D. tarberi* (post-flowering, October 2015)

Photo 2 Specimen of *Dendrobium gracilicaule* x *D. tarberi* (flowering, September 2016)

BioNet search results have identified one record of *Dendrobium melaleucaphilum* within 10 km of the site. The species has not been recorded within five km of the site.

6.4.3 Southern Swamp Orchid *Phaius australis*

The Southern Swamp-orchid *Phaius australis* (Family Orchidaceae) is a terrestrial (ground dwelling) orchid and produces the largest flowers of any Australian orchid (TSSC 2014). Each plant has 4–8 large, pleated leaves and 1–2 flower stalks. The leaves are long (approx. 70 cm) and narrow, in relation to width (3–10 cm wide). The flowers are red-brown with yellow veins inside the flower and grow in spikes on stalks that are 70–110 cm long (TSSC 2014).

P. australis grows in *Melaleuca quinquenervia* swamps and in sclerophyll forest, on the coast, at or near sea level (PlantNET 2015). It has been reported north from Lake Cathie, but chiefly north from the Evans Head district (PlantNET 2015). OEH (2014) notes that the species "Occurs in Queensland and north-east NSW as far south as Coffs Harbour". Historically, it extended farther south, to Port Macquarie". On this basis, the site at Sancrox is outside of the range limit of this species.

BioNet search results have identified one record of *P. australis* within 10 km of the site. The species has not been recorded within five kilometres of the site. Potential habitat for *P. australis* occurs within the small patch of Blackbutt-Pink Bloodwood shrubby open forest (NR117) along the southern boundary of the Development Site and within stands of swamp forest and paperbark forest within the proposed Offset Site. No individuals were recorded during targeted orchid surveys conducted during the flowering period of this species. Given that the distributional limit of the species doesn't include the study area at Sancrox and the lack of evidence for the species on the site, there is a low likelihood that this species could potentially occur on the site.

6.4.4 Impacts Requiring Further Consideration – General

There are no other impacts that require further consideration by the consent authority for the proposed development at Sancrox. With reference to the thresholds for such impacts in **Table 4** and Section 9.2 of the FBA:

- There are no significant rivers and streams, important wetlands or estuarine areas within the study area; hence there will be no impacts that substantially reduce the width of the riparian buffer zone of such features;
- There are no State significant biodiversity links within (or adjoining) the study area. Hence, the proposal will have no effect on the movement (of native fauna) along such links (corridors);
- The estimated impacts on native vegetation, as described in **Section 5.3** of this report, are in no way likely to cause the extinction (or significantly reduce the viability) of a TEC in the Macleay-Hastings IBRA subregion. The removal of 0.5 ha of Subtropical Coastal Floodplain Forest EEC will not reduce the viability of the patch of vegetation in the locality or IBRA subregion or cause its local extinction;
- There is no critical habitat within the study area;
- There are no threatened species or populations nominated in the SEARs as likely to become extinct (or have their viability reduced significantly) in the IBRA subregion if affected by the development; and
- The predicted impacts of the proposal on native vegetation are not likely to impact on a critically endangered species, or on any species that have not previously been recorded in the IBRA subregion on the *Atlas of NSW Wildlife* database.

6.5 Biodiversity Credit Requirement

The BioBanking Credit Calculator has been used to calculate the impacts of the proposed development and potential offset requirements, in accordance with Section 8 of the FBA. This section of the report provides a summary of the results of the credit calculations. A full copy of the credit profile for the impacts of the proposal is provided in **Appendix I**.

6.5.1 Ecosystem credits

The ecosystem credits required to offset the proposed development are listed by vegetation zone in **Table 21**. A total of 2,449 ecosystem credits would be required to offset the clearing of native vegetation as part of the proposed development. The Credit Calculator identifies matching ecosystem credits (and IBRA subregions) that can be used to offset these impacts (see **Section 6.6**).

Table 21 Vegetation zones requiring offset and credits required

Zone Name	Vegetation type name	Zone area (ha)	Current site value	Future site value	Credits
NR117_Mod-Good	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	0.55	74.00	0	33
NR247_Mod-Good	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	10.61	55.21	0	479
NR263_Mod-Good	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	30.32	78.00	0	1,887
NR263_Mod-Good-Poor	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	1.37	32.89	0	39
NR247_Mod-Good-Poor	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	0.25	51.04	0	11
	Total	**43.10**			**2,449**

The ecosystem credit required for offsetting the proposed development is summarised further in **Table 22**.

Table 22 Ecosystem credits required for offsetting the proposed development

Biometric Code	Ecosystem Credit Type	Credits
NR117	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	33
NR247	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	490
NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	1,926
	Total	**2,449**

6.5.2 Landscape Value Score

Landscape score for the Development Site was calculated as described in **Section 2.9**. The loss in landscape value score has been calculated in Credit Calculator as 15, as per the Full Credit Report in **Appendix I**.

6.5.3 Species Credits

No species polygons are required for impacts on threatened species that attract species credits because either:

- the species credits are associated with breeding habitat that is not present on the site (i.e. in the case of the Grey-headed Flying Fox, Little Bentwing-bat and Eastern Bentwing-bat) and impacts on those species with 'split credits' are addressed through generation of ecosystem credits; or

- the species was not recorded on the site during threatened species surveys and is considered unlikely to occur on other than a transient or temporary basis (e.g. Koala).

As shown in the attached credit reports (see **Appendix I**), no species credits are required to offset the impacts of the proposed development.

6.6 Biodiversity Credit Report

Copies of the BioBanking credit reports are provided in **Appendix I**. **Table 23** lists the credit types required to offset the proposed development and the matching credits and IBRA subregions that can be used as 'offset options'. Any such credits, can only be used as substitutes (or offset options) for credit types required if they belong to an IBRA subregion that adjoins the IBRA subregion in which the development occurs (i.e. Macleay-Hastings IBRA subregion).

Table 23 Ecosystem credits required for offset and matching credit types

Ecosystem Credit Required	No. Credits	Offset Options
Tallowwood Small fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast, (NR263)	1926	• Tallowwood Small fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast, (NR263) • Blackbutt Tallowwood dry grassy open forest of the central parts NSW North Coast Bioregion, (NR119) • Blackbutt Turpentine open forest of the foothills of the NSW North Coast Bioregion, (NR124) • Blackbutt grassy open forest of the lower Clarence Valley of the NSW North Coast Bioregion, (NR125) • Brush Box tall moist forest of the northern ranges of the NSW North Coast Bioregion, (NR144) • Red Mahogany open forest of the coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion, (NR222) • Tallowwood dry grassy forest of the far northern ranges of the NSW North Coast Bioregion, (NR267)

Ecosystem Credit Required	No. Credits	Offset Options
Blackbutt Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion (NR117)	33	• Blackbutt Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion, (NR117) • Flooded Gum Brush Box moist forest of the coastal ranges of the North Coast, (NR159) • Flooded Gum Tallowwood Brush Box moist open forest of the coastal ranges of the North Coast, (NR160) • Pink Bloodwood Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion, (NR219) • Spotted Gum Brush Box moist forest of ranges of the southern Clarence Valley of the NSW North Coast Bioregion, (NR243) • Spotted Gum Grey Ironbark shrubby open forest of the Richmond Range of the NSW North Coast, (NR248) • Sydney Blue Gum open forest on coastal foothills and escarpment of the North Coast, (NR258) • Tallowwood rush Box moist open forest of the coastal ranges of the central NSW North Coast, (NR260) • Tallowwood Narrow leaved White Mahogany Spotted Gum moist open forest in the Washpool area of the NSW North Coast, (NR261) • Turpentine moist open forest of the coastal hills and ranges of the NSW North Coast Bioregion, (NR274)
Spotted Gum Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion, (NR247)	490	• Spotted Gum Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion, (NR247)
Total Credits	**2449**	

7 Biodiversity Offset Strategy

This chapter provides the Biodiversity Offset Strategy, based on outputs of the BioBanking Credit Calculator, in accordance with Section 10 of the FBA.

7.1 Overview

The assessment completed as part of this BAR has determined that a biodiversity offset is required in accordance with the FBA and the *NSW Biodiversity Offsets Policy for Major Projects* (the 'Offsets Policy', NSW Government and OEH 2014).

According to the Offsets Policy, a *Biodiversity Offset Strategy* (BOS) is required to set out how the proponent intends to fulfil the project's offset requirement and is to be submitted to the Department of Planning & Environment with the project application. Offsets are generally required to be secured prior to commencement of construction, although this can be deferred if a Voluntary Planning Agreement (under the EP&A Act) is entered into prior to project approval.

In relation to the SEARs, OEH state that biodiversity offsets for the project should complement offset options discussed in the *Greater Sancrox Draft Structure Plan 2014-2034* for the lands adjacent to the quarry.

7.2 Biodiversity Matters Requiring Offsetting

The offset requirement for the project is described in **Section 6.5**.

The following biodiversity credits are required to offset the proposed development:

- A total of 2,449 ecosystem credits are required to offset the project impacts, with the type and number of required ecosystem credits, and matching credit options, listed in **Table 23**.
- No species credits are required as part of the offset.

7.3 Overview of Offset Options

A summary of the available offsetting options, listed in order of priority, for the proposed development at Sancrox are listed in **Table 24**.

According to the Offsets Policy, proponents can meet their offset obligations through one or a combination of the following offset options:

- Like-for-like credit purchase – the proponent purchases the required number and type of BioBanking credits from the BioBanking credit 'market' (publically available through the BioBanking Credit Register);
- Like-for-like credit creation - the proponent establishes a Stewardship Agreement on their own land, which generates the required credits to fulfil their offset requirement; the proponent retires the required number and type of credits from their own portfolio of credits;
- Variations – where like-for-like offsets are not available, and the proponent can demonstrate that "reasonable steps" have been taken to find a suitable offset, proponents may apply the FBA 'variation rules' (as outlined in Appendix A of the Offsets Policy);

- Rehabilitation of mine sites, which is not relevant to the current project;
- Supplementary measures. Supplementary measures are not preferred by the proponent; and/or
- Payment to Biodiversity Conservation Fund (BCF). Under this scenario, the proponent calculates the equivalent monetary value of their offset credit requirement using the Biodiversity Offsets Payment Calculator and pays this amount into the Fund.

Table 24 Options for Biodiversity Offsets for SSD projects

Offset Option	Offset Options/Comments

Purchase and retire matching (like-for-like) ecosystem credits	• Like-for-like ecosystem credits comprise:
	  ◦ Those of same PCT (see
	  ◦ **Table 21**); or
	  ◦ A PCT from the same vegetation class that has equal or higher percentage cleared value for the CMA (see
	  ◦ **Table 21**)
	• See list of matching credit types in **Table 23;**
	• Number and type of credits must be available on credit register, or will become available prior to construction (or during timeframe specified in in the Conditions of Approval for the SSD project application)

Create ecosystem credits through Stewardship Agreement over Offset Site	• Requires proponent to find suitable properties for sale in the IBRA subregion, purchase property (or properties) and set up Stewardship Agreement (pursuant to BC Act) over the land; • A potential Offset Site under ownership of proponent adjoins the Development Site; • Proposed Offset Site contains one matching ecosystem credit type; • Number and type of species credits in Offset Site not known but can be confirmed through targeted surveys or expert report (optional); • Proponent retires ecosystem credits generated on Offset Site to partially offset current project.
Variation rules - Purchase and retire other credits within same vegetation formation	• Apply variation rules when matching credit types in **Table 23** not available; • Find ecosystem credits for PCTs that fall within same formation, with equal or greater % cleared value.
Supplementary measures	• Apply FBA variation rules • Apply when suitable credits and/or biobank site unavailable or cannot be secured within BOS and construction timeframe
Fund Payment	• Proponent uses BOPC[#] to calculate monetary value of credits, and then applies to make payment of this amount into Biodiversity Conservation Fund. Confirmation of payment is then used to comply with relevant Condition of Approval for the SSD.

Biodiversity Offsets Payment Calculator, established under the NSW Biodiversity Offsets Scheme pursuant to the NSW *Biodiversity Conservation Act 2016*.

Where the proponent has demonstrated "reasonable steps" have been taken to find a suitable like-for-like offset, but none are available, 'supplementary measures' can be used to fulfil offset obligations. The rules for applying and calculating supplementary measures are provided in Appendix B of the Policy. .

With the advent of the BC Act, proponents of SSD applications can now fulfil their biodiversity offset obligations through payment of the equivalent value of the biodiversity credits to the NSW Biodiversity Conservation Fund. This option is discussed further in **Section 7.7**.

A proponent may use a combination of measures to fulfil an offset requirement. All feasible offsetting options, as applicable to the proposed development at Sancrox, have been considered and are discussed in the following sections.

7.4 Like-for-Like Offsets

7.4.1 Purchase Like-for-Like credits

The proponent may choose to purchase and retire some or all of the credits required for offsetting a project from the credit market ('BioBanking Credit Register'). Suitable like-for-like credits types that could be purchased for the Sancrox SSD project are listed in **Table 23.** However, at the time of writing, these credits are not available on the BioBanking Credit Register and no applicable expressions of interest are currently published showing an availability of these credit types within the Northern Rivers IBRA region.

7.4.2 Generate Credits via Stewardship Agreement[2]

The proponent may choose to create a Stewardship Agreement over a portion of land in order to generate biodiversity credits and retire these to fulfil an offset obligation (in part or in full) for an SSD application.

For the proposed development at Sancrox, the proponent owns surplus land adjacent to the Development Site, being the northern portion of Lot 2 (see **Figure 2**), that contains native vegetation, some of which comprises matching ecosystem credit types for those that are to be cleared within the Development Site. The proposed 'Offset Site' is described in **Section 7.8**.

7.5 Apply Variation Rules

In the case where the required credits are not available, and hence a 'like-for-like' offset is not achievable, proponents can apply the variation rules for matching ecosystem credits. However, a hierarchy of options must be followed, with the proponent demonstrating that "all reasonable steps have been taken…to secure a matching ecosystem credit".

The consent authority may approve a variation of the offset rules for matching ecosystem credits, by allowing ecosystem credits created for a PCT from the same vegetation formation as the required ecosystem credit to be proposed as part of the BOS, where in the consent authority's opinion the BOS demonstrates that:

- all "reasonable steps" to secure a matching ecosystem credit have been taken by the proponent, and
- the required ecosystem credit is not for a PCT associated with a CEEC listed on the BC Act or an ecological community listed on the EPBC Act, and

[2] Note: this BAR has been prepared according to the FBA, which refers to Biobanking Agreements established under the former NSW *Threatened Species Conservation Act 1995*. References to Biobanking Agreements in this version of the BAR have been replaced with 'Stewardship Agreements' which are established under the BC Act.

- the PCT from the same vegetation formation has a percent cleared value of the PCT in the major catchment area equal to or greater than the percent cleared of the PCT to which the required ecosystem credit relates, or
- where the required ecosystem credit is for a PCT that is associated with a CEEC/EEC, the PCT from the same formation is also associated with a CEEC/EEC.

"Reasonable steps" to locate like-for-like offsets are listed in Appendix A of the Offset Policy and summarised as follows:

- investigating land already owned by the proponent within the IBRA subregion, whether the development site or other properties;
- liaising with an OEH office and local council to obtain a list of potential sites that meet the requirements for offsetting;
- placing an Expression of Interest for the credits wanted on the BioBanking public register (i.e. the 'Credits Wanted Register') for at least six months, whilst regularly checking the register to see if the required credits have become available;
- considering properties for sale in the "required area" (i.e. within the IBRA subregion); and
- providing evidence of why offset sites are not feasible (e.g. unwillingness of a landowner to sell).

By applying the variation rules, the proponent may purchase and retire ecosystem credits from the same vegetation formation (see **Table 10**), as follows:

- For Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion (NR117), ecosystem credits for PCTs that fall within the 'Wet Sclerophyll Forests' formation, and that have >50% cleared value for the Northern Rivers CMA; and
- Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion (NR247), ecosystem credits for PCTs within the 'Dry Sclerophyll Forests' formation, with >35 % cleared value for the CMA.
- Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast (NR263), ecosystem credits for PCTs that fall within the 'Dry Sclerophyll Forests' formation, and that have >30% cleared value for the Northern Rivers CMA.

At the time of writing, no ecosystem credits within the vegetation formations listed above are available on the credit register or through the EOI web page. To demonstrate reasonable steps, the proponent should advertise the credit requirement via an Expression of Interest.

7.6 Supplementary Measures

Where a proponent can demonstrate that all reasonable steps have been taken to obtain like-for-like credits or a suitable offset site (as per the steps listed above), they can choose to use 'supplementary measures'. A formula for calculating the monetary contribution of supplementary measures is provided in Appendix B of the Offset Policy. Supplementary measures are not preferred as an offsetting option for the project application.

7.7 Fund Payment

The *Biodiversity Conservation Act 2016* and the *Biodiversity Conservation Regulation 2017* established the Biodiversity Offsets Scheme, which provides a mechanism to avoid, minimise and offset biodiversity impacts through land use planning and during the development assessment process. Under the Scheme, proponents can choose to make payments into the Biodiversity Conservation Fund to discharge an offset obligation, calculated using the Biodiversity Offsets Payment Calculator. The NSW Biodiversity Conservation Trust will then secure the biodiversity offsets.

It is proposed that a Fund payment would be made if the like-for-like or variation credits are not available during, or at the end of, the EOI period.

As the biodiversity credits required for offsetting the project presented herein have been calculated according to the FBA, it will be necessary (following approval of the SSD application) to submit an application to the Biodiversity Conservation Trust to have the credits converted into an equivalent number of BAM credits. Upon receipt of the 'statement of equivalence' from the Trust, the proponent can then apply to the Trust pay the required monetary value into the Biodiversity Conservation Fund.

7.8 Preferred Offsetting Option

7.8.1 Proposed Offset Site – Generate Credits for Offsetting

The proposed Offset Site is the northern portion of Lot DP 574308. The site is located immediately north of the proposed quarry expansion area is approximately 49 ha and occupies low lying land containing swampy vegetation types and open cleared grassland that is used for cattle grazing.

Native Vegetation on the Offset Site

Vegetation mapping for the Port Macquarie-Hastings LGA (Phillips *et al.* 2013) was applied to develop a preliminary vegetation map for the Offset Site. The vegetation types mapped by Phillips *et al.* (2013) within the Offset Site are shown in

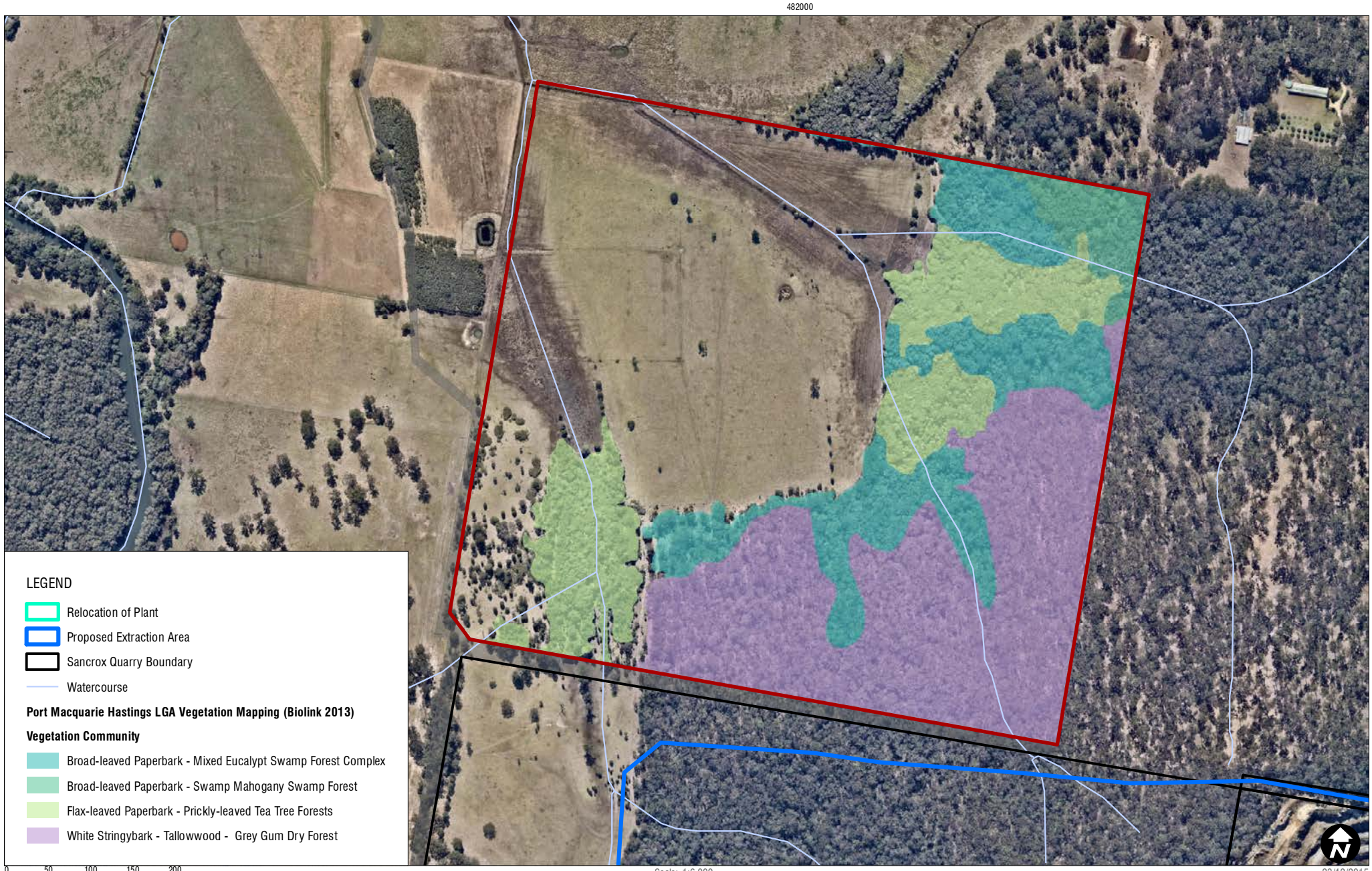
Figure 10 and the mapped areas are listed in **Table 25**.

Table 25 Vegetation types mapped within the Offset site

Code	Broad Vegetation Type #	Area (ha)
PMVC_062	Broad-leaved Paperbark – Mixed Eucalypt Swamp Forest Complex	12.3
PMVC_063	Broad-leaved Paperbark – Swamp Mahogany Swamp Forest	1.3
PMVC_037	White Stringybark - Tallowwood - Grey Gum Dry Forest	12.3
PMVC_062	Broad-leaved Paperbark – Mixed Eucalypt Swamp Forest Complex	23.1
	Total	**49**

Source: Phillips *et al.* (2013)

The Council vegetation types were converted into PCTs according to the VIS database. The equivalent PCTs mapped within the Offset Site, including vegetation formation and vegetation class, are listed in **Table 26.**



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Council Vegetation Mapping within Sancrox Offset Area

FIGURE 10

Table 26 PCTs, Formations and Classes Mapped within the Offset Site

Veg Formation	Veg Class	PCT Code	PCT Name	Area (ha)
Forested Wetlands	Coastal Swamp Forests	1064	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	35.4
Forested Wetlands	Coastal Swamp Forests	1230	Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	1.3
Dry Sclerophyll Forests (grassy)	Hunter-Macleay Dry Sclerophyll Forests	1548	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	12.3
			Total Area (ha)	**49**

An indicative map of PCTs within the Offset Site is presented in **Figure 11.** It is noted that only one of the PCTs mapped within the Offset Site, *Tallowwood - Small-fruited Grey Gum dry grassy open forest* (NR263), also occurs within the Development Site.

Ecosystem Credits

Based on Council vegetation mapping, vegetation zones have been identified within the Offset Site and are shown in **Figure 12**. A Stewardship Agreement will be placed over the Offset Site to generate part of the credit requirement for the Development. The following tasks were completed to estimate the likely ecosystem credits that would be created in a Stewardship Site:

- Application of the *BioBanking Assessment Methodology 2014* (BBAM 2014; OEH 2014b);
- Landscape value calculations using available vegetation mapping, aerial imagery and GIS techniques, as per the BBAM 2014;
- Calculation of site value score in the Credit Calculator using benchmark data for each PCT (noting that no plot data has been collected from the Offset Site); and
- Assuming standard rehabilitation and site management would be applied, with commensurate uplift in site value score in the Credit Calculator.

The ecosystem credits that have been estimated in the Credit Calculator for the Offset Site are listed in **Table 27**. It should be noted that the ecosystem credit estimates for the Offset Site will need to be re-calculated according to the BAM, including preparation of a Biodiversity Stewardship Site Assessment Report (BSSAR) following approval of the SSD Application to allow creation of a Stewardship Site and the associated credits.

Table 27 Ecosystem Credits potentially created in the Proposed Offset Site

PCT	Biometric Code	Vegetation type name	BBAM Credits Created
1064	NR217	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	353
1230	NR254	Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	14
1548	NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	135
		Total	**502**

Species Credits

No species credits have been calculated for the Offset Site as part of this Biodiversity Offset Strategy. Targeted surveys for relevant threatened species credit species identified in the Credit Calculator have not been conducted as part of this BAR.

7.8.2 Offset Strategy Proposed

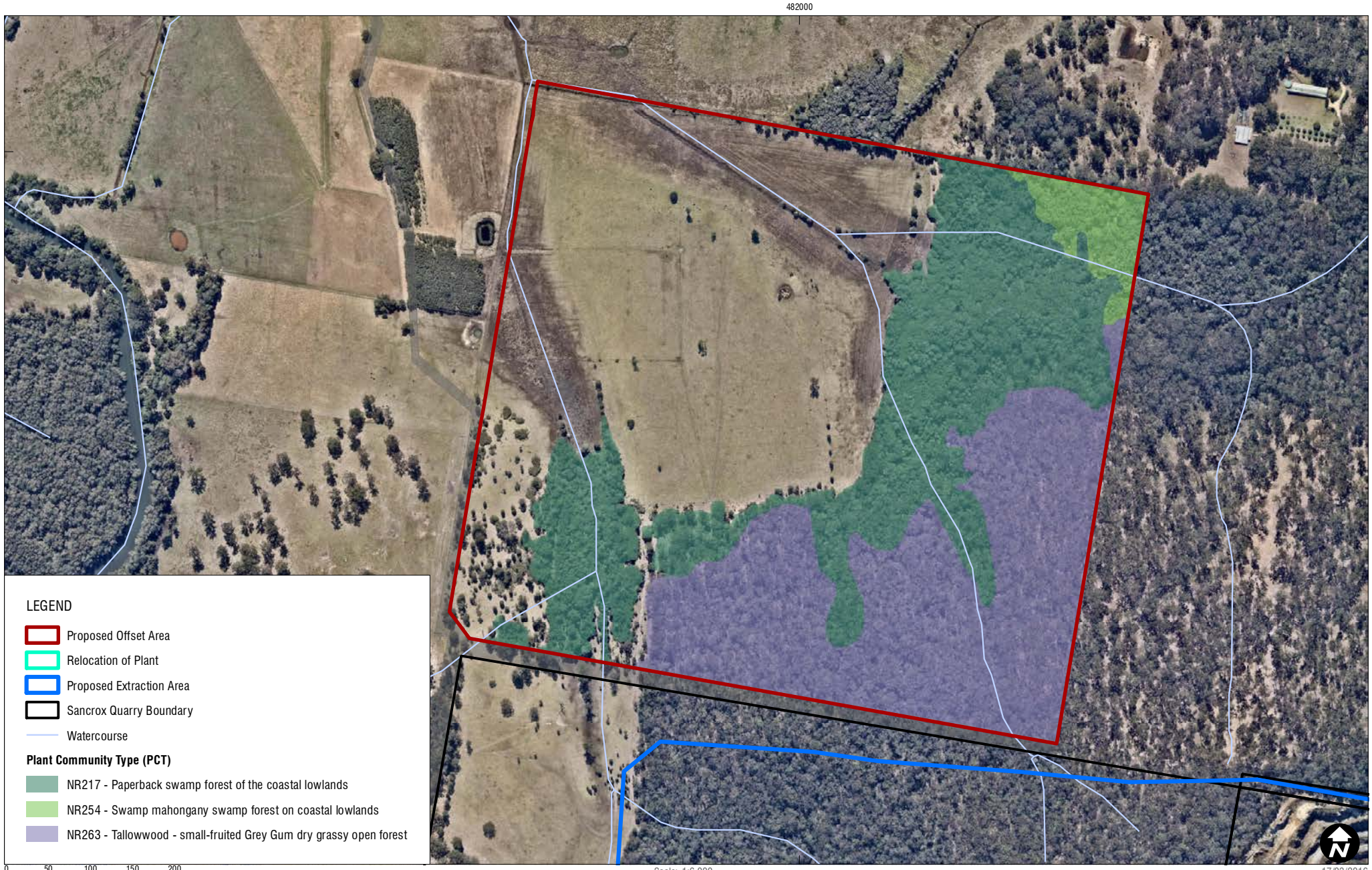
The preferred offsetting option for the proposed development is a combination of Options 1a and 1b, being:

Ecosystem credits:

- Generate available ecosystem credits from the proposed Offset Site – create a Stewardship Agreement over the Offset Site in consultation with OEH. This action will only provide some of the ecosystem credits required, as per **Table 28**. .
- Purchase like-for-like ecosystem credits from Credit Register (or approach potential credit sellers through the Expressions of Interest register).
- Purchase 'variation credits' by applying the variation rules under the FBA, in the scenario that like-for-like credit cannot be found after completing "reasonable steps". In this regard, an Expression of Interest for the required ecosystem credits will be published on the OEH BioBanking 'Credits Wanted' register.
- Pay the monetary of the remaining credit obligation into the BCF.

Species credits:

- No species credits required.



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Plant Community Types (PCTs) - Within Proposed Offset Area

FIGURE 11

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Vegetation Zones - Within Proposed Offset Area

FIGURE 12

A comparison of the ecosystem credits required for offsetting the proposed development and those potentially available in the Offset Site is provided in **Table 28** .

Table 28 Ecosystem Credit Balance – Credits Required vs Credits Generated in Offset

Biometric Code	Vegetation Type Name	FBA Credits Required	Credits in Offset	Remaining Credits to Purchase
NR117	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	33	0	33
NR247	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	490	0	490
NR263	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	1926	135	1791
NR254	Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	0	14	0
NR217	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	0	353	0
	Total	**2449**	**502**	**2314**

The ecosystem credits that form the offset obligation for the proposed development, as listed in **Table 28**, would either be sourced from the Offset Site or purchased from the BioBanking Credit Register (if available), with remainder converted into a monetary value using the BOPC and that value paid into the Biodiversity Conservation Fund. As the number and type of credits that will be available for purchase from the credit register following development approval is not known, the final payment into the Fund will be determined at the completion of the EOI period.

No species credits are required for offsetting the proposed development. However, it is important to note that targeted threatened species surveys have not been conducted in the proposed Offset Site; however, given the habitats and vegetation type present, it is likely that a range of threatened species could be present in the Offset Site. Hence, the Offset Site is likely to generate the some species credit types, although this will need to be confirmed through targeted surveys (during the appropriate season) as part of any future Stewardship Agreement application. For the purposes of this BOS, the number of species credits available in the Offset Site is presumed to be zero.

An Expression of Interest (EOI), listing the biodiversity credits required for offsetting the proposed development, will be published prior to finalisation of the BAR to commence the process of obtaining the required like-for-like credits. At the completion of the six month exhibition period, the proponent will have completed the 'reasonable steps' and may choose to seek other credit types under the variation rules.

7.8.3 Offset Strategy Actions

Actions proposed to fulfil the offset requirement for the project will involve:

- Subject to receipt of Minister's Conditions of Approval, apply to the Biodiversity Conservation Trust to have the ecosystem credits presented in this BAR converted into an equivalent number of BAM credits;
- Uploading an EOI for the required biodiversity credits on the 'Credit Wanted' register of the BioBanking Credit Register;

- Monitor the availability of matching ecosystem credits during the six month advertisement period (as required by OEH), including regularly checking the credit register for ecosystem credits that match the required type and number of credits (**Table 23**);
- During, or at the end of, the advertisement (EOI) period, either:
  - Purchase like-for-like credits or if not available purchase variation credits; if neither like-for-like nor variation credit types available, then:
  - pay fund deposit into Biodiversity Conservation Fund (calculated using BOPC).

8 EPBC ACT Matters

This chapter identifies matters of national environmental significance listed under the EPBC Act that are of potential relevance to the proposed development.

8.1 Predicted Matters of NES

The PMST database provides an indicative list of matters of national environmental significance (matters of NES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A copy of the PMST results is provided in **Appendix K**. The PMST results indicate the following matters (and/or or their habitats) are either present or are predicted to occur within the locality:

- 62 threatened species;
- 56 listed migratory species;
- three listed threatened ecological communities; and
- no wetlands of international importance (Ramsar Wetlands).

Of the above listed matters of NES that are predicted to occur within the locality of the site, those of potential relevance to the site and the proposed development are discussed in the following sections.

8.2 Relevant Matters of NES

8.2.1 Listed Threatened Species

The 62 threatened species (and/or their habitats) listed under the EPBC Act that are predicted to occur within the locality comprise 29 bird species, one fish species, eight mammal species, five reptile species, three amphibian, one insect and 15 plant species (**Appendix K**). These species and their legal status within NSW and at a national level are listed in **Table 29**.

Table 29 PMST Results – Listed Threatened Species

Common Name	Scientific Name	EPBC Act Listing	BC Act Listing
Regent Honeyeater	*Anthochaera phrygia*	Critically Endangered	Critically Endangered
Australasian Bittern	*Botaurus poiciloptilus*	Endangered	Endangered
Red Knot, Knot	*Calidris canutus*	Endangered	Not Listed
Curlew Sandpiper	*Calidris ferruginea*	Critically Endangered	Endangered
Lesser Sand Plover, Mongolian Plover	*Charadrius mongolus*	Endangered	Vulnerable
Eastern Bristlebird	*Dasyornis brachypterus*	Endangered	Endangered
Antipodean Albatross	*Diomedea antipodensis*	Vulnerable	Vulnerable
Gibson's Albatross	*Diomedea antipodensis gibsonii*	Vulnerable	Vulnerable
Southern Royal Albatross	*Diomedea epomophora (sensu stricto)*	Vulnerable	Not Listed
Wandering Albatross	*Diomedea exulans (sensu lato)*	Vulnerable	Endangered
Northern Royal Albatross	*Diomedea sanfordi*	Endangered	Not Listed

Common Name	Scientific Name	EPBC Act Listing	BC Act Listing
Red Goshawk	*Erythrotriorchis radiatus*	Vulnerable	Critically Endangered
Painted Honeyeater	*Grantiella picta*	Vulnerable	Vulnerable
Swift Parrot	*Lathamus discolor*	Critically Endangered	Endangered
Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit	*Limosa lapponica baueri*	Vulnerable	Not Listed
Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit)	*Limosa lapponica menzbieri*	Critically Endangered	Not Listed
Southern Giant-Petrel, Southern Giant Petrel	*Macronectes giganteus*	Endangered	Endangered
Northern Giant Petrel	*Macronectes halli*	Vulnerable	Vulnerable
Eastern Curlew, Far Eastern Curlew	*Numenius madagascariensis*	Critically Endangered	Not Listed
Fairy Prion (southern)	*Pachyptila turtur subantarctica*	Vulnerable	Not Listed
Australian Painted Snipe	*Rostratula australis*	Endangered	Endangered
Buller's Albatross, Pacific Albatross	*Thalassarche bulleri*	Vulnerable	Not Listed
Northern Buller's Albatross, Pacific Albatross	*Thalassarche bulleri platei*	Vulnerable	Not Listed
Shy Albatross, Tasmanian Shy Albatross	*Thalassarche cauta cauta*	Vulnerable	Vulnerable
White-capped Albatross	*Thalassarche cauta steadi*	Vulnerable	Not Listed
Chatham Albatross	*Thalassarche eremita*	Endangered	Not Listed
Campbell Albatross, Campbell Black-browed Albatross	*Thalassarche impavida*	Vulnerable	Not Listed
Black-browed Albatross	*Thalassarche melanophris*	Vulnerable	Vulnerable
Salvin's Albatross	*Thalassarche salvini*	Vulnerable	Not Listed
Black Rockcod, Black Cod, Saddled Rockcod	*Epinephelus daemelii*	Vulnerable	Not Listed
Green and Golden Bell Frog	*Litoria aurea*	Vulnerable	Endangered
Stuttering Frog, Southern Barred Frog	*Mixophyes balbus*	Vulnerable	Endangered
Giant Barred Frog, Southern Barred Frog	*Mixophyes iteratus*	Endangered	Endangered
Australian Fritillary	*Argynnis hyperbius inconstans*	Critically Endangered	Endangered
Large-eared Pied Bat, Large Pied Bat	*Chalinolobus dwyeri*	Vulnerable	Vulnerable
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	*Dasyurus maculatus maculatus* (SE mainland population)	Endangered	Vulnerable
Greater Glider	*Petauroides volans*	Vulnerable	Not Listed
Brush-tailed Rock-wallaby	*Petrogale penicillata*	Vulnerable	Endangered

Common Name	Scientific Name	EPBC Act Listing	BC Act Listing
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)	*Phascolarctos cinereus* (combined populations of Qld, NSW and the ACT)	Vulnerable	Vulnerable
Long-nosed Potoroo (SE mainland)	*Potorous tridactylus tridactylus*	Vulnerable	Vulnerable
New Holland Mouse, Pookila	*Pseudomys novaehollandiae*	Vulnerable	Not Listed
Grey-headed Flying-fox	*Pteropus poliocephalus*	Vulnerable	Vulnerable
Scented Acronychia	*Acronychia littoralis*	Endangered	Endangered
Dwarf Heath Casuarina	*Allocasuarina defungens*	Endangered	Endangered
	Allocasuarina thalassoscopica	Endangered	Not Listed
Hairy-joint Grass	*Arthraxon hispidus*	Vulnerable	Vulnerable
Trailing Woodruff	*Asperula asthenes*	Vulnerable	Vulnerable
Leafless Tongue-orchid	*Cryptostylis hunteriana*	Vulnerable	Vulnerable
White-flowered Wax Plant	*Cynanchum elegans*	Endangered	Endangered
	Euphrasia arguta	Critically Endangered	Critically Endangered
	Hakea archaeoides	Vulnerable	Vulnerable
Macadamia Nut	*Macadamia integrifolia*	Vulnerable	Not Listed
Biconvex Paperbark	*Melaleuca biconvexa*	Vulnerable	Vulnerable
Milky Silkpod	*Parsonsia dorrigoensis*	Endangered	Vulnerable
Lesser Swamp-orchid	*Phaius australis*	Endangered	Endangered
Magenta Lilly Pilly	*Syzygium paniculatum*	Vulnerable	Endangered
Austral Toadflax	*Thesium australe*	Vulnerable	Vulnerable
Loggerhead Turtle	*Caretta caretta*	Endangered	Endangered
Green Turtle	*Chelonia mydas*	Vulnerable	Vulnerable
Leatherback Turtle	*Dermochelys coriacea*	Endangered	Endangered
Hawksbill Turtle	*Eretmochelys imbricata*	Vulnerable	Not Listed
Flatback Turtle	*Natator depressus*	Vulnerable	Not Listed

Most of the species listed in **Table 29** are also listed under the BC Act and therefore are considered in Chapter 4 of this report, as well as in the likelihood of occurrence table in **Appendix H**.

Many of the EPBC Act listed species in **Table 29** are marine birds (21) or marine reptiles (i.e. five turtles). Being located inland from the coast, the site at Sancrox is of no relevance to marine species. The single threatened fish species, the Black Rockcod, is a marine species that occurs in rocky reef and inshore areas along the NSW coast. It is therefore not relevant to the site at Sancrox.

With regard to the EPBC Act listed threatened species that are not predicted to occur in the Credit Calculator or the NSW Wildlife Atlas:

- They are not predicted to occur in the Credit Calculator and therefore not likely to occur (i.e. suitable vegetation or habitat features is not present or their distributional range lies outside of the IBRA subregion); or

- They have not been recorded on the Wildlife Atlas within the locality.

The study area contains suitable foraging habitat for the Swift Parrot and Regent Honeyeater, in the form of winter flowering gums, such as Spotted Gum and Swamp Mahogany (which occurs in the Offset Site). Both species breed elsewhere in Australia (the Swift Parrot in Tasmania and the Regent Honeyeater in certain parts of central NSW) but migrate to coastal NSW during winter to feed on winter-flowering tree species. Accordingly, individual Regent Honeyeaters and Swift Parrots may utilise the site for foraging purposes seasonally during winter, although the site would not form a large or important area of winter forage for these species. As the Swift Parrot breeds in Tasmania and the Regent Honeyeater breeds elsewhere in NSW, the Development Site does not contain breeding habitat for these two species.

Similarly, the 44.36 hectares of forest habitat across the Development Site represents potential foraging habitat for the Grey-headed Flying Fox, Spotted-tail Quoll, Koala, Greater Glider, Large-eared Pied Bat, Painted Honeyeater and Long-nosed Potoroo. These species are discussed in the discussion of BC Act threatened species in Chapter 4.

8.2.2 Listed Threatened Communities

The listed threatened communities that have been recorded or are predicted to occur within the locality (**Appendix K**) include:

- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community;
- Lowland Rainforest of Subtropical Australia; and
- Subtropical and Temperate Coastal Saltmarsh;

None of these listed threatened communities is present within the study area.

8.2.3 Wetlands of National Significance

No Wetlands of International Importance or of National Significance were identified within the 10 km radius of the study area.

8.2.4 Migratory species

A total of 56 migratory species (and/or their habitats) are predicted to occur within the locality, 22 of which are wetland species (**Appendix K**). A total of 18 migratory marine birds are predicted to occur within the locality as well as 10 migratory marine species. The remaining six species are terrestrial and include the White-throated Needletail, Satin Flycatcher, Oriental Cuckoo, Black-faced Monarch, Spectacled Monarch and Rufous Fantail.

The study area does not contain suitable habitat for the listed wetland species, with the exception that large or sustained rainfall events could create periodic and temporary soaks or ponds within the low lying parts of the Development Site. Regardless of this, due to their large ranges, such species would not be dependent on the study area (if they use it at all) for foraging, breeding or other life cycle processes.

The terrestrial species all occupy a large variety of habitats and similarly have very large ranges. The vegetation within the study area does not constitute 'important habitat' for such species, as defined by DoE (2013), most of which utilise more intact and structurally complex woodlands.

The study area does not contain suitable habitat for the listed marine species. The only open water within the subject area is a retention dam which does not provide suitable habitat for the listed species. The site contains only relatively small first order steams which traverse the site. These watercourses do not provide suitable habitat or foraging area for the listed species.

8.3 Impacts on Relevant Matter of NES

8.3.1 Listed Threatened Species

The threatened species identified in **Section 8.2** have been considered in accordance with the 'significant impact criteria' for 'vulnerable' and 'endangered' species in the *Significant Impact Guidelines 1.1* (DoE 2013).

Taking into consideration all stages and components of the proposal, and all related activities and infrastructure, there is the potential for impacts, including indirect impacts, on matters of national environmental significance, being mainly loss of a potential foraging habitat for mobile threatened fauna species, including birds, bats and mammals. However, it is highly unlikely that any of such species will be adversely impacted by the proposal, because:

- suitable breeding habitat for most of the species is absent within the study area. For those species that have either been recorded or could utilise the habitats within the study area, there are not likely to be local populations present wholly within the study area or reliant on the study area for their survival in isolation. Any such populations present within the locality will not be rendered locally extinct by the proposed development. This is based on the large ranges of these species, the poor quality and condition of the habitats present within the study area.
- the study area is not assessed as likely to contain habitat critical to the survival of a species;
- the study area is not likely to support an 'important population' (as defined by DoE 2015) of any threatened species; and
- the proposed mitigation measures (see **Section 5.5**) will mitigate or reduce impacts on threatened species.

With reference to the criteria for vulnerable and endangered species, the proposal is not likely to:

- lead to a long-term decrease in the size of an important population of a species;
- reduce the area of occupancy of an important population;
- fragment an existing important population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of an important population;
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that a species is likely to decline;
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;
- introduce disease that may cause a species to decline; or
- interfere substantially with the recovery of any of these species.

8.3.2 Migratory species

The study area contains no habitat for the 22 listed migratory wetland species and only marginal habitat for the six listed terrestrial migratory species predicted to occur in the locality (**Appendix K)**.

In regards to the terrestrial migratory species, the forested and open areas of the site represent potential foraging habitat. It is theoretically possible that these highly mobile species could utilise the subject temporarily during foraging, dispersal or migration. Conversely, the study area constitutes only a relatively small proportion of the large ranges of these species and does not contain breeding habitat for these species.

With reference to the criteria for migratory species in the *Significant Impact Guidelines 1.1*, the study area does not contain an area of 'important habitat' for any migratory species. Furthermore, the proposal is highly unlikely to disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

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APPENDIX A

SEARS (Biodiversity)

Planning Services
Resource Assessments
Contact: Anthony Barnes
Phone: 8289 6709
Email: anthony.barnes@planning.nsw.gov.au

Matt Errington
Principal Environmental Consultant
Environmental Resources Management Australia
Locked Bag 3012 Australia Square
NSW 1215

Dear Mr Errington

Reissue of State Significant Development - Secretary's Requirements
Sancrox Quarry Extension Project (SSD 7293)

I have enclosed updated Secretary's requirements for the preparation of an Environmental Impact Statement (EIS) for the Sancrox Quarry Extension Project which replace the Secretary's requirements issued on 19 October 2015.

These requirements are based on the information you have previously provided, and reflect previous consultation with relevant government agencies.

Your attention is drawn to the environmental planning instruments (EPI), policies and guidelines to be addressed in your EIS (see Attachment 1). Please note that where these EPIs, guidelines and policies have changed or been updated, your EIS will need to address the latest available version.

The agencies' previous comments are attached for your information (see Attachment 2). You must have regard to these comments in the preparation of the EIS.

Please note that the Department may alter these requirements at any time, and that you must consult further with the Department if you do not lodge a development application and EIS for the project within the next two years.

You should establish whether the proposal requires a separate approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as soon as possible. If such an approval is required, please notify the Department immediately, as the Commonwealth approval process is likely to be integrated with the NSW approval process (under the bilateral agreement), and supplementary requirements will need to be issued.

Please contact the Department at least two weeks before you plan to submit the development application and EIS for the project. This will enable the Department to:

- confirm the applicable fee (see Division 1AA, Part 15 of the *Environmental Planning and Assessment Regulation 2000*); and
- determine the required number of copies of the EIS (hard copy and digital).

It is important for you to recognise that the Department will review the EIS for the project carefully before putting it on public exhibition. If it fails to adequately address these requirements, then you will be required to submit an amended EIS.

If you have any enquiries about these requirements, please contact Anthony Barnes on the details listed above.

Yours sincerely

Howard Reed

Howard Reed 18.9.17
Director
Resource Assessments
as the Secretary's delegate

Secretary's Environmental Assessment Requirements

State Significant Development

Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*
Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*

Application Number	SSD 7293
Proposal	The Sancrox Quarry Extension Project, which involves: • extending the approved extraction boundary by approximately 52 hectares, • extending the quarry life by ten years (from 20 to 30 years), • increasing the production limit from 455,000 tonnes per annum (tpa) to 750,000 tpa, • constructing and operating a concrete batching plant producing 20,000m^3 per annum (p/a), • constructing and operating a concrete recycling facility processing 20,000 tonnes p/a, • increasing truck movements and equipment loading from 7am–11pm weekdays, and 7am–1pm weekends and public holidays to 24 hours per day 7 days per week, • increasing quarry operations from 7am–5pm weekdays, and 7am–1pm Saturday to 24 hours per day 7 days per week, • transporting material off-site via public roads; and • Constructing and operating an asphalt plant producing 50,000 tonnes per annum.
Location	Sancrox Road Sancrox, Lot 2 DP 574308 Lot 353 DP 754434 Lot 1 DP 704890 Lot 1 DP 720807
Applicant	Hanson Construction Materials Pty Ltd (Hanson)
Date of Issue	18 September 2017
General Requirements	The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.* In particular, the EIS must include: • a stand-alone executive summary; • a full description of the development, including: – the resource to be extracted, including the amount, type and composition; – the site layout and extraction plan, including cross-sectional plans; – the production process and processing activities, including the in-flow and out-flow of materials and points of discharge to the environment; – surface infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate approvals process); – a waste (overburden, rejects, tailings etc) management strategy; – a water management strategy; – a rehabilitation strategy to apply during, and after completion of, extraction operations, and proposed final use of site; and – the likely interactions between the development and any existing, approved or proposed development in the vicinity of the site; • a strategic justification of the development focusing on site selection and the suitability of the proposed site; • a list of any approvals that must be obtained before the development may

	commence; • an assessment of the likely impacts of the development on the environment, focussing on the key issues identified below, including: – a description of the existing environment likely to be affected by the development, using sufficient baseline data; – an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice; – a description of the measures that would be implemented to avoid, minimise, mitigate and/or offset the likely impacts of the development, and an assessment of: o whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; o the likely effectiveness of these measures; and o whether contingency measures would be necessary to manage any residual risks; and – a description of the measures that would be implemented to monitor and report on the environmental performance of the development; • a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; • consideration of the development against all relevant environmental planning instruments (including Part 3 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007)*; • the reasons why the development should be approved, having regard to: - relevant matters for consideration under the *Environmental Planning and Assessment Act 1979*, including the objects of the Act; - the biophysical, economic and social impacts of the project, including the principles of ecologically sustainable development; - the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses; - feasible alternatives to the development (and its key components), including the consequences of not carrying out the development; • a signed declaration from the author of the EIS, certifying that the information contained within the document is neither false nor misleading. While not exhaustive, Attachment 1 contains a list of some of the environmental planning instruments, guidelines, policies, and plans that may be relevant to the environmental assessment of this development. In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*, the development application must be accompanied by a signed report from a suitably qualified expert that includes an accurate estimate of the capital investment value (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the development, including details of all the assumptions and components from which the capital investment value calculation is derived.
Key Issues	The EIS must address the following key issues: • **Noise & Blasting** – including: - a detailed assessment of the likely construction, operational and off-site transport noise impacts of the development in accordance with the *Interim Construction Noise Guideline*, *NSW Industrial Noise Policy* and the *NSW Road Noise Policy* respectively, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - if a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the *Interim Construction Noise Guideline*; - proposed blasting hours, frequency and methods; - a detailed assessment of the likely blasting impacts of the development (including noise, vibrations, overpressure, visual and odour) on people,

	animals, buildings, infrastructure and significant natural features, having regard to the relevant ANZEC guidelines; - reasonable and feasible mitigation measures to minimise noise emissions; and - monitoring and management measures, in particular real-time and attended noise monitoring; • **Air Quality** – including: - a detailed assessment of potential construction and operational impacts, in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW,* and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - an assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products; - reasonable and feasible mitigation measures to minimise dust and emissions; and - monitoring and management measures, in particular, real-time air quality monitoring; • **Water** – including: - a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures; - identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*; - demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP); - a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo; - an assessment of any likely flooding impacts of the development; - an assessment of the likely impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives; - an assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users; and - a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts; • **Biodiversity** – including: - accurate predictions of any vegetation clearing on site; - a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, and having regard to the *NSW Biodiversity Offsets Policy for Major Projects* and the *Framework for Biodiversity Assessment*; and - a strategy to offset any residual impacts of the development in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*, including evidence that the appropriate type and quantum of offsets will be available; • **Heritage** – including: - an assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including evidence of appropriate consultation with relevant Aboriginal communities/parties and documentation of the views of these stakeholders regarding the likely impact of the development on their cultural heritage; and - identification of historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items, having regard to the relevant policies and guidelines listed in

	Attachment 1; • **Traffic & Transport** – including: - accurate predictions of the road traffic generated by the construction and operation of the development, including a description of the types of vehicles likely to be used for transportation of quarry products; - a detailed assessment of potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road network (as identified above), including a road safety audit; and - a description of the measures that would be implemented to mitigate any impacts, including concept plans of any proposed upgrades, developed in consultation with the relevant road and rail authorities (if required); • **Land Resources** – including a detailed assessment of: - potential impacts on soils and land capability (including potential erosion and land contamination) and the proposed mitigation, management and remedial measures (as appropriate); - potential impacts on landforms (topography), paying particular attention to the long term geotechnical stability of any new landforms (such as overburden dumps, bunds etc); and - the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements in Clause 12 of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries)* 2007, paying particular attention to the agricultural land use in the region; • **Waste –** including estimates of the quantity and nature of the waste streams that would be generated or received by the development and any measures that would be implemented to minimise, manage or dispose of these waste streams; • **Hazards –** including an assessment of the likely risks to public safety, paying particular attention to the transport, handling and use of any hazardous or dangerous goods; • **Visual** – including a detailed assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, paying particular attention to any new landforms, and to minimising the lighting impacts of the development; • **Social & Economic** – including: - a detailed assessment of the likely social impacts of the development on the local and regional community in accordance with the *Social impact assessment guideline for State significant mining, petroleum production and extractive industry development*; and - a detailed assessment of the likely economic impacts of the development, paying particular attention to: o the significance of the resource; o the costs and benefits of the project; identifying whether the development as a whole would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates; and o the demand for the provision of local infrastructure and services; and • **Rehabilitation** – including the proposed rehabilitation strategy for the site having regard to the key principles in the *Strategic Framework for Mine Closure*, including: - rehabilitation objectives, progressive rehabilitation commitments, methodology, monitoring programs, performance standards and proposed completion criteria; - nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and - the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.
Consultation	During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities, service providers, Aboriginal stakeholders, community groups and affected landowners. You must:

	• consult with: - affected landowners; - community groups; - Port Macquarie-Hastings Council; - Office of Environment and Heritage (including the Heritage Branch); - Environment Protection Authority; - Division of Resources and Geoscience within the Department; - Department of Primary Industries (including the DPI Water, NSW Forestry, Agriculture and Fisheries sections and Crown Lands division); - North Coast Local Land Services; - Roads and Maritime Services; - NSW Rural Fire Service; and • establish a Community Consultative Committee for the project in accordance with the *Community Consultative Committee Guidelines for State Significant Projects,* and consult with the committee during the preparation of the EIS.
Further consultation after 2 years	If you do not lodge a development application and EIS for the development within 2 years of the issue date of these requirements, you must consult further with the Secretary in relation to the preparation of the EIS.

ATTACHMENT 1

Environmental Planning Instruments, Policies, Guidelines & Plans

Air	
	Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (DP&E)
	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA)
	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (EPA)
	Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'
	National Greenhouse Accounts Factors (Commonwealth)
Noise & Blasting	
	Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (DP&E)
	NSW Industrial Noise Policy (EPA)
	Interim Construction Noise Guideline (DECC)
	NSW Road Noise Policy (EPA)
	Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC)
Water	
Groundwater	NSW State Groundwater Policy Framework Document (NOW)
	NSW State Groundwater Quality Protection Policy (NOW)
	NSW State Groundwater Quantity Management Policy (NOW)
	NSW Aquifer Interference Policy 2012 (NOW)
	Office of Water Guidelines for Controlled Activities (2012)
	Groundwater Monitoring and Modelling Plans – Information for prospective mining and petroleum exploration activities (NOW)
	Australian Groundwater Modelling Guidelines 2012 (Commonwealth)
	National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
	Guidelines for the Assessment & Management of Groundwater Contamination (EPA)
Surface Water	NSW Government Water Quality and River Flow Objectives (EPA)
	Using the ANZECC Guideline and Water Quality Objectives in NSW (EPA)
	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Effluent Management (ARMCANZ/ANZECC)
	NSW Water Conservation Strategy (2000)
	State Water Management Outcomes Plan
	NSW State Rivers and Estuary Policy (1993)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (EPA)
	Managing Urban Stormwater: Soils & Construction (Landcom) and associated Volume 2E: Mines and Quarries (EPA)
	Managing Urban Stormwater: Treatment Techniques (EPA)
	Managing Urban Stormwater: Source Control (EPA)
	Technical Guidelines: Bunding & Spill Management (EPA)
	Environmental Guidelines: Use of Effluent by Irrigation (EPA)
	A Rehabilitation Manual for Australian Streams (LWRRDC and CRCCH)
	NSW Guidelines for Controlled Activities on Waterfront Land (NOW)

Land	
	Soil and Landscape Issues in Environmental Impact Assessment (NOW)
	Agfact AC.25: Agricultural Land Classification (NSW Agriculture)
	Agricultural Issues for Extractive Industries (NSW Trade and Investment)
	State Environmental Planning Policy No. 55 – Remediation of Land
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC)
Traffic	
	Guide to Traffic Generating Development (RMS)
	Road Design Guide (RMS) & relevant Austroads Standards
Biodiversity	
	Biodiversity Offsets Scheme (OEH)
	Guidelines for Threatened Species Assessment (DP&E)
	NSW State Groundwater Dependent Ecosystem Policy (NOW)
	Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW)
	State Environmental Planning Policy No. 44 – Koala Habitat Protection
Heritage	
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
	Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DP&E)
	Aboriginal Cultural Heritage Consultation Requirements for Proponents (OEH)
	Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (OEH)
	Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH)
	NSW Heritage Manual (OEH)
	Statements of Heritage Impact (OEH)
	Port Macquarie-Hastings Local Environmental Plan 2011
Hazards	
	State Environmental Planning Policy No. 33 – Hazardous and Offensive Development
	Hazardous and Offensive Development Application Guidelines – Applying SEPP 33
	Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis
Waste	
	Waste Classification Guidelines (EPA)
Rehabilitation	
	Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Strategic Framework for Mine Closure (ANZMEC-MCA)
Social & Economic	
	Social impact assessment guideline for State significant mining, petroleum production and extractive industry development (DP&E)
Environmental Planning Instruments - General	
	State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007
	State Environmental Planning Policy (State and Regional Development) 2011
	State Environmental Planning Policy (Infrastructure) 2007
	State Environmental Planning Policy 55 – Remediation of Land
	Port Macquarie-Hastings Local Environmental Plan 2011

ATTACHMENT 2

Agency Correspondence

Planning Services
Resource Assessments
Contact: Anthony Barnes
Phone: 8289 6709
Email: anthony.barnes@planning.nsw.gov.au

Matt Errington
Principal Environmental Consultant
Environmental Resources Management Australia
Locked Bag 3012 Australia Square
NSW 1215

Dear Mr Errington

Reissue of State Significant Development - Secretary's Requirements
Sancrox Quarry Extension Project (SSD 7293)

I have enclosed updated Secretary's requirements for the preparation of an Environmental Impact Statement (EIS) for the Sancrox Quarry Extension Project which replace the Secretary's requirements issued on 19 October 2015.

These requirements are based on the information you have previously provided, and reflect previous consultation with relevant government agencies.

Your attention is drawn to the environmental planning instruments (EPI), policies and guidelines to be addressed in your EIS (see Attachment 1). Please note that where these EPIs, guidelines and policies have changed or been updated, your EIS will need to address the latest available version.

The agencies' previous comments are attached for your information (see Attachment 2). You must have regard to these comments in the preparation of the EIS.

Please note that the Department may alter these requirements at any time, and that you must consult further with the Department if you do not lodge a development application and EIS for the project within the next two years.

You should establish whether the proposal requires a separate approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as soon as possible. If such an approval is required, please notify the Department immediately, as the Commonwealth approval process is likely to be integrated with the NSW approval process (under the bilateral agreement), and supplementary requirements will need to be issued.

Please contact the Department at least two weeks before you plan to submit the development application and EIS for the project. This will enable the Department to:

- confirm the applicable fee (see Division 1AA, Part 15 of the *Environmental Planning and Assessment Regulation 2000*); and
- determine the required number of copies of the EIS (hard copy and digital).

It is important for you to recognise that the Department will review the EIS for the project carefully before putting it on public exhibition. If it fails to adequately address these requirements, then you will be required to submit an amended EIS.

If you have any enquiries about these requirements, please contact Anthony Barnes on the details listed above.

Yours sincerely

Howard Reed

Howard Reed 18.9.17
Director
Resource Assessments
as the Secretary's delegate

Secretary's Environmental Assessment Requirements

State Significant Development

Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*
Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*

Application Number	SSD 7293
Proposal	The Sancrox Quarry Extension Project, which involves: • extending the approved extraction boundary by approximately 52 hectares, • extending the quarry life by ten years (from 20 to 30 years), • increasing the production limit from 455,000 tonnes per annum (tpa) to 750,000 tpa, • constructing and operating a concrete batching plant producing 20,000m^3 per annum (p/a), • constructing and operating a concrete recycling facility processing 20,000 tonnes p/a, • increasing truck movements and equipment loading from 7am–11pm weekdays, and 7am–1pm weekends and public holidays to 24 hours per day 7 days per week, • increasing quarry operations from 7am–5pm weekdays, and 7am–1pm Saturday to 24 hours per day 7 days per week, and • transporting material off-site via public roads.
Location	Sancrox Road Sancrox, Lot 2 DP 574308 Lot 353 DP 754434 Lot 1 DP 704890 Lot 1 DP 720807
Applicant	Mr Matt Errington
Date of Issue	18 September 2017
General Requirements	The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.* In particular, the EIS must include: • a stand-alone executive summary; • a full description of the development, including: – the resource to be extracted, including the amount, type and composition; – the site layout and extraction plan, including cross-sectional plans; – the production process and processing activities, including the in-flow and out-flow of materials and points of discharge to the environment; – surface infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate approvals process); – a waste (overburden, rejects, tailings etc) management strategy; – a water management strategy; – a rehabilitation strategy to apply during, and after completion of, extraction operations, and proposed final use of site; and – the likely interactions between the development and any existing, approved or proposed development in the vicinity of the site; • a strategic justification of the development focusing on site selection and the suitability of the proposed site; • a list of any approvals that must be obtained before the development may commence; • an assessment of the likely impacts of the development on the environment,

	focussing on the key issues identified below, including: – a description of the existing environment likely to be affected by the development, using sufficient baseline data; – an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice; – a description of the measures that would be implemented to avoid, minimise, mitigate and/or offset the likely impacts of the development, and an assessment of: o whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; o the likely effectiveness of these measures; and o whether contingency measures would be necessary to manage any residual risks; and – a description of the measures that would be implemented to monitor and report on the environmental performance of the development; • a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; • consideration of the development against all relevant environmental planning instruments (including Part 3 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007)*; • the reasons why the development should be approved, having regard to: – relevant matters for consideration under the *Environmental Planning and Assessment Act 1979*, including the objects of the Act; – the biophysical, economic and social impacts of the project, including the principles of ecologically sustainable development; – the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses; – feasible alternatives to the development (and its key components), including the consequences of not carrying out the development; • a signed declaration from the author of the EIS, certifying that the information contained within the document is neither false nor misleading. While not exhaustive, Attachment 1 contains a list of some of the environmental planning instruments, guidelines, policies, and plans that may be relevant to the environmental assessment of this development. In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*, the development application must be accompanied by a signed report from a suitably qualified expert that includes an accurate estimate of the capital investment value (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the development, including details of all the assumptions and components from which the capital investment value calculation is derived.
Key Issues	The EIS must address the following key issues: • **Noise & Blasting** – including: - a detailed assessment of the likely construction, operational and off-site transport noise impacts of the development in accordance with the *Interim Construction Noise Guideline*, *NSW Industrial Noise Policy* and the *NSW Road Noise Policy* respectively, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*; - if a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the *Interim Construction Noise Guideline*; - proposed blasting hours, frequency and methods; - a detailed assessment of the likely blasting impacts of the development (including noise, vibrations, overpressure, visual and odour) on people, animals, buildings, infrastructure and significant natural features, having regard to the relevant ANZEC guidelines;

- reasonable and feasible mitigation measures to minimise noise emissions; and
- monitoring and management measures, in particular real-time and attended noise monitoring;

- **Air Quality** – including:
  - a detailed assessment of potential construction and operational impacts, in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW,* and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}, and having regard to the *Voluntary Land Acquisition and Mitigation Policy*;
  - an assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products;
  - reasonable and feasible mitigation measures to minimise dust and emissions; and
  - monitoring and management measures, in particular, real-time air quality monitoring;
- **Water** – including:
  - a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures;
  - identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*;
  - demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP);
  - a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo;
  - an assessment of any likely flooding impacts of the development;
  - an assessment of the likely impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives;
  - an assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users; and
  - a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts;
- **Biodiversity** – including:
  - accurate predictions of any vegetation clearing on site;
  - a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, and having regard to the *NSW Biodiversity Offsets Policy for Major Projects* and the *Framework for Biodiversity Assessment*; and
  - a strategy to offset any residual impacts of the development in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*, including evidence that the appropriate type and quantum of offsets will be available;
- **Heritage** – including:
  - an assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including evidence of appropriate consultation with relevant Aboriginal communities/parties and documentation of the views of these stakeholders regarding the likely impact of the development on their cultural heritage; and
  - identification of historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items, having regard to the relevant policies and guidelines listed in Attachment 1;
- **Traffic & Transport** – including:

	- accurate predictions of the road traffic generated by the construction and operation of the development, including a description of the types of vehicles likely to be used for transportation of quarry products; - a detailed assessment of potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road network (as identified above), including a road safety audit; and - a description of the measures that would be implemented to mitigate any impacts, including concept plans of any proposed upgrades, developed in consultation with the relevant road and rail authorities (if required); • **Land Resources** – including a detailed assessment of: - potential impacts on soils and land capability (including potential erosion and land contamination) and the proposed mitigation, management and remedial measures (as appropriate); - potential impacts on landforms (topography), paying particular attention to the long term geotechnical stability of any new landforms (such as overburden dumps, bunds etc); and - the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements in Clause 12 of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries)* 2007, paying particular attention to the agricultural land use in the region; • **Waste** – including estimates of the quantity and nature of the waste streams that would be generated or received by the development and any measures that would be implemented to minimise, manage or dispose of these waste streams; • **Hazards** – including an assessment of the likely risks to public safety, paying particular attention to the transport, handling and use of any hazardous or dangerous goods; • **Visual** – including a detailed assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, paying particular attention to any new landforms, and to minimising the lighting impacts of the development; • **Social & Economic** – including: - a detailed assessment of the likely social impacts of the development on the local and regional community in accordance with the *Social impact assessment guideline for State significant mining, petroleum production and extractive industry development*; and - a detailed assessment of the likely economic impacts of the development, paying particular attention to: o the significance of the resource; o the costs and benefits of the project; identifying whether the development as a whole would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates; and o the demand for the provision of local infrastructure and services; and • **Rehabilitation** – including the proposed rehabilitation strategy for the site having regard to the key principles in the *Strategic Framework for Mine Closure*, including: - rehabilitation objectives, progressive rehabilitation commitments, methodology, monitoring programs, performance standards and proposed completion criteria; - nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and - the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.
Consultation	During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities, service providers, Aboriginal stakeholders, community groups and affected landowners. You must: • consult with: – affected landowners; – community groups;

	- Port Macquarie-Hastings Council; - Office of Environment and Heritage (including the Heritage Branch); - Environment Protection Authority; - Division of Resources and Geoscience within the Department; - Department of Primary Industries (including the DPI Water, NSW Forestry, Agriculture and Fisheries sections and Crown Lands division); - North Coast Local Land Services; - Roads and Maritime Services; - NSW Rural Fire Service; and • establish a Community Consultative Committee for the project in accordance with the *Community Consultative Committee Guidelines for State Significant Projects,* and consult with the committee during the preparation of the EIS.
Further consultation after 2 years	If you do not lodge a development application and EIS for the development within 2 years of the issue date of these requirements, you must consult further with the Secretary in relation to the preparation of the EIS.

ATTACHMENT 1

Environmental Planning Instruments, Policies, Guidelines & Plans

Air	
	Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (DP&E)
	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA)
	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (EPA)
	Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'
	National Greenhouse Accounts Factors (Commonwealth)
Noise & Blasting	
	Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (DP&E)
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	Interim Construction Noise Guideline (DECC)
	NSW Road Noise Policy (EPA)
	Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC)
Water	
Groundwater	NSW State Groundwater Policy Framework Document (NOW)
	NSW State Groundwater Quality Protection Policy (NOW)
	NSW State Groundwater Quantity Management Policy (NOW)
	NSW Aquifer Interference Policy 2012 (NOW)
	Office of Water Guidelines for Controlled Activities (2012)
	Groundwater Monitoring and Modelling Plans – Information for prospective mining and petroleum exploration activities (NOW)
	Australian Groundwater Modelling Guidelines 2012 (Commonwealth)
	National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
	Guidelines for the Assessment & Management of Groundwater Contamination (EPA)
Surface Water	NSW Government Water Quality and River Flow Objectives (EPA)
	Using the ANZECC Guideline and Water Quality Objectives in NSW (EPA)
	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Effluent Management (ARMCANZ/ANZECC)
	NSW Water Conservation Strategy (2000)
	State Water Management Outcomes Plan
	NSW State Rivers and Estuary Policy (1993)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (EPA)
	Managing Urban Stormwater: Soils & Construction (Landcom) and associated Volume 2E: Mines and Quarries (EPA)
	Managing Urban Stormwater: Treatment Techniques (EPA)
	Managing Urban Stormwater: Source Control (EPA)
	Technical Guidelines: Bunding & Spill Management (EPA)
	Environmental Guidelines: Use of Effluent by Irrigation (EPA)
	A Rehabilitation Manual for Australian Streams (LWRRDC and CRCCH)
	NSW Guidelines for Controlled Activities on Waterfront Land (NOW)

Land	
	Soil and Landscape Issues in Environmental Impact Assessment (NOW)
	Agfact AC.25: Agricultural Land Classification (NSW Agriculture)
	Agricultural Issues for Extractive Industries (NSW Trade and Investment)
	State Environmental Planning Policy No. 55 – Remediation of Land
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC)
Traffic	
	Guide to Traffic Generating Development (RMS)
	Road Design Guide (RMS) & relevant Austroads Standards
Biodiversity	
	Biodiversity Offsets Scheme (OEH)
	Guidelines for Threatened Species Assessment (DP&E)
	NSW State Groundwater Dependent Ecosystem Policy (NOW)
	Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW)
	State Environmental Planning Policy No. 44 – Koala Habitat Protection
Heritage	
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
	Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DP&E)
	Aboriginal Cultural Heritage Consultation Requirements for Proponents (OEH)
	Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (OEH)
	Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH)
	NSW Heritage Manual (OEH)
	Statements of Heritage Impact (OEH)
	Port Macquarie-Hastings Local Environmental Plan 2011
Hazards	
	State Environmental Planning Policy No. 33 – Hazardous and Offensive Development
	Hazardous and Offensive Development Application Guidelines – Applying SEPP 33
	Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis
Waste	
	Waste Classification Guidelines (EPA)
Rehabilitation	
	Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Strategic Framework for Mine Closure (ANZMEC-MCA)
Social & Economic	
	Social impact assessment guideline for State significant mining, petroleum production and extractive industry development (DP&E)
Environmental Planning Instruments - General	
	State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007
	State Environmental Planning Policy (State and Regional Development) 2011
	State Environmental Planning Policy (Infrastructure) 2007
	State Environmental Planning Policy 55 – Remediation of Land
	Port Macquarie-Hastings Local Environmental Plan 2011

ATTACHMENT 2

Agency Correspondence

NSW GOVERNMENT | Department of Primary Industries

OUT17/34142

Ms Genevieve Seed
Resource Assessments
NSW Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

genevieve.seed@planning.nsw.gov.au

Dear Ms Seed

Sancrox Quarry Extension (SSD 7293)
Request to re-issue SEARS

I refer to your email of 17 August 2017 to the Department of Primary Industries (DPI) in respect to the above matter. Comment has been sought from relevant branches of DPI.

Any further referrals to DPI can be sent by email to landuse.enquiries@dpi.nsw.gov.au.

DPI provides the following recommendations for matters to be addressed in the Environmental Impact Statement (EIS) for the proposal with additional comments at **Attachment A**.

Water

- Annual volumes of surface water and groundwater proposed to be taken by the activity (including through inflow and seepage) from each surface and groundwater source as defined by the relevant water sharing plan.
- Assessment of any volumetric water licensing requirements (including those for ongoing water take following completion of the project).
- The identification of an adequate and secure water supply for the life of the project. Confirmation that water can be sourced from an appropriately authorised and reliable supply. This is to include an assessment of the current market depth where water entitlement is required to be purchased.
- A detailed and consolidated site water balance.
- Assessment of impacts on surface and groundwater sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts.
- A detailed assessment against the NSW Aquifer Interference Policy (2012) using DPI Water's assessment framework.
- Full technical details and data of all surface and groundwater modelling, and an independent peer review.
- Proposed management and disposal of produced or incidental water.

- Works are to be in accordance with the "*Guidelines for Controlled Activities on Waterfront Land* (DPI Water 2012)". It is noted a number of first and second order watercourses are mapped within the proposed extension area.
- Details of the final landform of the site, including final void management (where relevant) and rehabilitation measures.
- Proposed surface and groundwater monitoring activities and methodologies.
- Assessment of any potential cumulative impacts on water resources, and any proposed options to manage the cumulative impacts.
- Consideration of relevant policies and guidelines.
- A statement of where each element of the SEARs is addressed in the EIS in the form of a table.

Land

Department of Industry – Lands & Forestry advises that in relation to the Crown road which traverses Lot 2 DP 574308, this proposal cannot be supported or approved whilst this land remains Crown road. To proceed, the adjoining land owner must make application to the Department for road closure and purchase. For further information and the relevant forms, please go to http://www.crownland.nsw.gov.au/crown_lands/roads.

The Crown road closure and purchase process can take a significant amount of time to complete and Lands & Forestry recommends early lodgement of the application. The applicant may request expedition of the application and should provide documentation to support any such request. This request will be assessed but priority cannot be guaranteed.

Yours sincerely

Mitchell Isaacs

Director, Planning Policy & Assessment Advice

1 September 2017

DPI appreciates your help to improve our advice to you. Please complete this three minute survey about the advice we have provided to you, here:

https://goo.gl/o8TXWz

ATTACHMENT A

Sancrox Quarry Extension (SSD 7293)
DPI Water General Assessment Requirements for State Significant Development and State Significant Infrastructure projects

The following detailed assessment requirements are provided to assist in adequately addressing the assessment requirements for State Significant Development (SSD) and State Significant Infrastructure (SSI) projects for Generic projects; Coal Mines and Gas projects; Quarries and Non Coal Mines and Linear projects respectively where relevant.

For further information visit the DPI Water website, www.water.nsw.gov.au

Key Relevant Legislative Instruments

This section provides a basic summary to aid proponents in the development of an Environmental Impact Statement (EIS), and should not be considered a complete list or comprehensive summary of relevant legislative instruments that may apply to the regulation of water resources for a project.

The EIS should take into account the objects and regulatory requirements of the *Water Act 1912* (WA 1912) and *Water Management Act 2000* (*WM Act*), and associated regulations and instruments, as applicable.

Water Management Act 2000 (WM Act)
Key points:

- Volumetric licensing in areas covered by water sharing plans
- Works within 40m of waterfront land
- SSD & SSI projects are exempt from requiring water supply work approvals and controlled activity approvals as a result of the *Environmental Planning & Assessment Act 1979 (EP&A Act)*.
- No exemptions for volumetric licensing apply as a result of the *EP&A Act*.
- Harvestable rights dams
- Aquifer interference activity approval provisions have not yet commenced and are regulated by the *Water Act 1912*
- Flood management work approval provisions have now commenced
- Maximum penalties of $ 2.2 million plus $ 264,000 for each day an offence continues apply under the *WM Act*

Water Act 1912 (WA 1912)
Key points:

- Monitoring bores
- Aquifer interference activities that are not regulated as a water supply work under the *WM Act*.
- No exemptions apply to licences or permits under the *WA 1912* as a result of the *EP&A Act*.
- Regulation of water bore driller licensing.

Water Management (General) Regulation 2011
Key points:

- Provides various exemptions for volumetric licensing and activity approvals
- Provides further detail on requirements for dealings and applications.

Access Licence Dealing Principles Order 2004

Harvestable Rights Orders

Water Sharing Plans these are considered regulations under the *WM Act*

It is important that the proponent understands and describes the ground and surface water sharing plans, water sources, and management zones that apply to the project. The relevant water sharing plans can be determined spatially at www.ourwater.nsw.gov.au. Multiple water sharing plans may apply and these must all be described.

The *Water Act 1912* applies to all water sources not yet covered by a commenced water sharing plan.

The EIS is required to:

- Demonstrate how the proposal is consistent with the relevant rules of the Water Sharing Plan including rules for access licences, distance restrictions for water supply works and rules for the management of local impacts in respect of surface water and groundwater sources, ecosystem protection (including groundwater dependent ecosystems), water quality and surface-groundwater connectivity.
- Provide a description of any site water use (amount of water to be taken from each water source) and management including all sediment dams, clear water diversion structures with detail on the location, design specifications and storage capacities for all the existing and proposed water management structures.
- Provide an analysis of the proposed water supply arrangements against the rules for access licences and other applicable requirements of any relevant WSP, including:
    - Sufficient market depth to acquire the necessary entitlements for each water source.
    - Ability to carry out a “dealing” to transfer the water to relevant location under the rules of the WSP.
    - Daily and long-term access rules.
    - Account management and carryover provisions.
- Provide a detailed and consolidated site water balance.
- Further detail on licensing requirements is provided below.

Relevant Policies and Guidelines

The EIS should take into account the following policies (as applicable):

- NSW Guidelines for Controlled Activities on Waterfront Land (NOW, 2012)
- NSW Aquifer Interference Policy (NOW, 2012)
- Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW, 2012)
- Australian Groundwater Modelling Guidelines (NWC, 2012)
- NSW State Rivers and Estuary Policy (1993)
- NSW Wetlands Policy (2010)
- NSW State Groundwater Policy Framework Document (1997)
- NSW State Groundwater Quality Protection Policy (1998)
- NSW State Groundwater Dependent Ecosystems Policy (2002)
- NSW Water Extraction Monitoring Policy (2007)

DPI Water policies can be accessed at the following links:
http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/default.aspx
http://www.water.nsw.gov.au/Water-licensing/Approvals/Controlled-activities/default.aspx

An assessment framework for the NSW Aquifer Interference Policy can be found online at: http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/Aquifer-interference.

Licensing Considerations

The EIS is required to provide:

- Identification of water requirements for the life of the project in terms of both volume and timing (including predictions of potential ongoing groundwater take following the cessation of operations at the site – such as evaporative loss from open voids or inflows).
- Details of the water supply source(s) for the proposal including any proposed surface water and groundwater extraction from each water source as defined in the relevant Water Sharing Plan/s and all water supply works to take water.
- Explanation of how the required water entitlements will be obtained (i.e. through a new or existing licence/s, trading on the water market, controlled allocations etc.).
- Information on the purpose, location, construction and expected annual extraction volumes including details on all existing and proposed water supply works which take surface water, (pumps, dams, diversions, etc).
- Details on all bores and excavations for the purpose of investigation, extraction, dewatering, testing and monitoring. All predicted groundwater take must be accounted for through adequate licensing.
- Details on existing dams/storages (including the date of construction, location, purpose, size and capacity) and any proposal to change the purpose of existing dams/storages
- Details on the location, purpose, size and capacity of any new proposed dams/storages.
- Applicability of any exemptions under the *Water Management (General) Regulation 2011* to the project.

Water allocation account management rules, total daily extraction limits and rules governing environmental protection and access licence dealings also need to be considered.

The Harvestable Right gives landholders the right to capture and use for any purpose 10% of the average annual runoff from their property if in the Eastern and Central Divisions. The Harvestable Right has been defined in terms of an equivalent dam capacity called the Maximum Harvestable Right Dam Capacity (MHRDC). The MHRDC is determined by the area of the property (in hectares) and a site-specific run-off factor. The MHRDC includes the capacity of all existing dams on the property that do not have a current water licence. Storages capturing up to the harvestable right capacity are not required to be licensed but any capacity of the total of all storages/dams on the property greater than the MHRDC may require a licence.

For more information on Harvestable Right dams, including a calculator, visit:
http://www.water.nsw.gov.au/Water-licensing/Basic-water-rights/Harvesting-runoff/Harvesting-runoff

Dam Safety

Where new or modified dams are proposed, or where new development will occur below an existing dam, the NSW Dams Safety Committee should be consulted in relation to any safety issues that may arise. Conditions of approval may be recommended to ensure safety in relation to any new or existing dams.

See www.damsafety.nsw.gov.au for further information.

Surface Water Assessment

The predictive assessment of the impact of the proposed project on surface water sources should include the following:

- Identification of all surface water features including watercourses, wetlands and floodplains transected by or adjacent to the proposed project.
- Identification of all surface water sources as described by the relevant water sharing plan.
- Detailed description of dependent ecosystems and existing surface water users within the area, including basic landholder rights to water and adjacent/downstream licensed water users.
- Description of all works and surface infrastructure that will intercept, store, convey, or otherwise interact with surface water resources.
- Assessment of predicted impacts on the following:
    - flow of surface water, sediment movement, channel stability, and hydraulic regime,
    - water quality,
    - flood regime,
    - dependent ecosystems,
    - existing surface water users, and
    - planned environmental water and water sharing arrangements prescribed in the relevant water sharing plans.

Groundwater Assessment

To ensure the sustainable and integrated management of groundwater sources, the EIS needs to include adequate details to assess the impact of the project on all groundwater sources.

Where it is considered unlikely that groundwater will be intercepted or impacted (for example by infiltration), a brief site assessment and justification for the minimal impacts may be sufficient, accompanied by suitable contingency measures in place in the event that groundwater is intercepted, and appropriate measures to ensure that groundwater is not contaminated.

Where groundwater is expected to be intercepted or impacted, the following requirements should be used to assist the groundwater assessment for the proposal.

- The known or predicted highest groundwater table at the site.
- Works likely to intercept, connect with or infiltrate the groundwater sources.
- Any proposed groundwater extraction, including purpose, location and construction details of all proposed bores and expected annual extraction volumes.
- Bore construction information is to be supplied to DPI Water by submitting a “Form A” template. DPI Water will supply “GW” registration numbers (and licence/approval numbers if required) which must be used as consistent and unique bore identifiers for all future reporting.

- A description of the watertable and groundwater pressure configuration, flow directions and rates and physical and chemical characteristics of the groundwater source (including connectivity with other groundwater and surface water sources).
- Sufficient baseline monitoring for groundwater quantity and quality for all aquifers and GDEs to establish a baseline incorporating typical temporal and spatial variations.
- The predicted impacts of any final landform on the groundwater regime.
- The existing groundwater users within the area (including the environment), any potential impacts on these users and safeguard measures to mitigate impacts.
- An assessment of groundwater quality, its beneficial use classification and prediction of any impacts on groundwater quality.
- An assessment of the potential for groundwater contamination (considering both the impacts of the proposal on groundwater contamination and the impacts of contamination on the proposal).
- Measures proposed to protect groundwater quality, both in the short and long term.
- Measures for preventing groundwater pollution so that remediation is not required.
- Protective measures for any groundwater dependent ecosystems (GDEs).
- Proposed methods of the disposal of waste water and approval from the relevant authority.
- The results of any models or predictive tools used.

Where potential impact/s are identified the assessment will need to identify limits to the level of impact and contingency measures that would remediate, reduce or manage potential impacts to the existing groundwater resource and any dependent groundwater environment or water users, including information on:

- Any proposed monitoring programs, including water levels and quality data.
- Reporting procedures for any monitoring program including mechanism for transfer of information.
- An assessment of any groundwater source/aquifer that may be sterilised from future use as a water supply as a consequence of the proposal.
- Identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency plans would be initiated (this may entail water level triggers or a beneficial use category).
- Description of the remedial measures or contingency plans proposed.
- Any funding assurances covering the anticipated post development maintenance cost, for example on-going groundwater monitoring for the nominated period.

Groundwater Dependent Ecosystems

The EIS must consider the potential impacts on any Groundwater Dependent Ecosystems (GDEs) at the site and in the vicinity of the site and:

- Identify any potential impacts on GDEs as a result of the proposal including:
    - the effect of the proposal on the recharge to groundwater systems;
    - the potential to adversely affect the water quality of the underlying groundwater system and adjoining groundwater systems in hydraulic connections; and
    - the effect on the function of GDEs (habitat, groundwater levels, connectivity).

- Provide safeguard measures for any GDEs.

Watercourses, Wetlands and Riparian Land

The EIS should address the potential impacts of the project on all watercourses likely to be affected by the project, existing riparian vegetation and the rehabilitation of riparian land. It is recommended the EIS provides details on all watercourses potentially affected by the proposal, including:

- Scaled plans showing the location of:
  - wetlands/swamps, watercourses and top of bank;
  - riparian corridor widths to be established along the creeks;
  - existing riparian vegetation surrounding the watercourses (identify any areas to be protected and any riparian vegetation proposed to be removed);
  - the site boundary, the footprint of the proposal in relation to the watercourses and riparian areas; and
  - proposed location of any asset protection zones.
- Photographs of the watercourses/wetlands and a map showing the point from which the photos were taken.
- A detailed description of all potential impacts on the watercourses/riparian land.
- A detailed description of all potential impacts on the wetlands, including potential impacts to the wetlands hydrologic regime; groundwater recharge; habitat and any species that depend on the wetlands.
- A description of the design features and measures to be incorporated to mitigate potential impacts.
- Geomorphic and hydrological assessment of water courses including details of stream order (Strahler System), river style and energy regimes both in channel and on adjacent floodplains.

Drill Pad, Well and Access Road Construction (applies to Coal Mines and Gas projects and Quarries and Non Coal Mine projects)

- Any construction activity within 40m of a watercourse, should be designed by a suitably qualified person, consistent with the NSW *Guidelines for Controlled Activities on Waterfront Land* (July 2012).
- Construction of all wells must be undertaken in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (3rd edition 2012) by a driller holding a bore drillers' licence valid in New South Wales.
- The length of time that a core hole is maintained as an open hole should be minimised.

Landform rehabilitation

Where significant modification to landform is proposed, the EIS must include:

- Justification of the proposed final landform with regard to its impact on local and regional surface and groundwater systems;
- A detailed description of how the site would be progressively rehabilitated and integrated into the surrounding landscape;
- Outline of proposed construction and restoration of topography and surface drainage features if affected by the project; and

- An outline of the measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation.

Additional Landform Rehabilitation Requirements for Coal mines and Gas projects and Quarries and Non Coal Mines (including final void management)

- Detailed modelling of potential groundwater volume, flow and quality impacts of the presence of an inundated final void (where relevant) on identified receptors specifically considering those environmental systems that are likely to be groundwater dependent;
- The measures that would be established for the long-term protection of local and regional aquifer systems and for the ongoing management of the site following the cessation of the project.

Consultation and general enquiries

Assessment of state significant development enquiries, or requests for review or consultation should be directed to the, Water Regulation Co-ordination Unit, water.referrals@dpi.nsw.gov.au.

A consultation guideline and further information is available online at:
www.water.nsw.gov.au/water-management/law-and-policy/planning-and-assessment

End Attachment A

NSW GOVERNMENT | Department of Primary Industries

OUT17/34142

Ms Genevieve Seed
Resource Assessments
NSW Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

genevieve.seed@planning.nsw.gov.au

Dear Ms Seed

Sancrox Quarry Extension (SSD 7293)
Request to re-issue SEARS

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- The identification of an adequate and secure water supply for the life of the project. Confirmation that water can be sourced from an appropriately authorised and reliable supply. This is to include an assessment of the current market depth where water entitlement is required to be purchased.
- A detailed and consolidated site water balance.
- Assessment of impacts on surface and groundwater sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts.
- A detailed assessment against the NSW Aquifer Interference Policy (2012) using DPI Water's assessment framework.
- Full technical details and data of all surface and groundwater modelling, and an independent peer review.
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- Proposed surface and groundwater monitoring activities and methodologies.
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- Consideration of relevant policies and guidelines.
- A statement of where each element of the SEARs is addressed in the EIS in the form of a table.

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Department of Industry – Lands & Forestry advises that in relation to the Crown road which traverses Lot 2 DP 574308, this proposal cannot be supported or approved whilst this land remains Crown road. To proceed, the adjoining land owner must make application to the Department for road closure and purchase. For further information and the relevant forms, please go to http://www.crownland.nsw.gov.au/crown_lands/roads.

The Crown road closure and purchase process can take a significant amount of time to complete and Lands & Forestry recommends early lodgement of the application. The applicant may request expedition of the application and should provide documentation to support any such request. This request will be assessed but priority cannot be guaranteed.

Yours sincerely

Mitchell Isaacs

Director, Planning Policy & Assessment Advice

1 September 2017

DPI appreciates your help to improve our advice to you. Please complete this three minute survey about the advice we have provided to you, here:

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ATTACHMENT A

Sancrox Quarry Extension (SSD 7293)
DPI Water General Assessment Requirements for State Significant Development and State Significant Infrastructure projects

The following detailed assessment requirements are provided to assist in adequately addressing the assessment requirements for State Significant Development (SSD) and State Significant Infrastructure (SSI) projects for Generic projects; Coal Mines and Gas projects; Quarries and Non Coal Mines and Linear projects respectively where relevant.

For further information visit the DPI Water website, www.water.nsw.gov.au

Key Relevant Legislative Instruments

This section provides a basic summary to aid proponents in the development of an Environmental Impact Statement (EIS), and should not be considered a complete list or comprehensive summary of relevant legislative instruments that may apply to the regulation of water resources for a project.

The EIS should take into account the objects and regulatory requirements of the *Water Act 1912* (WA 1912) and *Water Management Act 2000* (*WM Act*), and associated regulations and instruments, as applicable.

Water Management Act 2000 (WM Act)
Key points:

- Volumetric licensing in areas covered by water sharing plans
- Works within 40m of waterfront land
- SSD & SSI projects are exempt from requiring water supply work approvals and controlled activity approvals as a result of the *Environmental Planning & Assessment Act 1979 (EP&A Act)*.
- No exemptions for volumetric licensing apply as a result of the *EP&A Act*.
- Harvestable rights dams
- Aquifer interference activity approval provisions have not yet commenced and are regulated by the *Water Act 1912*
- Flood management work approval provisions have now commenced
- Maximum penalties of $ 2.2 million plus $ 264,000 for each day an offence continues apply under the *WM Act*

Water Act 1912 (WA 1912)
Key points:

- Monitoring bores
- Aquifer interference activities that are not regulated as a water supply work under the *WM Act*.
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- Regulation of water bore driller licensing.

Water Management (General) Regulation 2011
Key points:

- Provides various exemptions for volumetric licensing and activity approvals
- Provides further detail on requirements for dealings and applications.

Access Licence Dealing Principles Order 2004

Harvestable Rights Orders

Water Sharing Plans these are considered regulations under the *WM Act*

It is important that the proponent understands and describes the ground and surface water sharing plans, water sources, and management zones that apply to the project. The relevant water sharing plans can be determined spatially at www.ourwater.nsw.gov.au. Multiple water sharing plans may apply and these must all be described.

The *Water Act 1912* applies to all water sources not yet covered by a commenced water sharing plan.

The EIS is required to:

- Demonstrate how the proposal is consistent with the relevant rules of the Water Sharing Plan including rules for access licences, distance restrictions for water supply works and rules for the management of local impacts in respect of surface water and groundwater sources, ecosystem protection (including groundwater dependent ecosystems), water quality and surface-groundwater connectivity.
- Provide a description of any site water use (amount of water to be taken from each water source) and management including all sediment dams, clear water diversion structures with detail on the location, design specifications and storage capacities for all the existing and proposed water management structures.
- Provide an analysis of the proposed water supply arrangements against the rules for access licences and other applicable requirements of any relevant WSP, including:
    - Sufficient market depth to acquire the necessary entitlements for each water source.
    - Ability to carry out a “dealing” to transfer the water to relevant location under the rules of the WSP.
    - Daily and long-term access rules.
    - Account management and carryover provisions.
- Provide a detailed and consolidated site water balance.
- Further detail on licensing requirements is provided below.

Relevant Policies and Guidelines

The EIS should take into account the following policies (as applicable):

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- NSW State Rivers and Estuary Policy (1993)
- NSW Wetlands Policy (2010)
- NSW State Groundwater Policy Framework Document (1997)
- NSW State Groundwater Quality Protection Policy (1998)
- NSW State Groundwater Dependent Ecosystems Policy (2002)
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DPI Water policies can be accessed at the following links:
http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/default.aspx
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An assessment framework for the NSW Aquifer Interference Policy can be found online at: http://www.water.nsw.gov.au/Water-management/Law-and-policy/Key-policies/Aquifer-interference.

Licensing Considerations

The EIS is required to provide:

- Identification of water requirements for the life of the project in terms of both volume and timing (including predictions of potential ongoing groundwater take following the cessation of operations at the site – such as evaporative loss from open voids or inflows).
- Details of the water supply source(s) for the proposal including any proposed surface water and groundwater extraction from each water source as defined in the relevant Water Sharing Plan/s and all water supply works to take water.
- Explanation of how the required water entitlements will be obtained (i.e. through a new or existing licence/s, trading on the water market, controlled allocations etc.).
- Information on the purpose, location, construction and expected annual extraction volumes including details on all existing and proposed water supply works which take surface water, (pumps, dams, diversions, etc).
- Details on all bores and excavations for the purpose of investigation, extraction, dewatering, testing and monitoring. All predicted groundwater take must be accounted for through adequate licensing.
- Details on existing dams/storages (including the date of construction, location, purpose, size and capacity) and any proposal to change the purpose of existing dams/storages
- Details on the location, purpose, size and capacity of any new proposed dams/storages.
- Applicability of any exemptions under the *Water Management (General) Regulation 2011* to the project.

Water allocation account management rules, total daily extraction limits and rules governing environmental protection and access licence dealings also need to be considered.

The Harvestable Right gives landholders the right to capture and use for any purpose 10% of the average annual runoff from their property if in the Eastern and Central Divisions. The Harvestable Right has been defined in terms of an equivalent dam capacity called the Maximum Harvestable Right Dam Capacity (MHRDC). The MHRDC is determined by the area of the property (in hectares) and a site-specific run-off factor. The MHRDC includes the capacity of all existing dams on the property that do not have a current water licence. Storages capturing up to the harvestable right capacity are not required to be licensed but any capacity of the total of all storages/dams on the property greater than the MHRDC may require a licence.

For more information on Harvestable Right dams, including a calculator, visit:
http://www.water.nsw.gov.au/Water-licensing/Basic-water-rights/Harvesting-runoff/Harvesting-runoff

Dam Safety

Where new or modified dams are proposed, or where new development will occur below an existing dam, the NSW Dams Safety Committee should be consulted in relation to any safety issues that may arise. Conditions of approval may be recommended to ensure safety in relation to any new or existing dams.

See www.damsafety.nsw.gov.au for further information.

Surface Water Assessment

The predictive assessment of the impact of the proposed project on surface water sources should include the following:

- Identification of all surface water features including watercourses, wetlands and floodplains transected by or adjacent to the proposed project.
- Identification of all surface water sources as described by the relevant water sharing plan.
- Detailed description of dependent ecosystems and existing surface water users within the area, including basic landholder rights to water and adjacent/downstream licensed water users.
- Description of all works and surface infrastructure that will intercept, store, convey, or otherwise interact with surface water resources.
- Assessment of predicted impacts on the following:
    - flow of surface water, sediment movement, channel stability, and hydraulic regime,
    - water quality,
    - flood regime,
    - dependent ecosystems,
    - existing surface water users, and
    - planned environmental water and water sharing arrangements prescribed in the relevant water sharing plans.

Groundwater Assessment

To ensure the sustainable and integrated management of groundwater sources, the EIS needs to include adequate details to assess the impact of the project on all groundwater sources.

Where it is considered unlikely that groundwater will be intercepted or impacted (for example by infiltration), a brief site assessment and justification for the minimal impacts may be sufficient, accompanied by suitable contingency measures in place in the event that groundwater is intercepted, and appropriate measures to ensure that groundwater is not contaminated.

Where groundwater is expected to be intercepted or impacted, the following requirements should be used to assist the groundwater assessment for the proposal.

- The known or predicted highest groundwater table at the site.
- Works likely to intercept, connect with or infiltrate the groundwater sources.
- Any proposed groundwater extraction, including purpose, location and construction details of all proposed bores and expected annual extraction volumes.
- Bore construction information is to be supplied to DPI Water by submitting a “Form A” template. DPI Water will supply “GW” registration numbers (and licence/approval numbers if required) which must be used as consistent and unique bore identifiers for all future reporting.

- A description of the watertable and groundwater pressure configuration, flow directions and rates and physical and chemical characteristics of the groundwater source (including connectivity with other groundwater and surface water sources).
- Sufficient baseline monitoring for groundwater quantity and quality for all aquifers and GDEs to establish a baseline incorporating typical temporal and spatial variations.
- The predicted impacts of any final landform on the groundwater regime.
- The existing groundwater users within the area (including the environment), any potential impacts on these users and safeguard measures to mitigate impacts.
- An assessment of groundwater quality, its beneficial use classification and prediction of any impacts on groundwater quality.
- An assessment of the potential for groundwater contamination (considering both the impacts of the proposal on groundwater contamination and the impacts of contamination on the proposal).
- Measures proposed to protect groundwater quality, both in the short and long term.
- Measures for preventing groundwater pollution so that remediation is not required.
- Protective measures for any groundwater dependent ecosystems (GDEs).
- Proposed methods of the disposal of waste water and approval from the relevant authority.
- The results of any models or predictive tools used.

Where potential impact/s are identified the assessment will need to identify limits to the level of impact and contingency measures that would remediate, reduce or manage potential impacts to the existing groundwater resource and any dependent groundwater environment or water users, including information on:

- Any proposed monitoring programs, including water levels and quality data.
- Reporting procedures for any monitoring program including mechanism for transfer of information.
- An assessment of any groundwater source/aquifer that may be sterilised from future use as a water supply as a consequence of the proposal.
- Identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency plans would be initiated (this may entail water level triggers or a beneficial use category).
- Description of the remedial measures or contingency plans proposed.
- Any funding assurances covering the anticipated post development maintenance cost, for example on-going groundwater monitoring for the nominated period.

Groundwater Dependent Ecosystems

The EIS must consider the potential impacts on any Groundwater Dependent Ecosystems (GDEs) at the site and in the vicinity of the site and:

- Identify any potential impacts on GDEs as a result of the proposal including:
    - the effect of the proposal on the recharge to groundwater systems;
    - the potential to adversely affect the water quality of the underlying groundwater system and adjoining groundwater systems in hydraulic connections; and
    - the effect on the function of GDEs (habitat, groundwater levels, connectivity).

- Provide safeguard measures for any GDEs.

Watercourses, Wetlands and Riparian Land

The EIS should address the potential impacts of the project on all watercourses likely to be affected by the project, existing riparian vegetation and the rehabilitation of riparian land. It is recommended the EIS provides details on all watercourses potentially affected by the proposal, including:

- Scaled plans showing the location of:
  - wetlands/swamps, watercourses and top of bank;
  - riparian corridor widths to be established along the creeks;
  - existing riparian vegetation surrounding the watercourses (identify any areas to be protected and any riparian vegetation proposed to be removed);
  - the site boundary, the footprint of the proposal in relation to the watercourses and riparian areas; and
  - proposed location of any asset protection zones.
- Photographs of the watercourses/wetlands and a map showing the point from which the photos were taken.
- A detailed description of all potential impacts on the watercourses/riparian land.
- A detailed description of all potential impacts on the wetlands, including potential impacts to the wetlands hydrologic regime; groundwater recharge; habitat and any species that depend on the wetlands.
- A description of the design features and measures to be incorporated to mitigate potential impacts.
- Geomorphic and hydrological assessment of water courses including details of stream order (Strahler System), river style and energy regimes both in channel and on adjacent floodplains.

Drill Pad, Well and Access Road Construction (applies to Coal Mines and Gas projects and Quarries and Non Coal Mine projects)

- Any construction activity within 40m of a watercourse, should be designed by a suitably qualified person, consistent with the NSW *Guidelines for Controlled Activities on Waterfront Land* (July 2012).
- Construction of all wells must be undertaken in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (3rd edition 2012) by a driller holding a bore drillers' licence valid in New South Wales.
- The length of time that a core hole is maintained as an open hole should be minimised.

Landform rehabilitation

Where significant modification to landform is proposed, the EIS must include:

- Justification of the proposed final landform with regard to its impact on local and regional surface and groundwater systems;
- A detailed description of how the site would be progressively rehabilitated and integrated into the surrounding landscape;
- Outline of proposed construction and restoration of topography and surface drainage features if affected by the project; and

- An outline of the measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation.

Additional Landform Rehabilitation Requirements for Coal mines and Gas projects and Quarries and Non Coal Mines (including final void management)

- Detailed modelling of potential groundwater volume, flow and quality impacts of the presence of an inundated final void (where relevant) on identified receptors specifically considering those environmental systems that are likely to be groundwater dependent;
- The measures that would be established for the long-term protection of local and regional aquifer systems and for the ongoing management of the site following the cessation of the project.

Consultation and general enquiries

Assessment of state significant development enquiries, or requests for review or consultation should be directed to the, Water Regulation Co-ordination Unit, water.referrals@dpi.nsw.gov.au.

A consultation guideline and further information is available online at:
www.water.nsw.gov.au/water-management/law-and-policy/planning-and-assessment

End Attachment A

DOC17/427522-01; EF13/3037 (SSD 7293)

Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Attention: Genevieve Seed

By email: genevieve.seed@planning.nsw.gov.au

Dear Ms Seed

Sancrox Quarry Extension (SSD 7293)
Reissue of Secretary's Environmental Assessment Requirements

I refer to your email to the Environment Protection Authority (EPA), dated 17 August 2017, seeking the EPA's recommended Secretary Environmental Assessment Requirements (SEARS) for the Sancrox Quarry extension proposal, SSD 7293. Provided with your email is the report titled '*Sancrox Quarry Expansion Project – Preliminary Environmental Impact Statement*', dated August 2015.

The EPA notes the request is for the reissuing of the SEARS, as previous SEARS were provided in relation to this proposal in October 2015. As the proposal, has not been altered from the previous 2015 application, the EPA has reviewed the 2015 SEARS submitted and updated them accordingly. These updates primarily relate to the guideline references.

The updated SEARS have been provided at **Attachment A** and the updated guidance material list at **Attachment B**.

The EPA's key information requirements for the project are summarised below and include an adequate description and assessment of:

1. Project proposal including size of the operation, proposed processes, operational hours, maximum and average annual production rate, staging and timing of the proposal;
2. Air quality impacts including a description of all emissions and a specific description of proposed air pollution management strategies;
3. Noise and vibration impacts associated with the proposed construction and hours of operation.
4. Water management onsite including process and stormwater management, sedimentation ponds, details and justification for any proposed discharge(s) and the sensitivity of the receiving environment.
5. Waste generation, source location, classification, quantities, reuse and management measures for activities undertaken at the premises;
6. A proposed monitoring plan to assess the impact on the environment and surrounding receivers over time;
7. An assessment of the cumulative impacts associated with this proposal and other activities in the local area; and

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8. Actions that will be taken to avoid or mitigate impacts or compensate for any unavoidable impacts associated with proposed operations.

In carrying out the assessment, the proponent should refer to the relevant guidelines listed in **Attachment B** and any relevant industry codes of practice and best practice management guidelines.

The proponent should also be aware that any commitments made in the EIS may be formalised as approval conditions and subsequently environment protection licence conditions. Pollution control measures should not be proposed if they are impractical, unrealistic or beyond the financial viability of the development. It is important that all conclusions are supported by adequate data.

If you require any further information regarding this matter, please contact me on 4908 6819 or by email to hunter.region@epa.nsw.gov.au.

Yours sincerely

30/8/17

MICHAEL HOWAT
A/Head Strategic Programs Unit - Hunter
Environment Protection Authority

Encl: **Attachment A** – EPA's Recommended Secretary's Environmental Assessment Requirements – Sancrox Quarry Extension Project (SSD 7293)

Attachment B – Guidance Material

ATTACHMENT A

EPA's Recommended Secretary's Environmental Assessment Requirements – Sancrox Quarry Extension Project (SSD 7293)

1 Environmental impacts of the project

Impacts related to the following environmental issues need to be assessed, quantified and reported on:

- Air Quality
- Noise and Vibration
- Water and Soil Quality and Management
- Waste Management
- Dangerous Goods, Chemical Storage and Bunding

The Environmental Impact Statement (EIS) should address the specific requirements outlined under each heading below and assess impacts in accordance with the relevant guidelines mentioned. A full list of guidelines is at Attachment B.

2 Licensing requirements

Should project approval be granted, the proponent will need to make a separate application to EPA for any variations to the existing Environment Protection Licence No. 5289 for the quarry. Additional information is available through EPA's *Guide to Licensing* document.
http://www.epa.nsw.gov.au/resources/licensing/licensing-guide-160369.pdf

General information on licence requirements can also be obtained from EPA's Environment Line on 131 555 during office hours, or can be found at the EPA web site at:
http://www.epa.nsw.gov.au/licensing/

3 The Proposal and Premises

The objectives of the proposal should be clearly stated and refer to:

- The size and type of the operation;
- The nature of the processes and the products, by-products and wastes produced;
- The types and quantities of any chemicals to be used and stored onsite;
- Proposed operational hours, including any heavy vehicle movements;
- Proposed maximum and average annual production rates that will occur at the premises; and
- Proposed staging and timing of the proposal.

The EIS will need to fully identify all the processes and activities intended for the site over the life of the development. This will include details of:

- The location of the proposed facility and details of the surrounding environment;
- The proposed layout of the site;
- Appropriate land use zoning;
- Ownership details of any residence and/or land likely to be affected by the proposed operations;
- Maps/diagrams showing the location of residences and properties likely to be affected and other industrial developments, conservation areas, wetlands, etc. in the locality that may be affected by the facility;
- All equipment proposed for use at the site;
- All chemicals, including fuel, used on the site and proposed methods for their transportation, storage, use and emergency management;
- Clearly detail the boundary of the premises; and
- Methods to mitigate any expected environmental impacts of the development.

4 Air Issues

Given the proposed extension of the extraction boundary and addition of potentially odorous activities such as asphalt production, the EIS should include a detailed assessment of air quality and odour impacts. The following matters should be addressed as part of the EIS.

- Assess the risk associated with potential discharges of fugitive and point source emissions for all stages of the proposal. Assessment of risk relates to environmental harm, risk to human health and amenity.

- Justify the level of assessment undertaken on the basis of risk factors, including but not limited to:
    - proposal location;
    - characteristics of the receiving environment; and
    - type and quantity of pollutants emitted.

- Describe the receiving environment in detail. The proposal must be contextualised within the receiving environment (local, regional and inter-regional as appropriate). The description must include but need not be limited to:
    - meteorology and climate;
    - topography;
    - surrounding land-use; receptors; and
    - ambient air quality.

- Include a detailed description of the proposal. All processes that could result in air emissions must be identified and described. Sufficient detail to accurately communicate the characteristics and quantity of all emissions must be provided.

- Include a consideration of 'worst case' emission scenarios and impacts at proposed emission limits.

- Account for cumulative impacts associated with existing emission sources as well as any currently approved developments linked to the receiving environment.

- Include air dispersion modelling where there is a risk of adverse air quality impacts, or where there is sufficient uncertainty to warrant a rigorous numerical impact assessment. Air dispersion modelling must be conducted in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2016).

- Demonstrate the proposal's ability to comply with the relevant regulatory framework, specifically the *Protection of the Environment Operations* (POEO) *Act* (1997) and the POEO (Clean Air) Regulation (2010).

- Provide an assessment of the project in terms of the priorities and targets adopted under the NSW State Plan 2010 and its implementation plan Action for Air.

- Detail emission control techniques/practices that will be employed by the proposal.

- Detail monitoring that will be conducted to assess the impacts of the proposal.

5 Noise and Vibration

The following matters should be addressed in relation to noise and vibration impacts associated with the proposal. This includes identification of the hours of operations, assessment of all activities where proposed, and impacts on sensitive receivers associated with the proposed hours of operation. The following matters should be addressed as part of the EIS.

General

- Construction noise associated with the proposed development should be assessed using the Interim Construction Noise Guideline (DECC, 2009).

- Vibration from all activities (including construction and operation) to be undertaken on the premises should be assessed using the guidelines contained in the Assessing Vibration: a technical guideline (DEC, 2006).

- Blast impacts should be demonstrated to be capable of complying with the guidelines contained in Australian and New Zealand Environment Council – Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC, 1990).

Industry

- Operational noise from all industrial activities (including private haul roads) to be undertaken on the premises should be assessed using the guidelines contained in the NSW Industrial Noise Policy (EPA, 2000) and Industrial Noise Policy Application Notes.

Road

- Noise on public roads from increased road traffic generated by land use developments should be assessed using the guidelines contained in the NSW Road Noise Policy (DECCW, 2011).

- Noise from new or upgraded public roads should be assessed using the NSW Road Noise Policy (DECCW, 2011).

Monitoring

- Detail monitoring that will be conducted to assess the impacts of the proposal.

6 Water and Soils

6.1 Water Quality

Describe Proposal

- Describe the proposal including position of any intakes and discharges, volumes, water quality and frequency of all water discharges.

- Demonstrate that all practical options to avoid discharges have been implemented and environmental impact minimised where discharge is necessary.

- Where relevant include a water balance for the development including water requirements (quantity, quality and source(s)) and proposed storm and wastewater disposal, including type, volumes, proposed treatment and management methods and re-use options.

Background Conditions

- Describe existing surface and groundwater quality. An assessment needs to be undertaken for any water resource likely to be affected by the proposal. Issues to be discussed should include but are not limited to:
  - a description of any impacts from existing industry or activities on water quality
  - a description of the condition of the local catchment e.g. erosion, soils, vegetation cover, etc.
  - an outline of baseline groundwater information, including, for example, depth to water table, flow direction and gradient, groundwater quality, reliance on groundwater by surrounding users and by the environment

  - historic river flow data

- State the Water Quality Objectives for the receiving waters relevant to the proposal. These refer to the community's agreed environmental values and human uses endorsed by the NSW Government as goals for ambient waters (http://www.environment.nsw.gov.au/ieo/index.htm). Where groundwater may be impacted the assessment should identify appropriate groundwater environmental values.

- State the indicators and associated trigger values or criteria for the identified environmental values. This information should be based on the ANZECC (2000) Guidelines for Fresh and Marine Water Quality as a minimum but should also be based on advice from Hunter Water Corporation given the sensitive receiving environment of Grahamstown Dam water supply.

- State any locally specific objectives, criteria or targets which have been endorsed by the NSW Government.

Impact Assessment

- Describe the nature and degree of impact that any proposed discharges will have on the receiving environment, both surface water and groundwater.
- Detail contractual and other arrangements that will be put in place to prevent pollution from haul roads and unsealed roads per se, particularly rights of carriageways not owned by the proponent.
- Assess impacts against the relevant ambient water quality outcomes. Demonstrate how the proposal will be designed and operated to:
  - protect the Water Quality Objectives for receiving waters where they are currently being achieved; and
  - contribute towards achievement of the Water Quality Objectives over time where they are not currently being achieved.
- Where a discharge is proposed that includes a mixing zone, the proposal should demonstrate how wastewater discharged to waterways will ensure the ANZECC (2000) water quality criteria for relevant chemical and non-chemical parameters are met at the edge of the initial mixing zone of the discharge, and that any impacts in the initial mixing zone are demonstrated to be reversible.
- Propose water quality limits for any discharge(s) that adequately protects the receiving environment.
- Assess impacts on groundwater and groundwater dependent ecosystems.
- Describe how stormwater will be managed both during and after construction.

Monitoring

- Describe how predicted impacts will be monitored and assessed over time.

6.2 Soil

The EIS should include:

- An assessment of potential impacts on soil and land resources should be undertaken, being guided by Soil and Landscape Issues in Environmental Impact Assessment (DLWC 2000). The nature and extent of any significant impacts should be identified. Particular attention should be given to:
  - Soil erosion and sediment transport - in accordance with Managing urban stormwater: soils and construction, vol. 1 (Landcom 2004) and vol. 2 (A. Installation of services; B Waste landfills; C. Unsealed roads; D. Main Roads; E. Mines and quarries) (DECC 2008).

- Mass movement (landslides) – in accordance with Landslide risk management guidelines presented in Australian Geomechanics Society (2007).
- Urban and regional salinity – guidance given in the Local Government Salinity Initiative booklets which includes Site Investigations for Urban Salinity (DLWC, 2002).

- A description of the mitigation and management options that will be used to prevent, control, abate or minimise identified soil and land resource impacts associated with the project. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.

7 Waste

The EIS should:

- Include a detailed plan for in-situ classification of waste material, including the sampling locations and sampling regime that will be employed to classify the waste, particularly with regards to the identification of contamination hotspots.

- Identify, quantify, characterise and classify all waste that currently exists at the site. Identify the intended end use, for example reuse or disposal, and the end use location(s) for the waste. Also, specify the mechanism under which waste will be reused or disposed, such as a Resource Recovery Exemption. Note: All waste must be classified in accordance with EPA's Classification Guidelines.

- Identify, characterise and classify all waste that will be generated onsite through excavation, demolition or construction activities, including proposed quantities of the waste.
  Note: All waste must be classified in accordance with EPA's Waste Classification Guidelines.

- Identify, characterise and classify all waste that is proposed to be disposed of to an offsite location, including proposed quantities of the waste and the disposal locations for the waste. This includes waste that is intended for re-use or recycling.
  Note: All waste must be classified in accordance with EPA's Classification Guidelines.

- Include a commitment to retaining all sampling and classification results for the life of the project to demonstrate compliance with EPA's Waste Classification Guidelines.

- Provide details of how waste will be handled and managed onsite to minimise pollution, including:

  a) Stockpile location and management
     - Labelling of stockpiles for identification, ensuring that all waste is clearly identified and stockpiled separately from other types of material (especially the separation of any contaminated and non-contaminated waste).
     - Proposed height limits for all waste to reduce the potential for dust and odour.
     - Procedures for minimising the movement of waste around the site and double handling.
     - Measures to minimise leaching from stockpiles into the surrounding environment, such as sediment fencing, geofabric liners etc.

  b) Erosion, sediment and leachate control including measures to be implemented to minimise erosion, leachate and sediment mobilisation at the site during works. The EIS should show the location of each measure to be implemented. The Proponent should consider measures such as:
     - Sediment traps
     - Diversion banks
     - Sediment fences
     - Bunds (earth, hay, mulch)

- Geofabric liners
- Other control measures as appropriate

The Proponent should also provide details of:
- how leachate from stockpiled waste material will be kept separate from stormwater runoff;
- treatment of leachate through a wastewater treatment plant (if applicable); and
- any proposed transport and disposal of leachate off-site.

- Provide details of how the waste will be handled and managed during transport to a lawful facility. If the waste possesses hazardous characteristics, the Proponent must provide details of how the waste will be treated or immobilised to render it suitable for transport and disposal.

- Include details of all procedures and protocols to be implemented to ensure that any waste leaving the site is transported and disposed of lawfully and does not pose a risk to human health or the environment.

- Include a statement demonstrating that the Proponent is aware of EPA's requirements with respect to notification and tracking of waste.

- Include a statement demonstrating that the Proponent is aware of the relevant legislative requirements for disposal of the waste, including any relevant Resource Recovery Exemptions, as gazetted by EPA from time to time.

- Outline contingency plans for any event that affects operations at the site that may result in environmental harm, including: excessive stockpiling of waste, volume of leachate generated exceeds the storage capacity available on-site etc.

8 Dangerous Goods, Chemical storage and Bunding

- The EIS must outline all details regarding the transport, handling, storage and use of dangerous goods, chemicals and products, including fuel, both on site and with ancillary activities and describe the measures proposed to minimise the potential for leakage or the migration of pollutants into the soil/waters or from the site.

- The EIS should identify any fuel or chemical storage areas proposed for the site.

- The EIS should consider compliance with the following legislation, standards and guidelines where relevant:
  - Australian Standard AS1692:1989 Tanks for Flammable and combustible liquids;
  - The DECC's "Bunding and Spill Management" Technical Guideline (November 1997)
  - Australian Standard AS 1940:2004 The Storage and Handling of Flammable and Combustible Liquids
  - Australia Standard AS 4452-1997: The Storage and Handling of Toxic Substances;
  - Australian/New Zealand Standard AS/NZS 4452:1997: The Storage and Handling of Mixed Classes of Dangerous Goods in Packages and Intermediate Bulk Containers; and
  - Road and Rail Transport (Dangerous Goods) Act 1997

9 Monitoring Programs

The EIS should include a detailed assessment of any noise, air quality, weather, water or waste monitoring required during the construction and on-going operation of the site to ensure that the development achieves a satisfactory level of environmental performance. The evaluation should include a detailed description of the monitoring locations, sample analysis methods and the level of reporting proposed.

ATTACHMENT B

Guidance Material

Title	Web address
Relevant Legislation	
Protection of the Environment Operations Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+156+1997+cd+0+N
Protection of the Environment Operations (Clean Air) Regulation 2010	http://www.legislation.nsw.gov.au/maintop/view/inforce/subordleg+428+2010+cd+0+N
Licensing	
Guide to Licensing	http://www.epa.nsw.gov.au/resources/licensing/licensing-guide-160369.pdf
Air Issues	
Air Quality	
Approved methods for the Modelling and Assessment of Air Pollutants in NSW (2016)	http://www.epa.nsw.gov.au/resources/epa/approved-methods-for-modelling-and-assessment-of-air-pollutants-in-NSW-160666.pdf
Approved methods for the Sampling and Analysis of Air Pollutants in NSW (2016)	http://www.epa.nsw.gov.au/resources/air/07001amsaap.pdf
POEO (Clean Air) Regulation 2010	http://www.legislation.nsw.gov.au/maintop/view/inforce/subordleg+428+2010+cd+0+N
Noise and Vibration	
Interim Construction Noise Guideline (DECC, 2009)	http://www.epa.nsw.gov.au/resources/noise/09265cng.pdf
Assessing Vibration: a technical guideline (DEC, 2006)	http://www.epa.nsw.gov.au/resources/noise/vibrationguide0643.pdf
Australian and New Zealand Environment Council – Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC, 1990)	http://www.epa.nsw.gov.au/resources/noise/ANZECBlasting.pdf
NSW Industrial Noise Policy	http://www.epa.nsw.gov.au/resources/noise/ind_noise.pdf
NSW Road Noise Policy (DECCW, 2011)	http://www.epa.nsw.gov.au/resources/noise/2011236nswroadnoisepolicy.pdf
Waste	
Waste Classification Guidelines (EPA, 2014)	http://www.epa.nsw.gov.au/wasteregulation/classify-guidelines.htm
Resource recovery exemption	http://www.epa.nsw.gov.au/wasteregulation/recovery-exemptions.htm
Water and Soils	
Soils – general	
Soil and Landscape Issues in Environmental Impact Assessment (DLWC 2000)	http://www.dnr.nsw.gov.au/care/soil/soil_pubs/pdfs/tech_rep_34_new.pdf

Title	Web address
Managing urban stormwater: soils and construction, vol. 1 (Landcom 2004) and vol. 2 (A. Installation of services; B Waste landfills; C. Unsealed roads; D. Main Roads; E. Mines and quarries) (DECC 2008)	Vol 1 - Available for purchase at http://www.landcom.com.au/whats-new/publications-reports/the-blue-book.aspx Vol 2 - http://www.environment.nsw.gov.au/stormwater/publications.htm
Landslide risk management guidelines	http://www.australiangeomechanics.org/resources/downloads/
Site Investigations for Urban Salinity (DLWC, 2002)	http://www.environment.nsw.gov.au/resources/salinity/booklet3siteinvestigationsforurbansalinity.pdf
Local Government Salinity Initiative Booklets	http://www.environment.nsw.gov.au/salinity/solutions/urban.htm
Water	
Water Quality Objectives	http://www.environment.nsw.gov.au/ieo/index.htm
ANZECC (2000) Guidelines for Fresh and Marine Water Quality	http://www.mincos.gov.au/publications/australian_and_new_zealand_guidelines_for_fresh_and_marine_water_quality
Applying Goals for Ambient Water Quality Guidance for Operations Officers – Mixing Zones	http://deccnet/water/resources/AWQGuidance7.pdf
Approved Methods for the Sampling and Analysis of Water Pollutant in NSW (2004)	http://www.epa.nsw.gov.au/resources/legislation/approvedmethods-water.pdf

Heritage Council of New South Wales

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File No: EF17/9967
Ref No: DOC17/427040

Genevieve Seed
Senior Planning Officer - Resource Assessments
Department of Planning & Environment
23-33 Bridge Street
SYDNEY NSW 2000

E-mail:Genevieve.Seed@planning.nsw.gov.au

Dear Ms Seed

Request for Secretary's Environmental Assessment Requirements (SEARs) for Sancrox Quarry Extension Project (SSD 7293).

Reference is made to your correspondence received on 17 August 2017 requesting SEARs input from the Heritage Council of NSW (the Heritage Council) for the above proposal.

After a review of the documentation, it appears that the proposed State Significant Development (SSD) site does not include any items on the State Heritage Register. However, it is noted that an early grave is identified from the National Trust Register in the suburb of Sancrox and this area may have other historical archaeological potential associated with the development of the settlement of Port Macquarie Hastings Council LGA which requires consideration and management.

It is recommended that although the Proponent did not identify heritage as an issue, the following additional SEARS are included to address this potential:

- The Environmental Impact Statement (EIS) should identify if there are any potential heritage items within the proposed project area including historical archaeological potential. If any potential heritage items are likely to be affected, a Heritage Impact Statement (HIS) must be prepared in accordance with the guidelines in the NSW Heritage Manual 1996. The HIS should assess how the development would impact on any places of heritage significance in or surrounding the SSD site.
- A historical archaeological assessment should be prepared by a suitably qualified historical archaeologist in accordance with the Heritage Division, Office of Environment and Heritage Guidelines *'Assessing Significance for Historical Archaeological Sites and 'Relics'* 2009. This assessment should identify what relics, if any, are likely to be present, assess their significance and consider the impacts from the proposal on this potential resource. Where harm is likely to occur, it is recommended that the significance of the relics be considered in determining an appropriate mitigation strategy. If harm cannot be avoided in whole or part, an appropriate Research Design and Excavation Methodology should also be prepared to guide any proposed excavations.

If you have any questions regarding the above matter, please contact Felicity Barry, Senior Archaeologist, at the Heritage Division, Office of Environment and Heritage on telephone (02) 9995 6914 or by e-mail: Felicity.Barry@environment.nsw.gov.au.

Yours sincerely

25/08/2017
Katrina Stankowski
Acting Manager, Listings
Heritage Division
Office of Environment & Heritage
As Delegate of the Heritage Council of NSW

NSW GOVERNMENT | Office of Environment & Heritage

Our Ref: DOC17/428839
Your Ref: SSD 7293

Ms Genevieve Seed
Senior Planning Officer
Department of Planning & Environment
GPO Box 39
Sydney NSW 2001

Dear Ms Seed

Re: Request for OEH Environmental Assessment Requirements – Hanson Construction Materials Pty Ltd Sancrox Quarry Extension, within the Port Macquarie Hasting Council Local Government Area (SSD 7293)

Thank you for your e-mail of 18 August 2017 inviting input from the Office of Environment and Heritage (OEH) for the preparation of Secretary's Environmental Assessment Requirements (SEARs) for the Sancrox Quarry Extension proposal. I appreciate the opportunity to provide advice.

The OEH notes that the proposal will be assessed as State Significant Development/Infrastructure in accordance with Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Environmental Impact Statement (EIS) SEARs provided by OEH are limited to Aboriginal cultural heritage, biodiversity, OEH estate, historic heritage, acid sulphate soils, flooding, stormwater and coastal erosion.

We also advise that the OEH SEARs, as it relates to biodiversity, have been issued with respect to the *Biodiversity Conservation Act 2016.*

The proponent should ensure that the EIS will be sufficiently comprehensive to enable unambiguous determination of the extent of the direct and indirect impact(s) of the proposal. The EIS should include an appropriate assessment of the potential impacts on biodiversity (threatened species, ecological communities, or their habitat), and Aboriginal cultural heritage. OEH considers that this information is necessary to assess an EIS for the proposal.

The full lists of OEH's standard and project specific requirements that may need to be addressed in the EIS are provided in **Attachment A** and **Attachment B** respectively. In preparing the EIS, the proponent should refer to the relevant guidance material listed in **Attachment C.**

If you have any further questions about this issue, Ms Rachel Binskin, Regional Operations Officer, Regional Operations, OEH, can be contacted on 6659 8247or at rachel.binskin@environment.nsw.gov.au.

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Federation House, Level 8, 24 Moonee Street
Coffs Harbour NSW 2450
Tel: (02) 6659 8200 Fax: (02) 6651 5356
ABN 30 841 387 271
www.environment.nsw.gov.au

Yours sincerely

7.9.17

KRISTER WAERN
A/Senior Team Leader Planning, North East Region
Regional Operations

Contact officer: RACHEL BINSKIN
6659 8247

Enclosure: Attachment A – OEH Standard Environmental Assessment Requirements, Attachment B – OEH Project Specific Requirements, and Attachment C – Guidelines Materials

Attachment A – OEH Standard Environmental Assessment Requirements (SSD 7036)

Biodiversity
1. Biodiversity impacts related to the proposed project are to be assessed in accordance with the Biodiversity Offset Scheme (BOS), and documented in a Biodiversity Development Assessment Report (BDAR) in accordance with Part 6 of the *Biodiversity Conservation Act 2016* (BC Act). The BDAR is to be prepared by a person accredited in accordance with s6.10 of the BC Act.
Aboriginal cultural heritage
2. The EIS must identify and describe the Aboriginal cultural heritage values that exist across the whole area that will be affected by the project and document these in the EIS. This may include the need for surface survey and test excavation. The identification of cultural heritage values should be guided by the *Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW* (DECCW, 2011) and consultation with OEH regional officers.
3. Where Aboriginal cultural heritage values are identified, consultation with Aboriginal people must be undertaken and documented in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW). The significance of cultural heritage values for Aboriginal people who have a cultural association with the land must be documented in the EIS.
4. Impacts on Aboriginal cultural heritage values are to be assessed and documented in the EIS. The EIS must demonstrate attempts to avoid impact upon cultural heritage values and identify any conservation outcomes. Where impacts are unavoidable, the EIS must outline measures proposed to mitigate impacts. Any objects recorded as part of the assessment must be documented and notified to OEH.
Historic heritage
5. The EIS must provide a heritage assessment including but not limited to an assessment of impacts to *State and local heritage* including conservation areas, natural heritage areas, places of Aboriginal heritage value, buildings, works, relics, gardens, landscapes, views, trees should be assessed. Where impacts to State or locally significant heritage items are identified, the assessment shall: a. outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) generally consistent with the NSW Heritage Manual (1996), b. be undertaken by a suitably qualified heritage consultant(s) (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria), c. include a statement of heritage impact for all heritage items (including significance assessment), d. consider impacts including, but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, landscape and vistas, and architectural noise treatment (as relevant), and e. where potential archaeological impacts have been identified develop an appropriate archaeological assessment methodology, including research design, to guide physical archaeological test excavations (terrestrial and maritime as relevant) and include the results of these test excavations.

Water and soils

6. The EIS must map the following features relevant to water and soils including:
   a. Acid sulfate soils (Class 1, 2, 3 or 4 on the Acid Sulfate Soil Planning Map).
   b. Rivers, streams, wetlands, estuaries (as described in s4 of the Biodiversity Assessment Method as part of the Landscape Context).
   c. Groundwater.
   d. Groundwater dependent ecosystems.
   e. Proposed intake and discharge locations.

7. The EIS must describe background conditions for any water resource likely to be affected by the project, including:
   a. Existing surface and groundwater.
   b. Hydrology, including volume, frequency and quality of discharges at proposed intake and discharge locations.
   c. Water Quality Objectives (as endorsed by the NSW Government http://www.environment.nsw.gov.au/ieo/index.htm) including groundwater as appropriate that represent the community's uses and values for the receiving waters.
   d. Indicators and trigger values/criteria for the environmental values identified at (c) in accordance with the ANZECC (2000) Guidelines for Fresh and Marine Water Quality and/or local objectives, criteria or targets endorsed by the NSW Government.

8. The EIS must assess the impacts of the project on water quality, including:
   a. The nature and degree of impact on receiving waters for both surface and groundwater, demonstrating how the project protects the Water Quality Objectives where they are currently being achieved, and contributes towards achievement of the Water Quality Objectives over time where they are currently not being achieved. This should include an assessment of the mitigating effects of proposed stormwater and wastewater management during and after construction.
   b. Identification of proposed monitoring of water quality.

9. The EIS must assess the impact of the project on hydrology, including:
   a. Water balance including quantity, quality and source.
   b. Effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas.
   c. Effects to downstream water-dependent fauna and flora including groundwater dependent ecosystems.
   d. Impacts to natural processes and functions within rivers, wetlands, estuaries and floodplains that affect river system and landscape health such as nutrient flow, aquatic connectivity and access to habitat for spawning and refuge (e.g. river benches).
   e. Changes to environmental water availability, both regulated/licensed and unregulated/rules-based sources of such water.
   f. Mitigating effects of proposed stormwater and wastewater management during and after construction on hydrological attributes such as volumes, flow rates, management methods and re-use options.
   g. Identification of proposed monitoring of hydrological attributes.

Flooding and coastal erosion

10. The EIS must map the following features relevant to flooding as described in the Floodplain Development Manual 2005 (NSW Government 2005) including:
    a. Flood prone land
    b. Flood planning area, the area below the flood planning level.
    c. Hydraulic categorisation (floodways and flood storage areas).
11. The EIS must describe flood assessment and modelling undertaken in determining the design flood levels for events, including a minimum of the 1 in 10 year, 1 in 100-year flood levels and the probable maximum flood, or an equivalent extreme event.
12. The EIS must model the effect of the proposed project (including fill) on the flood behaviour under the following scenarios:
    a. Current flood behaviour for a range of design events as identified in 8) above. The 1 in 200 and 1 in 500-year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.
13. Modelling in the EIS must consider and document:
    a. The impact on existing flood behaviour for a full range of flood events including up to the probable maximum flood.
    b. Impacts of the development on flood behaviour resulting in detrimental changes in potential flood affection of other developments or land. This may include redirection of flow, flow velocities, flood levels, hazards and hydraulic categories.
    c. Relevant provisions of the NSW Floodplain Development Manual 2005.
14. The EIS must assess the impacts on the proposed project on flood behaviour, including:
    a. Whether there will be detrimental increases in the potential flood affectation of other properties, assets and infrastructure.
    b. Consistency with Council floodplain risk management plans.
    c. Compatibility with the flood hazard of the land.
    d. Compatibility with the hydraulic functions of flow conveyance in floodways and storage in flood storage areas of the land.
    e. Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site.
    f. Whether there will be direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.
    g. Any impacts the development may have upon existing community emergency management arrangements for flooding. These matters are to be discussed with the SES and Council.
    h. Whether the proposal incorporates specific measures to manage risk to life from flood. These matters are to be discussed with the SES and Council.
    i. Emergency management, evacuation and access, and contingency measures for the development considering the full range or flood risk (based upon the probable maximum flood or an equivalent extreme flood event). These matters are to be discussed with and have the support of Council and the SES.
    j. Any impacts the development may have on the social and economic costs to the community as consequence of flooding.

Attachment B – OEH Project-specific Environmental Assessment Requirements (SSD 7036)

Biodiversity

1. The species listed below as 1(a) and (b) are to be included, as part of the 'potential' serious and irreversible impacts, on other threatened entities as part of s10.2.1.5 of the *Biodiversity Assessment Method 2017* (BAM), not listed in the *Guidance and criteria to assist a decision maker to determine a serious and irreversible*. Should one of these entities be identified during survey, the proponent is required to provide additional information in accordance with section 10.2 of the BAM.
    a. *Dendrobium melaleucaphilum* – Spider Orchid
    b. *Phaius australis* – Southern Swamp Orchid
2. The EIS is to include relevant local planning undertaken by the Port Macquarie - Hastings Council for the Greater Sancrox Area, in the context of the greater landscape to assess existing, and future habitat connectivity, especially in regards to alignment of subregional corridors, and local habitat linkages in accordance with s4.2.1.3 (d) of the BAM.

Aboriginal cultural heritage

3. The assessment of cultural heritage values must include a surface survey undertaken by a qualified archaeologist in areas with potential for subsurface Aboriginal deposits. The result of the surface survey is to inform the need for targeted test excavation to better assess the integrity, extent, distribution, nature and overall significance of the archaeological record. The results of surface surveys and test excavations are to be documented in the EIS.
4. The EIS must outline procedures to be followed if Aboriginal objects are found at any stage of the life of the proposal to formulate appropriate measures to manage unforeseen impacts.
5. The EIS must outline procedures to be followed in the event Aboriginal burials or skeletal material is uncovered during construction to formulate appropriate measures to manage the impacts to this material.

Flooding and coastal erosion

6. The EIS must consider the effects of sea level rise on all flood risks on the site under the following scenarios:
    a. Current sea level.
    b. Projected sea levels in 2050 and 2100 which have been peer-reviewed and widely accepted by scientific opinion.

Attachment C – OEH Guidance Material (SSD 7036)

Title	Web address
Relevant Legislation	
Biodiversity Conservation Act 2016	https://www.legislation.nsw.gov.au/~/view/act/2016/63/full
Coastal Management Act 2016	https://www.legislation.nsw.gov.au/~/view/act/2016/20
Commonwealth Environment Protection and Biodiversity Conservation Act 1999	http://www.austlii.edu.au/au/legis/cth/consol_act/epabca1999588/
Environmental Planning and Assessment Act 1979	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+203+1979+cd+0+N
Fisheries Management Act 1994	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+38+1994+cd+0+N
Marine Parks Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+64+1997+cd+0+N
National Parks and Wildlife Act 1974	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+80+1974+cd+0+N
Protection of the Environment Operations Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+156+1997+cd+0+N
Water Management Act 2000	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+92+2000+cd+0+N
Wilderness Act 1987	http://www.legislation.nsw.gov.au/viewtop/inforce/act+196+1987+FIRST+0+N
Biodiversity	
Biodiversity Conservation Regulation 2017	https://www.legislation.nsw.gov.au/~/view/regulation/2017/432
Biodiversity Conservation (Savings and Transitional) Regulation 2017	https://www.legislation.nsw.gov.au/~/view/regulation/2017/433
Biodiversity Assessment Method (OEH, 2017)	http://www.environment.nsw.gov.au/biodiversity/assessmentmethod.htm
Online Biodiversity Assessment Method Calculator	https://www.lmbc.nsw.gov.au/bamcalc
Serious and irreversible impact (OEH, 2017)	http://www.environment.nsw.gov.au/biodiversity/seriousirreversibleimpacts.htm
Offset Rules	http://www.environment.nsw.gov.au/biodiversity/offsetrules.htm
Fisheries NSW policies and guidelines	http://www.dpi.nsw.gov.au/fisheries/habitat/publications/policies,-guidelines-and-manuals/fish-habitat-conservation
List of national parks	http://www.environment.nsw.gov.au/NationalParks/parksearchatoz.aspx
Revocation, re-categorisation and road adjustment policy (OEH, 2012)	http://www.environment.nsw.gov.au/policies/RevocationOfLandPolicy.htm
Guidelines for developments adjoining land and water managed by the Department of Environment, Climate Change and Water (DECCW, 2010)	http://www.environment.nsw.gov.au/protectedareas/developmntadjoiningdecc.htm
Heritage	

Title	Web address
The Burra Charter (The Australia ICOMOS charter for places of cultural significance)	http://australia.icomos.org/wp-content/uploads/The-Burra-Charter-2013-Adopted-31.10.2013.pdf
Statements of Heritage Impact 2002 (HO & DUAP)	http://www.environment.nsw.gov.au/resources/heritagebranch/heritage/hmstatementsofhi.pdf
NSW Heritage Manual (DUAP) (scroll through alphabetical list to 'N')	http://www.environment.nsw.gov.au/Heritage/publications/
Aboriginal Cultural Heritage	
Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010)	http://www.environment.nsw.gov.au/resources/cultureheritage/commconsultation/09781ACHconsultreq.pdf
Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW, 2010)	http://www.environment.nsw.gov.au/resources/cultureheritage/10783FinalArchCoP.pdf
Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011)	http://www.environment.nsw.gov.au/resources/cultureheritage/20110263ACHguide.pdf
Aboriginal Site Recording Form	http://www.environment.nsw.gov.au/resources/parks/SiteCardMainV1_1.pdf
Aboriginal Site Impact Recording Form	http://www.environment.nsw.gov.au/resources/cultureheritage/120558asirf.pdf
Aboriginal Heritage Information Management System (AHIMS) Registrar	http://www.environment.nsw.gov.au/contact/AHIMSRegistrar.htm
Care Agreement Application form	http://www.environment.nsw.gov.au/resources/cultureheritage/20110914TransferObject.pdf
Water and Soils	
Acid sulphate soils	
Acid Sulfate Soils Planning Maps via Data NSW	http://data.nsw.gov.au/data/
Acid Sulfate Soils Manual (Stone et al. 1998)	http://www.environment.nsw.gov.au/resources/epa/Acid-Sulfate-Manual-1998.pdf
Acid Sulfate Soils Laboratory Methods Guidelines (Ahern et al. 2004)	http://www.environment.nsw.gov.au/resources/soils/acid-sulfate-soils-laboratory-methods-guidelines.pdf This replaces Chapter 4 of the Acid Sulfate Soils Manual above.
Flooding and Coastal Erosion	
Reforms to coastal erosion management	http://www.environment.nsw.gov.au/coasts/coastalerosionmgmt.htm
Floodplain development manual	http://www.environment.nsw.gov.au/floodplains/manual.htm
Guidelines for Preparing Coastal Zone Management Plans	Guidelines for Preparing Coastal Zone Management Plans http://www.environment.nsw.gov.au/resources/coasts/130224CZMPGuide.pdf
NSW Climate Impact Profile	http://climatechange.environment.nsw.gov.au/
Climate Change Impacts and Risk Management	Climate Change Impacts and Risk Management: A Guide for Business and Government, AGIC Guidelines for Climate Change Adaptation
Water	
Water Quality Objectives	http://www.environment.nsw.gov.au/ieo/index.htm

Title	Web address
ANZECC (2000) Guidelines for Fresh and Marine Water Quality	www.environment.gov.au/water/publications/quality/australian-and-new-zealand-guidelines-fresh-marine-water-quality-volume-1
Applying Goals for Ambient Water Quality Guidance for Operations Officers – Mixing Zones	http://deccnet/water/resources/AWQGuidance7.pdf
Approved Methods for the Sampling and Analysis of Water Pollutant in NSW (2004)	http://www.environment.nsw.gov.au/resources/legislation/approvedmethods-water.pdf

NSW RURAL FIRE SERVICE

The Secretary
NSW Planning & Environment
GPO Box 39
Sydney NSW 2001

Your Ref: SSD 7293
Our Ref: D15/2871
DA17082308907 AB

ATTENTION: Genevieve Seed

31 August 2017

Dear Ms Seed,

Request for Secretary's Environmental Assessment Requirements - Sancrox Quarry Extension

I refer to your email from the NSW Department of Planning & Environment dated 17 August 2017 seeking comment from the NSW Rural Fire Service on matters to be included in the Secretary's Environmental Assessment Requirements for the proposed Sancrox Quarry extension.

The subject land is mapped as bushfire prone land by Port Macquarie - Hastings Council. The NSW Rural Fire Service considers that the environmental assessment for the proposed development should address the following:

- the aim and objectives of 'Planning for Bushfire Protection 2006';
- identification of bush fire prone land within 140 metres of the proposed development;
- identification of potential ignition sources during construction and operation of the development;
- storage of fuels and other hazardous materials (e.g. explosives for blasting);
- stockpiling of any mulched vegetation;
- proposed bushfire protection measures for the development, including vegetation management and fire suppression capabilities;
- operational access for fire fighting appliances to the site; and
- emergency and evacuation planning.

Postal address
Records
NSW Rural Fire Service
Locked Bag 17
GRANVILLE NSW 2142

Street address
NSW Rural Fire Service
Planning and Environment Services (North)
Suite 1, 129 West High Street
COFFS HARBOUR NSW 2450

T (02) 6691 0400
F (02) 6691 0499
www.rfs.nsw.gov.au
Email: pes@rfs.nsw.gov.au

For any queries regarding this correspondence please contact Alan Bawden on 6691 0400.

Yours sincerely,

Ian Cook
Acting Manager – Planning and Environment Services North
The RFS has made getting information easier. For general information on 'Planning for Bush Fire Protection, 2006', visit the RFS web page at www.rfs.nsw.gov.au and search under 'Planning for Bush Fire Protection, 2006'.

File No: NTH12/00067/06
Your Ref: SSD_7293

The Manager
Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Attention: Genevieve Seed – Senior Planning Officer

Dear Sir / Madam,

Secretary's Environmental Assessment Requirements for SSD 7293 – Sancrox Quarry, Sancrox Road, Sancrox

I refer to your email of 17 August 2017 requesting an updated to the Secretary's Environmental Assessment Requirements (EARs) for the abovementioned state significant development.

Roles and Responsibilities

The key interests for Roads and Maritime Services are the safety and efficiency of the road network, traffic management, the integrity of infrastructure assets and the integration of land use and transport.

Port Macquarie-Hastings Council is the Roads Authority for all public roads in the subject area pursuant to Section 7 of the *Roads Act 1993* Roads and Maritime is the roads authority for freeways and can exercise road authority functions for classified roads in accordance with the Roads Act. Council is responsible setting standards, determining priorities and carrying out works on public (local) roads.

Roads and Maritime Response

Roads and Maritime requests that the Environmental Assessment be supported by a Traffic Impact Assessment (TIA) prepared by a suitably qualified person in accordance with the Austroads Guide to Traffic Management Part 12, the complementary Roads and Maritime Supplement and RTA Guide to Traffic Generating Developments. The TIA is to address the following;

- The total impact of existing and proposed development on the road network with consideration for a 10 year horizon.
- The volume and distribution of traffic generated by the proposed development.
- Intersection sight distances at key intersections along the primary haul route.
- Existing and proposed site access standards.
- Details of proposed improvements to affected intersections.
- Details of servicing and parking arrangements.

- Impact on public transport (public and school bus routes) and consideration for alternative transport modes such as walking and cycling.
- Impacts of road traffic noise and/or dust generated along the primary haul route/s.
- Consideration for Clause 16(1) of the Mining SEPP regarding;
    - Impact on school zones and residential areas.
    - Code of Conduct for haulage operators
    - Road safety assessment of key haulage route/s

  Should Council wish to condition the preparation of a Code of Conduct for haulage operators, this could include, but not be limited to;

    a. A map of the primary haulage routes highlighting critical locations.
    b. Safety initiatives for haulage through residential areas and/or school zones.
    c. An induction process for vehicle operators & regular toolbox meetings.
    d. A complaint resolution and disciplinary procedure.
    e. Any community consultation measures for peak haulage periods.

Where road safety concerns are identified at a specific location along the identified haulage route/s, Roads and Maritime suggests that the TIA be supported by a targeted Road Safety Audit undertaken by suitably qualified persons.

The current Austroads Guidelines, Australian Standards and Roads and Maritime Supplements are to be adopted for any proposed works on the classified road network.

The Developer would be required to enter into a 'Works Authorisation Deed' (WAD) with Roads and Maritime for any works deemed necessary on the classified road network. The developer would be responsible for all costs associated with the works and administration for the WAD. Further information on undertaking private developments adjacent to classified roads can be accessed at:

http://www.rms.nsw.gov.au/projects/planning-principles/index.html

Advice to the Consent Authority

Roads and Maritime highlights the Consent Authority is responsible for considering the environmental impacts of any road works which are ancillary to the development. This includes any works which form part of the proposal and/or any works deemed necessary to include as requirements in the conditions of development consent.

If you have any further enquiries regarding the above comments please contact Bill Butler, A / Manager Land Use Assessment on (02) 6640 1362 or via email at: development.northern@rms.nsw.gov.au

Yours faithfully

W.R Butler

for Liz Smith
A / Network & Safety Manager, Northern Region

Port Macquarie-Hastings Council
PO Box 84
Port Macquarie
NSW Australia 2444
DX 7415
e council@pmhc.nsw.gov.au

ABN 11 236 901 601

PORT MACQUARIE HASTINGS COUNCIL

21 August 2017

Refers to: CRM 16196/2017
Your Ref: SSD 7293
Parcel No.: 18314, 18327, 28897 & 28898

Genevieve Seed
Senior Planning Officer
GPO Box 39
SYDNEY NSW 2001
genevieve.seed@planning.nsw.gov.au

Dear Genevieve

Updated Secretary's Environmental Assessment Requirements (SEARs) for Sancrox Quarry Extension Project (SSD 7293) at Sancrox Road, Sancrox

I refer to your email to Council dated 17 August 2017 regarding the above matter.

Please be advised that Council staff have reviewed the current proposal, the SEARs issued on 19 October 2015 and the previous requirements of the other Government Departments. A summary of the key Council matters for consideration include:

- The property is largely zoned RU1 Primary Production under the Port Macquarie Hastings Local Environmental Plan 2011. However, Lot 1 DP 704890 also contains IN1 General Industrial and SP2 Special Purposes zoning. Proposal to address permissibility of the quarry and associated aspects.
- Compliance with State Environmental Planning Policy (State and Regional Development) 2011 to be outlined.
- State Environmental Planning Policy No 33 - Hazardous and Offensive Development to be considered.
- State Environmental Planning Policy No 44 – Koala Habitat Protection to be considered.
- State Environmental Planning Policy No 55 – Remediation of Land to be considered.
- State Environmental Planning Policy No 62 – Sustainable Aquaculture to be considered given proximity to Hastings River and tributaries.
- State Environmental Planning Policy No 64 – Advertising and Signage to be considered if any signage proposed (ie quarry business identification signs).
- State Environmental Planning Policy No 71 – Coastal Protection applies to part of the land and is therefore to be considered.
- State Environmental Planning Policy (Infrastructure) 2007 to be considered. In particular, Division 17, Subdivision 2 provisions.
- State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 to be considered.
- State Environmental Planning Policy (Rural Lands) 2007 to be considered.
- Proposal to have regard for the Port Macquarie Hastings Local Environmental Plan 2011 (LEP 2011).

PORT MACQUARIE OFFICE
17 Burrawan Street, Port Macquarie NSW 2444
t 02 6581 8111 f 02 6581 8123

WAUCHOPE OFFICE
49 High Street, Wauchope NSW 2446
t 02 6589 6500

LAURIETON OFFICE
9 Laurie Street, Laurieton NSW 2443
t 02 6559 9958

Parcel No.: 18314, 18327, 28897 & 28898

- Lot 2 DP 574308 contains potential acid sulphate soils and is flood prone. These aspects will need to be addressed.
- Proposal should consider consolidating all the parcels of land into one lot.
- Noise, air and vibration impacts from the quarry operations, concrete batching plant etc and associated flow on activities (ie truck movements) to be addressed. Any proposed buffers will need to be contained on the quarry site or an agreement in place with impacted neighbours.
- The applicant is to contact Council's Contribution Section to ascertain if any s94A contributions, s64 contributions and/or Voluntary Planning Agreement (VPA) is required to address impacts associated with the extension.
- Details of any staging to be included in the application.
- Details of any rehabilitation and final use to be detailed in the application.
- Confirmation on what will happen to the existing consents applying to the site, including their rehabilitation and proposed final use.
- Proposal to address potential fly rock impacts on surrounding industrial and rural residential land. Any proposed buffers will need to be contained on the quarry site or an agreement in place with impacted neighbours.
- Traffic impact assessment should be required.
- Proposal to detail any existing structures/buildings to be retained and or demolished.
- Consideration should be given to closing and obtaining all of the Crown Road that traverses the site, not just the northern section.
- Stormwater management plan required.
- All processes involved in the quarry, batching plants etc to be detailed in the EIS.
- The application is to outline the proposed water and sewer supply with any connection to Council's reticulated system requiring Council approval.
- At this stage, the Sancrox area is also being considered by Council as a potential long term urban growth area.

Should you have any questions in relation to the above, please call me on 65818538 or email clinton.tink@pmhc.nsw.gov.au.

Yours sincerely

Clinton Tink
Development Assessment Planner

APPENDIX B

Methods Statement

1 OVERVIEW

The following field surveys were conducted as part of preparation of the Biodiversity Assessment Report (BAR) for the proposed Sancrox Quarry Expansion State Significant Development. The survey methods and effort were generally in accordance with the relevant sections of the *Framework for Biodiversity Assessment* ('FBA'; OEH 2014):

- Threatened species surveys, in accordance with Section 6.6 of the FBA, as follows:
  - A targeted survey for locally occurring threatened orchid species, conducted during the flowering periods of candidate threatened orchid species by an SLR Principal Ecologist on the 16 October 2015;
  - a five-day four-night survey for threatened fauna species conducted by two SLR ecologists from 30 November – 4 December, 2015;
  - an additional threatened species survey over one-night and one day, conducted by one SLR ecologist between 14 and 15 December 2015, to meet recommended survey effort for a selection of potentially occurring threatened species;
- a plot-based full floristic survey (or 'plot/transect survey') of the Development Site, conducted by two SLR ecologists over two days, to collect site value data for vegetation condition and habitat values, according to Section 5.2 of the FBA.

Further details of the above survey techniques and survey effort are provided below.

2 ASSESSING SITE VALUE

2.1 Mapping native vegetation extent

Patches of native vegetation were identified on the site prior to field work using available regional vegetation data for the Northern Rivers catchment and for Port Macquarie-Hastings LGA and aerial imagery. Broad vegetation formations and vegetation classes were mapped across the site and their areas calculated. This mapping allowed a field survey design to be completed, and formed the starting point for identifying native vegetation types.

These patches were assessed during field surveys to ascertain the extent, type and distribution of native vegetation types within these patches. Other parts of the site, including especially those where the proposed PPUs are located, were inspected on foot or driven to determine whether additional areas of native vegetation are present. In accordance with the Biobanking Methodology (DECC 2009) "*Cleared land is land on which the native over-storey has been cleared, there is no native mid-storey, and less than 50% of the ground cover vegetation is indigenous species, or greater than 90% of the ground cover is cleared*".

Subsequent to field work the OEH (2011) vegetation mapping was reviewed. Detailed consideration was given to methods used in that mapping (eg validation effort, patch size, canopy cover) and it was determined that whilst various additional patches of native vegetation are included in that vegetation the field efforts by SLR are most reliable in determining the presence of vegetation patches across the site.

2.2 Stratifying native vegetation

Based on field survey results, vegetation types (or plant community types, PCTs) were identified by matching floristic results from plot surveys (see next section) to floristic descriptions for relevant vegetation types listed for the Northern Rivers CMA in the *NSW Vegetation Types Database* (OEH, 2012). Patches of native vegetation types were further stratified into broad condition states of 'low' condition and 'moderate to good condition' (definitions as per DECC 2009a and thereby identified as distinct vegetation zones, according to Section 5.2.2 of the FBA. Vegetation zones are mapped and described in the accompanying report.

2.3 Plot and transect surveys

A plot-based full floristic survey of the development site was undertaken according to the methods outlined in Chapter 5 of the FBA. Plot and transect surveys were conducted to gather data on 'site value' for each vegetation zone and sample the environmental variation encountered within each zone. The number of plots sampled per vegetation zone was done according to the minimum requirements of the FBA, as listed in **Table 1**.

Table 1 Plots/transects required and collected per vegetation zone

Vegetation zone name	Vegetation type name	Total area (ha)	Minimum plots reqd	Plots done
NR117_Moderate/Good	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	0.55	1	1
NR247_Moderate/Good	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	10.61	3	3
NR263_Moderate/Good	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	30.32	4	4
NR263_Moderate/Good_Poor	Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	1.37	1	1
NR247_Moderate/Good_Poor	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	0.25	1	1
	Total:	**43.10**	**10**	**10**

As listed in Table 1, the minimum number of plots/transects was completed for each vegetation zone.

The surveys were standard biobanking plot surveys (see DECC 2009 and OEH 2014) and involved

- Establishing a plot location randomly within a given vegetation zone, based on marking points randomly within each zone on a map of vegetation types. The locations of all plot/transects are shown in **Figure 8** of the BAR;
- A full floristic survey based on a 'nested' 20 m X 20 m quadrat, with all species recorded within the plot, including species name, growth form, and cover-abundance score according to the Braun-Blanquet scoring system (see Poore 1955)
- Establishing a 50 m transect through the centre of the plot and collecting data on six variables at various intervals along the transect (as listed in Table 2 of the FBA). The start point of the 50 m transect was recorded using a hand held GPS unit to allow mapping of the locations of all plot/transects;
- Establishing a 20 m X 50 m plot using the boundaries of the 20 m X 20 m plot and the 50 m transect, and recording (i) total length of fallen logs (>10 cm diameter and over 50 cm in length) and (ii) number of trees with hollows;
- Estimating the proportion of canopy trees that are regenerating within the zone.

The above data were collected using biobanking field sheets (DECC 2009b). The completed field data sheets are attached to the accompanying report in **Appendix C**.

3 THREATENED SPECIES SURVEYS

3.1 Overview

A range of threatened species have previously been recorded within the locality of the site. Section 6.6 of the FBA specifies the requirements for threatened species surveys:

- should be carried out at the appropriate time of year, as specified in the Threatened Species Profile Database;
- adopt repeatable methods
- must target all 'candidate' species credit species identified according to Section 6.5 of the FBA.
- Be conducted according to DEC (2004) guidelines for all species excluding frogs (see below); and
- For frogs, be conducted according to DECC (2009) guidelines.

Based on our search for previous records of threatened species in the Atlas of NSW Wildlife database (within 10 km of the site), we have generated a table listing threatened flora and fauna for consideration in the BAR. The table is provided in Appendix A and provides the recommended survey techniques and survey effort for each of group of threatened fauna. In identifying survey requirements for the BAR, we have relied on the following key guidelines:

- DEC (2004) Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities, for threatened species (excluding frogs) listed under the TSC Act.
- DECC (2009) Threatened species survey and assessment guidelines: field survey methods for fauna. Amphibians, for threatened frogs listed under the TSC Act.
- DEWHA survey guidelines for Australia's threatened birds, bats, frogs and mammals, for threatened fauna listed under the EPBC Act.

In the SEARs, OEH have also identified threatened species 'requiring further consideration' in the BAR, as noted above, which are the threatened plants *Melaleuca biconvexa*, *Dendrobium melaleucaphilum* and *Phaius australis*.

The aim of the surveys was to gather site data and observations to inform this *Biodiversity Assessment Report* and involved:

- inspecting areas of native vegetation to refine vegetation community mapping and conditions in accordance with the FBA (OEH 2014);
- collection of detailed floristic and habitat data within the plant community types in accordance with the requirements of the BioBanking methodology;
- Spotlighting surveys throughout bushland areas and around waterbodies to detect nocturnal fauna species
- Call playback of relevant threatened forest owls and threatened amphibian calls during nocturnal surveys.
- Infrared and motion sensing camera surveys across various woodland habitats on the site to detect ground mammals and other fauna;
- Amphibian surveys (searches and call playback as well as dipnetting for tadpoles) in all waterbodies of bushland areas and quarry area.
- Anabat monitoring and Harp trapping for microchiropteran bats, focusing on areas where bat activity would be highest;
- Arboreal hairtube surveys for arboreal mammals in woodland habitats across the site;
- Glider-tube trap surveys for arboreal mammals in woodland habitats across the site;
- Elliot trap surveys for ground mammals in woodland habitats across the site;

- Cage surveys for ground mammals;
- Dawn bird surveys, in particular to target threatened species of birds known to the locality; and
- Surveys for important fauna habitat features.

3.2 Details of Survey Techniques

3.2.1 ELLIOT TRAP SURVEYS

Elliot trap surveys were conducted throughout the Site, to target threated ground mammals. Traps were set in a variety of habitats on the site including woodland on the ridge as well as gully area. Traps were placed adjacent to favorable habitat features for ground mammals such as hollow logs or dense ground vegetation. The traps were checked each morning before or on sunrise to minimize disturbance or heat stress to any captured nocturnal mammals.

Table 2 Elliot trap surveys

Date (2015)	Survey Effort (trap Nights)	Fauna groups targeted	Threatened species targeted	Comments
30 November – 3 December (4 nights)	3 transects with 10 units	Ground mammals	Rufous Bettong, Eastern Chestnut Mouse, Common Planigale	15 traps baited with peanut butter/oats/honey; 15 traps baited with meat
Total	120 TN			

3.3 ARBOREAL HAIR TUBE SURVEYS

Arboreal hair tube traps were installed on tree trunks throughout the site, to target threatened arboreal mammals (primarily the Brush-tailed Phascogale and Squirrel glider).

Date (2015)	Survey Effort (Trap Nights)	Fauna groups targeted	Threatened species targeted	Comments
01 December-15 December	30 units x 14 nights	Arboreal mammals	Squirrel glider, Yellow-bellied glider, Brush-tailed Phascogale	Traps baited with peanut butter/oats/honey and attached to trees 3m above ground height.
Total	420 TN			

3.4 GLIDER TUBE SURVEYS

Glider tube surveys were conducted throughout the site, to target threatened arboreal mammals. Tubes were installed on tree trunks approximately 3m above ground height and were baited with a peanut butter/oats/honey mix. Tree trunks were also sprayed with molasses liquid to attract gliders. Trap locations are shown in Figure 09. All habitat types were surveyed including ridge top woodland and the gully woodland.

Table 3 Glider tube surveys

Date (2015)	Survey Effort (Trap Nights)	Fauna groups targeted	Threatened species targeted	Comments
01 December-15 December	17 units x 4 nights	Arboreal mammals	Squirrel glider, Brush-tailed Phascogale	Traps baited with peanut butter/oats/honey Tubes placed 3m above ground

				height Tree trunks sprayed with molasses/water mixture
	Total	68 TN		

3.5 CAGE TRAP SURVEYS

Cage trap surveys were conducted throughout the site, to target a range of threatened ground mammals. Priority was given to areas of the site with denser vegetation and favorable habitat features such as hollow logs. Such areas were more likely occurring in the various gullies across the site.

Table 4 Cage trap surveys

Date (2015)	Survey Effort (Trap Nights)	Fauna groups targeted	Threatened species targeted	Comments
30 November-3 December	5 units x 4 nights	Ground Mammals	Spotted-tailed Quoll, Common Planigale, Rufous Bettong, Eastern Chestnut Mouse	Traps baited with dog food and banana 2 cages set on ridge top 3 cages set in gully habitat
Total	20 TN			

3.6 INFRARED CAMERA SURVEYS

Infrared cameras were set up throughout the site to target threatened ground mammals. Cameras were installed adjacent to favorable habitat features such as hollow logs or near to evidence of ground mammal activity (burrows or scratchings). Cameras are also motion sensing which allowed constant monitoring during day and night.

Table 5 Infrared Camera surveys

Date (2015)	Survey Effort (Trap Nights)	Fauna groups targeted	Threatened species targeted	Comments
30 November-3 December	5 units x 4 nights	Ground mammals	Spotted-tailed Quoll, Common Planigale, Rufous Bettong, Eastern Chestnut Mouse	Cameras baited with dog food, banana and molasses. Installed near favourable habitat features such as hollow logs.
04– 14 December-	4 units x10 nights	As above	As above	As above
Total	60 TN			

3.7 SPOTLIGHTING

Spotlighting surveys were conducted throughout the site, to target nocturnal mammals, owls, amphibians and other nocturnal fauna. All vegetation types were surveyed and special attention was given to areas of higher habitat value. Fauna species were detected both visually and aurally. Refer to Figure xx for location of transects for spotlighting and Call Playback surveys.

Table 6 Spotlighting surveys

Date (2015)	Survey Effort (person-hours)	Survey notes	Fauna groups targeted	Threatened species targeted
30 November (8-9pm; 9.30-10pm)	4.5	3 persons surveyed western area of site	Forest Owls, arboreal mammals, ground mammals	Powerful Owl, Sooty Owl, Masked Owl, Barking Owl, Brush-tailed Phascogale, Squirrel Glider, Yellow-bellied Glider, Grey-headed Flying-fox, Koala, Common Planigale, Spotted-tailed Quoll, Eastern Chestnut Mouse and Rufous Bettong.
01 December (9.10 – 10.30pm)	2.7	2 persons surveyed ridge top and gully near quarry	Forest Owls, arboreal mammals, ground mammals	As above
02 December (10.30- 11pm)	0.5	1 person surveyed southeast area	Forest Owls, arboreal mammals, ground mammals	As above
03 December (9-10pm)	3	3 persons surveyed northern/central area and southern gully	Forest Owls, arboreal mammals, ground mammals	As above
14 December (9-9.45pm)	1.5	2 persons surveyed western area	Forest Owls, arboreal mammals, ground mammals	As above
Total	12.2			

3.8 CALL PLAYBACK

Pre-recorded calls of the Masked Owl, Powerful Owl Sooty Owl, Barking Owl, and Grass Owl were broadcast on numerous locations during the 2015 field surveys. Surveys commenced after dusk with each call being broadcast for 5 minutes followed by a two minute listening period. Ten minutes were spent listening for calls prior to and after playback. Call playback was conducted within three hours after sunset.

Table 7 Call playback surveys

Date (2015)	Survey Effort (hrs)	Calls Broadcast	Survey Area	Comments
30 November (9.30-10pm)	1.0	Powerful Owl, Sooty Owl, Masked Owl, Grass Owl, Barking Owl	Western area of site	Broadcast during final half-hour of spotlight; 2 persons observing
01 December (9-10pm)	1.0	Powerful Owl, Sooty Owl, Masked Owl, Grass Owl, Barking Owl	Central area of site	2 persons broadcast at random throughout spotlight
02 December (10.30- 11pm)	0.5	Powerful Owl, Sooty Owl, Masked Owl, Grass Owl, Barking Owl	Southeast area of site	1 person broadcasting and spotlight
03 December (9.30- 10pm)	0.5	Powerful Owl, Sooty Owl, Masked Owl, Grass Owl, Barking Owl	Central area of site	1 person broadcasting and spotlight
14 December(9.30 – 10.15)	1.5	Powerful Owl, Masked Owl, Barking Owl	Western bushland area	Broadcast during final 45 minutes of spotlight; 2 persons observing
TOTAL	**4.5 hours (5 nights)**			

3.9 STAGWATCHING

Table 8 Stagwatching

Date	Survey Effort (person-hours)	Survey notes	Fauna groups targeted	Threatened species targeted
01 December (7.40-9.10pm)	3.0	2 persons. Large grey gum and large stag near ridge	Forest owls, arboreal mammals, microchiropteran bats	Powerful Owl, Sooty Owl, Masked Owl, Barking Owl, Brush-tailed Phascogale, Squirrel Glider, Yellow-bellied Glider and microchiropteran bats.
02 December (7.30- 9pm)	3.0	2 persons. Large Blackbutt on ridge (near quarry) and large Bloodwood in western area.	As above	As above
03 December (7.30- 9 pm)	4.5	3 persons. Large Grey Gum near central disturbed area, large stag in northern area and large Grey Gum closer to Quarry.	As above	As above
14 December (7.30- 9pm)	3.0	2 persons. Large stag and large Spotted Gum, both in central northern area.	As above	As above
Total	13.5 hrs			

3.10 AMPHIBIAN SURVEYS

Diurnal and Nocturnal searches including broadcasts of pre-recorded calls of threatened amphibians including Green and Golden Bell Frog, Giant Barred Frog, Green-thighed Frog, Wallum Froglet. All waterbodies were surveyed including three large retention dams in quarry. Various soaks and depressions were also surveyed during rain periods. Tadpoles were surveyed for using dip-netting in shallow areas although due to the man-made nature of the waterbodies (farm and quarry dams) access was sometimes difficult and due to deep centres, only edges of waterbodies could be sampled.

Table 9 Amphibian surveys

Date	Survey Effort (person-hours)	Method	Surveyed Area	Species targeted	Comments
30 November (7 -8pm; 9-9.30pm)	4.5	Diurnal survey and call playback	Western farm dam	Green and Golden Bell Frog, Giant Barred Frog, Green-thighed Frog, Wallum Froglet	3 persons observing
01 December (5 - 6.45pm)	3.5	Diurnal survey and call playback	Large dams inside quarry	As above	2 persons observing
02 December(6-7pm & 9-10:30pm)	2	Call playback and dipnetting	Western farm dam	As above	2 persons observing
02 December(9-10.30pm)	3	Dipnetting, Call playback and spotlighting	central disturbed area depressions and 2 large quarry dams	As above	2 persons observing
3rd December (5:30-7:30pm)	6	Dipnetting, Call playback and	Main quarry dams.	As above	3 persons observing
3rd December (9 – 9:15pm)	0.25	Brief call playback	Soak in southern gully area	Green-thighed Frog, Wallum Froglet	1 person
14th December (6-7:30pm)	3	Diurnal searches and call playback	Two large dams in quarry and farm dam in western area	Green and Golden Bell Frog, Giant Barred Frog	2 persons observing
Total	**22.25 hrs**				

3.11 MICROCHIROPTERAN BAT SURVEYS

Harp Traps and Anabat recorders were employed to detect microchiropteran bats. Harp Traps were placed in appropriate areas for bat detection including coastal woodland and dry sclerophyll forest. Traps were left for a minimum of two nights. Anabat recorders are useful in detecting high flying microchiropteran bats that are often under sampled by bat (harp) trapping. Anabat surveys were conducted passively using three units at stationary points from dusk until dawn.

In addition to electronic monitoring, Harp traps were deployed in various locations of the site to physically catch low-flying microchiropteran bats. Harp traps were set at dusk each night in some of the small roads/trails found across the site. These trails act as 'fly ways' for bats and are more likely to be frequented during the night.

Table 10 Microchiropteran bat surveys.

Survey Type	Date (2015)	Survey (hours)	Survey effort (Detector nights)	Area Surveyed
Anabat				
	30/11-01/12	(7pm -6am)	3	3 units placed in western area of site; one on edge of farm dam
	01/12-02/12	(7pm -6am)	3	As above

	02/12-03/12	(7pm -6am)	3	One unit remain at farm dam. Two units moved to woodland areas near ridge and central disturbed area.
	03/12-04/12	(7pm -6am)	3	As above except for one unit moved to large southern dam in quarry.
	TOTAL		**12 'Detector Nights'**	
Harp Trap				
	03/12 –	6pm -5:30am	2 trap nights	One unit near western farm dam. One unit on fire trail on ridge (eastern area).
	04/12	6pm -5:30am	2 trap nights	Same as above
	TOTAL		**4 TN**	

3.12 AVIFAUNA SURVEYS

Diurnal bird surveys involved visual observation of species as well as identification of calls. Terrestrial bird surveys were conducted at dawn while aquatic bird surveys were conducted at random times of day.

In addition, bird species were also recorded on an opportunistic basis throughout all surveys.

Table 11 Avifauna surveys

Date (2015)	Survey Effort (person-hours)	Surveyed Area
01 December (5.30 -7.30am)	4	Opportunistic survey across site during trap checks at dawn. Searches for nests.
02 December (5am-7:30am)	5	Opportunistic survey across site during trap checks at dawn. Searches for nests. Active searches on ridge and in southern gully.
03 December (6am-8am)	6	Opportunistic survey across site during trap checks at dawn.
TOTAL	**15 person hours**	

3.13 KOALA SPOT ASSESSMENT TECHNIQUE

During the SLR 2015 studies, the SPOT assessment technique was conducted in all areas and habitat types of the site. Koala scats were searched for at the bases of 30 trees within each plot (10 plots were completed). Evidence of other threatened fauna was also targeted such as, Powerful Owl roost sites and michrochiropteran bat roost sites *etc*.

Table 12 Spot Assessments

Date (2015)	Survey Effort (person-hours)	Surveyed Area
02 December	6	Plots in western woodland areas (2 persons)
03 December	9	Plots in central and eastern woodland areas (3 persons)
TOTAL	**15 person hours**	

3.14 HABITAT SEARCHES

During the surveys, the subject site was thoroughly examined for the occurrence of habitat features including hollow-bearing trees, dead stags, ground logs and debris as well as suitable vegetation types. Habitat features suitable for threatened species were also targeted. The presence of old growth hollows / dead stags favorable for threatened owl species were mapped and were also targeted in Spotlighting and stagwatching surveys. Field ecologists carried out random, opportunistic log and debris searches, targeting reptiles and small mammals.

The methods by which candidate 'species credit' threatened species of potential relevance to the site were identified are described in Section 4 of the accompanying BAR. Targeted surveys for species credit species were conducted, where possible for relevant species, during the January and February field surveys described above.

3.15 Weather

Weather conditions during days of the detailed survey were hot and sunny with gentle north winds (gusty at times) and intermittent occasional rainfall events ( ).

Table 13 Weather conditions during the survey period[1]

Date (2015)	24-hr Rainfall (mm)	Humidity (%)	Max Wind (km/hr)	Temp Range (ºC)	Moon phase
Nov 30 (diurnal)	0	68	18 S	28 clear sky	_
Nov 30 (nocturnal)	0	88	11 NNE	18 - 22	77% moon waning gibbous
Dec 01 (diurnal)	0	56	NE winds strengthening throughout morning	22 – 32 Morning fog becoming hot and sunny	_
Dec 01 (nocturnal)	0.2 evening shower	76	19 NW	20 - 24	68% moon waning gibbous
Dec 02 (diurnal)	0	88	9 W	20 – 28 overcast	_
Dec 02 (nocturnal)	2 light showers continuing overnight	76	17 S	20 - 24	58% moon waning gibbous
Dec 03 (diurnal)	20	53	24 S	23 overcast	_
Dec 03 (nocturnal)	0	62	13 SSW	16 – 19 clear sky	
Dec 04 (diurnal)					
Dec 14 (diurnal)					
Dec 14 (nocturnal)	Last rain 13mm on 10/12/15	79	19 N	20 Clear sky	10% moon waxing crescent

1 Recorded at the nearest BOM weather station (Port Macquarie, approximately 6 kilometres from Sancrox)

4 REFERENCES

Cropper, SC. 1993. Management of endangered plants. CSIRO Publishing, East Melbourne.

DECC. 2009a. BioBanking Assessment Methodology and Credit Calculator Operational Manual. Department of Environment and Climate Change NSW, Sydney.

DECC. 2009b. Field data sheets for BioBanking: biobank / development site proposal package February 2009. Department of Environment and Climate Change NSW, Sydney.

OEH. 2014. Framework for Biodiversity Assessment. State of NSW and Office of Environment and Heritage, Sydney.

OEH. 2012. NSW BioMetric Vegetation Types CMA. State of NSW and Office of Environment and Heritage, Sydney.

APPENDIX C

Plot and Transect Data

No.	Species	Cover/abundance Score (see table above)
1	Carex appressa	3
2	Gahnia clarkei	4
3	Melaleuca linariifolia	3
4	Melaleuca stypheliodes	3
5	Corymbia intermedia	3
6	Lomandra longifolia	3
7	Geitonoplesium cymosum	3
8	*Cinnamomum camphora	1
9	Hibbertia scandens	2
10	Dichondra repens	2
11	Entolasia marginata	2
12	Glochid. fend. var. fend.	4
13	Echinopogon ovatus	2
14	Centella asiatica	2
15	Rubus moluc. s. trilob.	2
16	Platycerium bifurc. s. bifurc.	1
17	Pandorea pandorana	3
18	Microlaena stip. s. stip.	3
19	Phyllanthus (?) gunnii	1
20	Jagera pseudorhus	1
21	Doodia aspera	3
22	Oplismenus hirtellus	3
23	Callistemon salignus	3
24	Parsonsia straminea	2
25	Adiantum hispidulum	2
26	Smilax australis	1
27	Lophostemon confertus	4
28	Hypolaena muelleri	3
29	Euca. microcorys	3
30	Dianella caerulea	2
	Poa sieb.	2
	Glycine clandestina	2

Total species	37
Total native species	36
Total exotic species	1
% perennial native understorey cover*	80

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Viola (?) banksii 2
Myrsine variabilis 3
Euca. carnea 3
Euca. propinqua 3
Maclura cochinchinensis 2

Site value:
Transect tally table

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern Rivers		V. Pepper	01/12

Proposal ID	Proposal name	Zone ID
VZ1	Sancrox Quarry	VZ1 P1

Vegetation formation: Forested Wetlands

Vegetation class: Coastal Floodplain Wetlands

Vegetation type: PMVC_73 Flax-leaved Paper - Mixed Euc.

Condition (low or mod/good)	**Zone descriptor** (optional)	**Geographic/habitat features** (tick after printing step 2 of Credit Calculator)
Mod-good	Good	☐

Transect number VZ1 P1	Number of hits (tally)	%
Native over-storey cover (%)	225	22.5
Native mid-storey cover (%)	580	58
Native ground cover (grasses) (%)	29	58
Native ground cover (shrubs) (%)	2	4
Native ground cover (other) (%)	46	92
Exotic plant cover (%)	1	2

Transect number_____	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect number_____	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover (grasses) (%)		
Native ground cover (shrub) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect number_____	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover grasses (%)		
Native ground cover shrubs (%)		
Native ground cover other (%)		
Exotic plant cover (%)		

VZ1 P1

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ1 P1 **Date:** 01/12/15 **Recorder(s):** J. Peppe

Vegetation type: Flax-leaved Paperbark **AMG Zone** 56 **Easting/Northing:** 31.42544 / +152.81408 **Photos:**

Native over-storey species list At 10 points along the 50-m transect	Regeneration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect	Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5 10%	50	50%	1 1		5		2.5
10 10	50		4		5		6.0
15 10	60		3		5		6.5
20 10	60		*		3		4.0
25 20	70	→ 0	2		4		4.5
30 25	70		4		5		7.0
35 50	40		4		5	1	5.0
40 40	40		4		4		
45 40	70		4	1 1	5		
50 10	70		3	1 1	5		
225							
	0.75						
Total number of species = 37 Foliage cover (%) = Benchmark value (%FC) = Average crown diameter = Average foliage cover (%) = 22.5% Number of trees = Sample area = 20x50 **Whole zone** Number of trees with hollows = 0 Sample area = 20x50 Benchmark value =		Total no of species = 5 Foliage cover (%) = 50	Total no of species = 29 Foliage cover (%) = 58	Total no of species = 2 Foliage cover (%) = 1	Total no of species = 46 Foliage cover (%) = 92	Total no of species = 1 Foliage cover (%) = 2	Total (m) = 35.5 Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Field data sheets for BioBanking : Biobank site proposal package February 2009

bearing 351° slope +2°

Myrsine variabilis
Eclipta platyglossa

Site value:
Transect plot data sheet

(Start a new sheet for each vegetation zone)

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern Ri.		J. Pepper	01/12

Proposal ID	Proposal name	Zone ID
VZ1	Sancrox Quarry	VZ1 P1

Vegetation formation: Forested Wetlands / Wet Sclerophyll Forest

Vegetation class: Coastal Floodplain Wetlands

Vegetation type: PMVC 73 Flax-leaved Paperbark PCT 686

Condition (low or mod/good): Mod-good

Zone descriptor (optional):

Geographic/habitat features (tick after printing step 2 of Credit Calculator): ☐

NR117 (686) Blackbutt - Pink Bloodwood shrubby open forest

Coordinates (GPS datum GDA94:_____)

Transect / plot number	P1	2	3	4	5	6	7	8	9	10
Easting										
Northing										
Zone AMG										

Transect 10 points along 50-m transect (see transect tally table for % foliage cover variables)

Native over-storey cover (%)	22.5									
Native mid-storey cover (%)	58									
Native ground cover (grasses) (%)	58									
Native ground cover (shrubs) (%)	4									
Native ground cover (other) (%)	92									
Exotic plant cover	2									

Larger sampling area

Native plant species richness [1]	~~37~~ 36									
Number of trees with hollows [2]	0									
Over-storey regeneration [3]	0.75									
Total length of fallen logs (m) [2]	35.5									

Comments/additional conservation values (riparian areas, special features, geology, etc.):

- Southern swamp forest patch
- Cryptostylis erecta recorded on Wedge

[1] 20 x 20 m plot [2] 20 x 50 m plot [3] whole zone

Floristic datasheet – 20 m X 20 m quadrat

V2 2 P1

No.	Species	Cover/abundance Score (see table above)
1	Lepidosperma laterale	2
2	Eucalyptus sideroxylon	5
3	Corymbia maculata	4
4	Entolasia marginata	3
5	Imperata cylindrica var. major	4
6	Brunoniella pumilio	2
7	Adenostemma lavenia	3
8	Eclipta platyglossa	2
9	Lomandra hystrix	3
10	Allocasuarina torulosa	3
11	Eucalyptus globoidea	3
12	Hibbertia dentata	1
13	Bidens pilosa	2
14	Dichelachne micrantha	3
15	Hibbertia aspera	1
16	Breynia oblongifolia	1
17	Persoonia stradbrokensis	1
18	Desmodium rhytidophyllum	2
19	Polyscias sambucifolia	2
20	Dianella caerulea	2
21	Lissanthe strigosa	2
22	Dipodium variegatum	2
23	Dampiera stricta	2
24	Platylobium formosum	2
25	Lomandra longifolia	2
26	Hypoxis exilis	2
27	Cheilanthes sieberi	2
28	Panicum simile	3
29	Echinopogon ovatus	3
30	Glycine clandestina	2
	Pratia purpurascens	2
	Desmodium varians	2

Total species	35
Total native species	35
Total exotic species	
% perennial native understorey cover*	75

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Themeda triandra 2
Hardenbergia violacea 2
Corymbia intermedia 3

VZ2

Site value:
Transect plot data sheet

(Start a new sheet for each vegetation zone)

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern Ri		T. Pepper	01/12

Proposal ID	Proposal name	Zone ID
VZ2	Sancrox Quarry	VZ2

Vegetation formation Dry Sclerophyll Forests

Vegetation class Hunter-Macleay Dry Sclerophyll

Vegetation type PMVC_35 Spotted Gum Grassy Dry Forest

Condition (low or mod/good)	**Zone descriptor** (optional)	**Geographic/habitat features** (tick after printing step 2 of Credit Calculator)
Mod-good	Good	☐

Coordinates (GPS datum GDA94:_____)

Transect / plot number	P1	P2	P3	4	5	6	7	8	9	10
Easting										
Northing										
Zone AMG										

Transect 10 points along 50-m transect (see transect tally table for % foliage cover variables)

Native over-storey cover (%)	25.5	28	18							
Native mid-storey cover (%)	5.5	6.5	3.5							
Native ground cover (grasses) (%)	70	84	68							
Native ground cover (shrubs) (%)	2	4	4							
Native ground cover (other) (%)	48	52	32							
Exotic plant cover	0	0	0							

Larger sampling area

Native plant species richness [1]	35	32	35							
Number of trees with hollows [2]	0	0	0							
Over-storey regeneration [3]	1.0	0.5	0.5							
Total length of fallen logs (m) [2]	78	64	112							

Comments/additional conservation values (riparian areas, special features, geology, etc.):

[1] 20 x 20 m plot [2] 20 x 50 m plot [3] whole zone

VZ2P1

[Tallied] JP 01/12

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ2P1 **Date:** 30/11 **Recorder(s):** A. Pepper

Vegetation type: Spotted Gum **AMG Zone** 56 **Easting/Northing:** -31.43471 / +152.81526 **Photos:**

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect	Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5 30		30	2		2		9
10 5		0	3		3		1.5
15 30		0	1		1		25
20 25		25	5		5		1.3
25 40		0	5		2		6
30 35		0	4		3		3.5
35 25		0	5		2		7
40 20		0	2		1		1.0
45 25		0	4	1	4		1.0
50 20		6	4		1		1.5
255							1.0
	1.0	55					8.5
Total number of species =							
Foliage cover (%) =							
Benchmark value (%FC) =							
Average crown diameter =							
Average foliage cover (%) = 25.5							
Number of trees =							
Sample area = 20x50							
Whole zone							
Number of trees with hollows = 0							
Sample area = 20x50		Total no of species = 55	Total no of species = 35	Total no of species = 1	Total no of species = 24	Total no of species = 0	Total (m) = 78
Benchmark value =		Foliage cover (%) = 5.5	Foliage cover (%) = 70	Foliage cover (%) = 2	Foliage cover (%) = 48	Foliage cover (%) = 0	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

bearing 295° slope - 7.5°

VZ2P2

[Rolled] 30 01/12

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ2P2 **Date:** 30.11.15 **Recorder(s):** J. Pepper

Vegetation type: Spotted Gum **AMG Zone** 56 **Easting/Northing:** -31.43585° / +152.81419 **Photos:**

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect	Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
0 25		20	1 5 / 1 6	1	1 / 1		25
5 10		30	1 / 1 6		1 / 1		6
10 30		0	1 / 1 5		1 /		0
15 35		0	1 / 1 5 / 1 / 1 6		1 /		3
20 50		0	1 / 1 6 / 1 / 5		1 / 1		3.5
25 55		6	1 / 1		1 / 1		4
30 50		0	1 / 1				3
35 60		0	1 / 1				1.5
40 0		35	1 / 1		1 / 1		12
45 6		0	1 / 1				
50			1 / 1		1 /		
280	0.5	65	1 / 1	1	1		
Total number of species =			1 / 1		1		
Foliage cover (%) =			1 / 1		1		
Benchmark value (%FC) =			1 / 1		1 / 1		
Average crown diameter =			1 / 1		1 / 1		
Average foliage cover (%) = 28.0			1 / 1		1 / 1		
Number of trees =			1 / 1		1 / 1		
Sample area = 20 x 50 = 1000 m²			1 / 1		1 / 1		
Whole zone			1 / 1		1 / 1		
Number of trees with hollows = 0			1 / 1		1 / 1		
Sample area = 20x50m			1 / 1		1 / 1		
Benchmark value =			1 / 1 1 1 1		1 / 1		
		Total no of species = 65	Total no of species = 42	Total no of species = 2	Total no of species = 26	Total no of species = 0	Total (m) = 64
		Foliage cover (%) = 6.5	Foliage cover (%) = 84	Foliage cover (%) = 4	Foliage cover (%) = 52	Foliage cover (%) = 0	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Slope 7° bearing 304°

VZ2P3

Transect plot worksheet

[Tallied] OP 01/12

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ2P3 **Date:** 01/12 **Recorder(s):** J. Pepper

Vegetation type: Spotted Gum **AMG Zone** 56 **Easting/Northing:** -31.43849/+150.81654 **Photos:**

Native over-storey species list At 10 points along the 50-m transect		Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect		**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect		**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5	10		1 6	1 1 1 1	4	1	1 1	2		3.
10	30		0	1 1 1 1 1	5					15
15	10		0	1 1 1 1	4	1				1.0
20	25		0	1 1 1 1 1	5		1 1	2		10.0
25	25		0	1 1 1	3		1 1	2		4,5
30	5		0				1 1	2		3.5
35	5		0	1 1 1	3		1 1	2		3.0
40	20		35	1 1 1 1	4		1 1 1	3		10.0
45	25		0	1 1 1 1	4		1	1		10.0
50	25		0	1 1	2		1 1	2		14.0
	180	0.5								18.0
										5.0
										5.0
										4.0
										1.0
										4.0

Total number of species =
Foliage cover (%) =
Benchmark value (%FC) =
Average crown diameter =
Average foliage cover (%) = 18%
Number of trees =
Sample area = 20 x 50

Whole zone
Number of trees with hollows = 0
Sample area = 20x50
Benchmark value =

Total no of species = 35	Total no of species = 34	Total no of species = 2	Total no of species = 16	Total no of species = 0	Total (m) = 112
Foliage cover (%) = 3.5	Foliage cover (%) = 68	Foliage cover (%) = 4	Foliage cover (%) = 22	Foliage cover (%) = 0	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

bearing 350° slope + 5°

Site value:
Transect tally table

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern R		T. Peppe	01/12

Proposal ID	Proposal name	Zone ID
VZ2	Sancrox Quarry	VZ2

Vegetation formation Dry Sclerophyll Forests

Vegetation class Hunter_Macleay Dry Sclerophyll

Vegetation type PMVC_35 Spotted Gum Grassy Dry Forest

Condition (low or mod/good)	**Zone descriptor** (optional)	**Geographic/habitat features** (tick after printing step 2 of Credit Calculator)
Mod-good	Good	☐

Transect number VZ2 P1	Number of hits (tally)	%
Native over-storey cover (%)	255	25.5
Native mid-storey cover (%)	55	5.5
Native ground cover (grasses) (%)	35	70
Native ground cover (shrubs) (%)	1	2
Native ground cover (other) (%)	24	48
Exotic plant cover (%)	0	0

Transect number VZ2 P2	Number of hits (tally)	%
Native over-storey cover (%)	280	28
Native mid-storey cover (%)	65	6.5
Native ground cover (grasses) (%)	42	84
Native ground cover (shrubs) (%)	2	4
Native ground cover (other) (%)	26	52
Exotic plant cover (%)	0	0

Transect number VZ2 P3	Number of hits (tally)	%
Native over-storey cover (%)	180	18
Native mid-storey cover (%)	35	3.5
Native ground cover (grasses) (%)	34	68
Native ground cover (shrub) (%)	2	4
Native ground cover (other) (%)	16	32
Exotic plant cover (%)	0	0

Transect number_____	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover grasses (%)		
Native ground cover shrubs (%)		
Native ground cover other (%)		
Exotic plant cover (%)		

Floristic datasheet – 20 m X 20 m quadrat

V2 2 P 2

No.	Species	Cover/abundance Score (see table above)
1	Brunon. pumilio	2
2	Imperata cyl. var. maj.	3
3	Adiantum aethiopic.	2
4	Oplismenus imbecil	3
5	Entolasia stricta	2
6	Entolasia marginata	2
7	Oxalis perennans	2
8	Glycine clandestina	2
9	Desmodium rhytidoph.	2
10	Dianella caerulea	2
11	Corymbia maculata	4
12	Allocasuarina torulosa	3
13	Adenostemma lavenia	2
14	Breynia oblongifolia	2
15	Hydrocotyl pedunculara	3
16	Pandorea Pandorana	3
17	Hibbertia aspera	2
18	Echinopogon ovatus	2
19	Hypotis exilis	2
20	* Paspalum urvillei	2
21	Platylobium formosum	2
22	Eucalyptus globoidea	3
23	Acacia floribunda	1
24	* Conyza bonariensis	2
25	Polyscias sambucif.	3
26	Eucalyptus acmenoides	3
27	Pratia purpurascens	2
28	Poa sieberiana	2
29	Hardenbergia violacea	2
30	Lophostemon confertus	3
	Glochid. ferdin. var. ferdin.	1
	Calotis (?) dentex	2

Total species	34
Total native species	32
Total exotic species	2
% perennial native understorey cover*	65

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Melichrus urceolatus 1
Billardiera scandens 2

Floristic datasheet – 20 m X 20 m quadrat

VZ ~~3~~ ~~2~~ P2b

No.	Species	Cover/abundance Score (see table above)
1	Corymbia intermedia	3
2	Allocasuarina torulosa	3
3	Alphitonia excelsa	1
4	Parsonsia straminea	1
5	Rubus moluca. tril.	3
6	Themeda triandra	3
7	Hibbertia scandens	2
8	Polyscias sambuc.	3
9	Imperata cyl. var. major	4
10	Breynia oblongif.	2
11	Euc. acmenoides	3
12	Euc. propinqua	3
13	Euc. carnea	3
14	Dianella caerulea	3
15	Euc. siderophloia	4
16	Oplismenus aemulus	3
17	Brunoniella pumil.	2
18	Desmodium rhytidophyllum	2
19	Allocas. torulosa	2
20	Entolasia marginata	3
21	Pandorea pandorana	2
22	Pimelea ligustrina	2
23	Desmodium varians	2
24	Hydrocotyle pedicellata	2
25	Geitonopl. cym.	2
26	Eustrephus latif.	2
27	Bidens pilosa	2
28	Paspalum orbiculare	2
29	Cheilanthes sieberi subsp sie	1
30	Glycine clandestina	2
	Adenostemma lavenia	2
	Oplismenus imbecillis	3

Total species	35
Total native species	35
Total exotic species	
% perennial native understorey cover*	85

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Cassytha glab.	1
Hardenbergia violac.	1
Callistemon salignus	1

Floristic datasheet – 20 m X 20 m quadrat

VZ3P1

No.	Species	Cover/abundance Score (see table above)
1	Centella asiatica	3
2	Carex appressa	3
3	Microlaena stip. var. stip.	4
4	Hydrocotyle peduncularis	3
5	Entolasia marginata	2
6	Oplismenus undulatifolius	2
7	Oxalis perennans	2
8	Echinopogon ovatus	3
9	Oplismenus imbecillis	3
10	Callistemon salignus	4
11	Glochidion ferd. var. ferd.	3
12	Allocasuarina littoralis	4
13	Melaleuca linariifolia	3
14	Viola hederacea	3
15	Eucalyptus globoidea	3
16	Corymbia gummifera	3
17	Alphitonia excelsa	2
18	Pteridium esculentum	2
19	Gahnia clarkei	2
20	Breynia oblongifolia	2
21	Lomandra longifolia	2
22	Hibbertia scandens	3
23	Pittosporum undulatum	2
24	Dichondra repens	3
25	Eucalyptus microcorys	3
26	Billardiera scandens	2
27	Eucalyptus sideroxylon	3
28	Glycine clandestina	2
29	*Cinnamomum camphora	2
30	Lysanthe strigosa	2
	Pandorea pandorana	2
	Imperata cylind. var. major	3

Total species	33
Total native species	32
Total exotic species	1
% perennial native understorey cover*	80

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Cassytha glabra 2

VZ3P1

[data tallied] JP 01/12

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ3P1 **Date:** 30.11.15 **Recorder(s):** J. Pepper

Vegetation type: White Stringy bark **AMG Zone** 56 **Easting/Northing:** -31.43494 / +152.81037 **Photos:**

Native over-storey species list At 10 points along the 50-m transect		Regen-eration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect	Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5	0		35	5		5		8
10	10		5	4	1	5		27
15	30		10	5		4		14
20	35		0	4		4		2.5
25	40		0	4	1	4		4
30	30		0	5	3	4		13
35	20		0	5		3		6
40	25		0	5		5		2.5
45	30		0	4		2		2
50	30		5	5		2		2
	240/10							3
	= 24%	0.25						4
								6
								15

Total number of species = 34
Foliage cover (%) = 24%
Benchmark value (%FC) =
Average crown diameter = -
Average foliage cover (%) = 24%
Number of trees =
Sample area = 20 x 50

Whole zone
Number of trees with hollows = 0
Sample area = 20x50
Benchmark value =

Total no of species = 55	Total no of species = 46	Total no of ~~species~~ hits = 5	Total no of species = 38	Total no of species = 0 / Total (m) = 104
Foliage cover (%) = 5.5	Foliage cover (%) = 92	Foliage cover (%) = 10	Foliage cover (%) = 72	Foliage cover (%) = 0 / Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

Field data sheets for BioBanking : Biobank site proposal package February 2009

bearing 168° slope +5°

VZ3P2

Transect plot worksheet

Flatland JP 01/12

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ3P2 **Date:** 30/11 **Recorder(s):** J Peppe

Vegetation type: White Stringybark **AMG Zone** 56 **Easting/Northing:** -31.43482 / +152.81595 **Photos:**

Native over-storey species list At 10 points along the 50-m transect		Regeneration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect	Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5	0		5	5	1	3		14
10	80		70	3	2	2		17
15	40		0	4	1			20
20	50		50	5	2	2		3
25	20		0	4	1	4		9
30	0		0	5		4		23
35	25		35	4		1		91
40	0		50	1		5		
45	0		70	4		3		
50	0		40	5	1	5		
	185							
		1.0						

Total number of species =
Foliage cover (%) = 18.5
Benchmark value (%FC) =
Average crown diameter =
Average foliage cover (%) = 18.5%
Number of trees =
Sample area = 20 x 50

Whole zone
Number of trees with hollows = 1
Sample area = 20x50
Benchmark value =

Total no of species = 32	Total no of species = 40	Total no of species = 8	Total no of species = 29	Total no of species = 0	Total (m) = 81
Foliage cover (%) = 32%	Foliage cover (%) = 80	Foliage cover (%) = 16	Foliage cover (%) = 58	Foliage cover (%) = 0	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

bearing 20° Slope -12°

VZ3P3

[tallied 30/11]

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ3P3 **Date:** 30/11 **Recorder(s):** J. Pepper

Vegetation type: White Stringybark **AMG Zone** 56 **Easting/Northing:** -31.43793 / +152.81008 **Photos:**

Native over-storey species list At 10 points along the 50-m transect		Regen-eration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect		Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect		Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5	30		0	1	1		1	1		1.5
10	0		0	1 1 1 1	4		1 1	2		3.5
15	25		0	1 1 1 1 1	5		1 1 1 1 1	5		0.5
20	25		0	1 1 1 1 1	5		1 1 1 1 1	5		11
25	50		0	1 1 1 1	4		1 1 1	3		5
30	30		0	1 1 1 1 1	5	1	1 1	2		1
35	10		20	1 1 1 1 1	5	1	1	1		13
40	25		0	1 1 1	3		1 1 1	3		3
45	10		0	1 1 1 1 1	5		1 1 1	3		3
50	0		0	1 1 1	3		1	1		3
										3.5
		0.5								10
										3
										6
										8.5
										5
										8
										1
										10
Total number of species =										
Foliage cover (%) =										
Benchmark value (%FC) =										
Average crown diameter =										
Average foliage cover (%) =										
Number of trees =										
Sample area = 20x50										
Whole zone										
Number of trees with hollows = 1.0										
Sample area = 20x50										
Benchmark value =			Total no of species =	Total no of species = 40		Total no of species = 2	Total no of species = 26		Total no of species = 0	Total (m) = 98.5
			Foliage cover (%) =	Foliage cover (%) = 80%		Foliage cover (%) = 4	Foliage cover (%) = 52		Foliage cover (%) = 6	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

bearing 187° Slope + 3°

VZ3P4

[tallied] TP 01/12

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ3P4 **Date:** 01/12 **Recorder(s):** J. Pepper

Vegetation type: White Stringybark **AMG Zone** 56 **Easting/Northing:** -31.43889 / +152.81824 **Photos:**

Native over-storey species list At 10 points along the 50-m transect		Regen-eration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect	Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5	40		0	5		3		3.0
10	30		30	5				10.6
15	10		50	3		3		5.0
20	10		5	3		5		
25	50		10			3		5.0
30	30		40	3		3		
35	40		30	5		1		
40	30		50	5		3		
45	10		0			2		
50	60		50	1		3		
	310	1.0						

Total number of species = 30
Foliage cover (%) =
Benchmark value (%FC) =
Average crown diameter =
Average foliage cover (%) = 31%
Number of trees =
Sample area = 20x50

Whole zone
Number of trees with hollows = 0
Sample area = 20x50
Benchmark value =

Total no of species = 265	Total no of species = 30	Total no of species = 0	Total no of species = 26	Total no of species = 0	Total (m) = 23
Foliage cover (%) = 26.5	Foliage cover (%) = 60	Foliage cover (%) = 0	Foliage cover (%) = 52	Foliage cover (%) = 0	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

bearing 136° slope − 3°

added rule 0cm ... 10cm VZ3P5

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** VZ3P2 **Date:** 30/11/15 **Recorder(s):** J Pepper

Vegetation type: White Stringybark/Tall **AMG Zone** 56 **Easting/Northing:** -31.43566 / +152.81531 **Photos:**

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5 · 40		25	//// 4		/// 3		16
10 · 5		50	/ 1		// 2		25
15 · 30		0	/// 3		//// 5		4
20 · 60		0	//// 4		/// 3		11
25 · 20		0	//// 4		// 2		13
30 · 10		0	//// 4	/	//// 4		12
35 · 70		0	///// 5		// 2		4
40 · 50		0	//// 4		/ 1		4
45 · 50		0	///// 5	/			6
50 · 30		0	///// 5				3
365							
	1.0						

Total number of species =
Foliage cover (%) = 36.5
Benchmark value (%FC) =
Average crown diameter =
Average foliage cover (%) = 36.5
Number of trees =
Sample area = 20x50 m

Whole zone
Number of trees with hollows = 0
Sample area = 20x50m
Benchmark value =

Total no of species = 35	Total no of species = 39	Total no of species = 2	Total no of species = 22	Total no of species = 0	Total (m) = 91
Foliage cover (%) = 7.5	Foliage cover (%) = 28	Foliage cover (%) = 4	Foliage cover (%) = 44	Foliage cover (%) = 0	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

slope 6° down 18° bearing

Site value:
Transect tally table

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern Rivers		J. Pepper	30. 11. 15

Proposal ID	Proposal name	Zone ID
VZ3	Sancrox Quarry	VZ3

Vegetation formation: Dry Sclerophyll Forest (Grassy)

Vegetation class: Hunter Macleay Dry Sclerophyll Forest s

Vegetation type: White Stringybark

Condition (low or mod/good)	Zone descriptor (optional)	Geographic/habitat features (tick after printing step 2 of Credit Calculator)
Mod- good	good	☐

Transect number VZ3P3	Number of hits (tally)	%
Native over-storey cover (%)	(30+25+25+50+30+10+25+10)	20.5
Native mid-storey cover (%)	20%	2
Native ground cover (grasses) (%)	1+4+5.1 5+4+5+3+5+3	80
Native ground cover (shrubs) (%)	2	4
Native ground cover (other) (%)	1+2+5+5+3+2+1+3+3.1	52
Exotic plant cover (%)	0	0

Transect number VZ3 P5	Number of hits (tally)	%
Native over-storey cover (%)	40+5+30+60+20+10+70+50+50+30	365
Native mid-storey cover (%)	(25+50)/10	7.5
Native ground cover (grasses) (%)	39	78
Native ground cover (shrubs) (%)	2	4
Native ground cover (other) (%)	22	44
Exotic plant cover (%)	0	0

Transect number VZ3P1	Number of hits (tally)	%
Native over-storey cover (%)	240/10	24
Native mid-storey cover (%)	55/10	5.5
Native ground cover (grasses) (%)	46	92
Native ground cover (shrub) (%)	5	10
Native ground cover (other) (%)	38	72
Exotic plant cover (%)	0	0

Transect number VZ3P2	Number of hits (tally)	%
Native over-storey cover (%)	185	18.5
Native mid-storey cover (%)	320	32
Native ground cover grasses (%)	40	80
Native ground cover shrubs (%)	8	16
Native ground cover other (%)	29	58
Exotic plant cover (%)	0	0

VZ3

Transect number VZ3P4	Number of hits (tally)	%
Native over-storey cover (%)	310	31
Native mid-storey cover (%)	265	265
Native ground cover (grasses) (%)	30	60
Native ground cover (shrubs) (%)	0	0
Native ground cover (other) (%)	26	52
Exotic plant cover (%)	0	0

Transect number______________	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect number______________	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect number______________	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect number______________	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

Transect number______________	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-storey cover (%)		
Native ground cover (grasses) (%)		
Native ground cover (shrubs) (%)		
Native ground cover (other) (%)		
Exotic plant cover (%)		

VZ3

Site value:
Transect plot data sheet

(Start a new sheet for each vegetation zone)

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern Rivers		J. Pepper	30.11.15

Proposal ID	Proposal name	Zone ID
	Sancrox Quarry	VZ3

Vegetation formation: Dry Sclerophyll Forest (Grassy)

Vegetation class: Hunter-Macleay Dry Sclerophyll Forests

Vegetation type: White Stringybark

Condition (low or mod/good)	Zone descriptor (optional)	Geographic/habitat features (tick after printing step 2 of Credit Calculator)
Mod-good	good	☐

Coordinates (GPS datum GDA94:_____)

Transect / plot number	1 P3	2 P5	3 P1	4 P2	5 P4	6	7	8	9	10
Easting										
Northing										
Zone AMG	56	56	56	56	56					

Transect 10 points along 50-m transect (see transect tally table for % foliage cover variables)

Native over-storey cover (%)	20.5	36.5	24	18.5	31					
Native mid-storey cover (%)	2	7.5	5.5	32	26.5					
Native ground cover (grasses) (%)	80	78	92	80	60					
Native ground cover (shrubs) (%)	4	4	10	16	0					
Native ground cover (other) (%)	52	44	72	58	52					
Exotic plant cover	0	0	0	0	0					

Larger sampling area

Copy →

Native plant species richness [1]	30	35	32	33	29					
Number of trees with hollows [2]	1	0	1	1	6					
Over-storey regeneration [3]	0.5	1.0	0.25	1.0	1.0					
Total length of fallen logs (m) [2]	98.5	97	104	81	23					

Comments/additional conservation values (riparian areas, special features, geology, etc.):

[1] 20 x 20 m plot [2] 20 x 50 m plot [3] whole zone

Site value:
Transect tally table

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern Rivers		J. Pepper	30. 11. 15

Proposal ID	Proposal name	Zone ID
VZ3	Sancrox Quarry	VZ3

Vegetation formation Dry Sclerophyll Forest (Grassy

Vegetation class Hunter Macleay Dry Sclerophyll Forest s

Vegetation type White Stringybark

Condition (low or mod/good)	Zone descriptor (optional)	Geographic/habitat features (tick after printing step 2 of Credit Calculator)
Mod- good	good	☐

Transect number VZ3P3	Number of hits (tally)	%
Native over-storey cover (%)	(30+25+25+50+30+10+25+10)	20.5
Native mid-storey cover (%)	20%	2
Native ground cover (grasses) (%)	1+4+5+5+4+5+5+2+5+3	80
Native ground cover (shrubs) (%)	2	4
Native ground cover (other) (%)	1+2+5+5+3+2+1+3+3+1	52
Exotic plant cover (%)	0	0

Transect number VZ3 P5	Number of hits (tally)	%
Native over-storey cover (%)	40+5+30+60+20+10+70+50+50+30	365
Native mid-storey cover (%)	(25+50)/10	7.5
Native ground cover (grasses) (%)	39	78
Native ground cover (shrubs) (%)	2	4
Native ground cover (other) (%)	22	44
Exotic plant cover (%)	0	0

Transect number VZ3P1	Number of hits (tally)	%
Native over-storey cover (%)	240/10	24
Native mid-storey cover (%)	55/10	5.5
Native ground cover (grasses) (%)	46	92
Native ground cover (shrub) (%)	5	10
Native ground cover (other) (%)	38	72
Exotic plant cover (%)	0	0

Transect number VZ3P2	Number of hits (tally)	%
Native over-storey cover (%)	185	18.5
Native mid-storey cover (%)	320	32
Native ground cover grasses (%)	40	80
Native ground cover shrubs (%)	8	16
Native ground cover other (%)	29	58
Exotic plant cover (%)	0	0

Floristic datasheet – 20 m X 20 m quadrat

V23P2

No.	Species	Cover/abundance Score (see table above)
1	Veronica calycina	3
2	Echinopogon ovatus	2
3	Dichondra repens	3
4	Lomandra hystrix	2
5	Melichrus urceol.	2
6	Pandorea pandorana	2
7	Imperata cylindrica v. m.	4
8	Desmodium rhytidop.	2
9	Oxalis perennans	2
10	Hardenbergia violacea	2
11	Pratia purpurascens	2
12	Lomandra longifolia	3
13	Adenostemma [illegible]	2
14	Dianella caerulea	2
15	Capparis clematidea	2
16	Glycine clandestina	2
17	Calotis (?) dentex	2
18	Brunoniella pumilio	2
19	Allocasuarina torulosa	3
20	Euca. sideroph.	4
21	Entolasia marginata	3
22	Oplismenus aemulus	3
23	Eustrephus latifolius	2
24	Geitonoplesium cymosum	2
25	Desmodium varians	3
26	Euca. propinqua	3
27	Themeda triandra	2
28	Cassinia (?) uncata	2
29	Euca. acmenoides	4
30	* Lantana camara	1
	Allocas. littoralis	2
	Polyscias sambucif.	2

Total species	34
Total native species	1
Total exotic species	33
% perennial native understorey cover*	75

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Rytidosperma (?) longifolium 2
Aphanopetalum resinosum 1

Floristic datasheet – 20 m X 20 m quadrat

V23 P3

No.	Species	Cover/abundance Score (see table above)
1	Alphitonia excelsa	2
2	Euca. miaroc.	3
3	Eucca. acmenoid.	4
4	Euca. globoidea	4
5	Centella asiatica	3
6	Micrel. styp. var. styp.	3
7	Cyperus umbrecilla	3
8	Lomandra longifolia	3
9	Imperata cylind. v. maj.	3
10	Euca. propinqua	4
11	Sonnantha gimilis	2
12	Paspalum orbiculan	2
13	Oxalis perennan	2
14	Poreysia oblongifolia	2
15	Oplismenus aemulus	3
16	Melaleuca linariifolia	3
17	Acacia floribunda	3
18	Melichrus urceolatus	2
19	Echinopogon ovatus	2
20	Oplismenus imbecillis.	2
21	Glochidion ferd. var ferd.	2
22	Entolasia marginata	2
23	Hibbertia scandens	2
24	Brunoniella pumilu	2
25	Hydrocotyle pedunculat.	2
26	Cheilanthes sieberi ssp sieb.	2
27	Adenostemma lav.	2
28	Panicum simile	2
29	Entolasia stricta	2
30	Arthropodium minus	2

Total species	30
Total native species	30
Total exotic species	
% perennial native understorey cover*	85

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Floristic datasheet – 20 m X 20 m quadrat

V23 P4

No.	Species	Cover/abundance Score (see table above)
1	* Solanum mauritianum	2
2	* Lantana camara	3
3	* Paspalum urvillei	2
4	* Passiflora edulis	1
5	Solanum (?) prinophyllum	2
6	Euca. microcorys	4
7	Allocas. torulosa	3
8	Rubus molucc. tril.	2
9	Calochlaena dubia	3
10	Acacia floribunda	2
11	Gahnia clarkei	2
12	Parsonsia straminea	2
13	Persoonia stradbrokensis	2
14	Desmodium varians	2
15	Microlaena stipoides v. stip.	3
16	Oplismenus imbecillis	3
17	Adenostem. lav.	2
18	Pratia purpurascens	2 2
19	Hydrocotyle peduncularis	2 2
20	Lepidosperma laterale	2
21	Poa sieberiana	3
22	Echinopogon ovatus	2
23	Entolasia marginata	3
24	Desmodium rhytidophyllum	2
25	Euca. siderophloia	3
26	Corymbia intermedia	4
27	Lomandra longifolia	2
28	Platylobium formosum	2
29	Euca. globoidea	3
30	Cordyline stricta	2
	Brunoniella pumilio	2

Lomandra hystrix 2

Total species	33
Total native species	4
Total exotic species	29
% perennial native understorey cover*	75

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Imperata cylind. v. maj. 2

V4/V4

Floristic datasheet – 20 m X 20 m quadrat

VZ ~~31~~ P2b

No.	Species	Cover/abundance Score (see table above)
1	Corymbia intermedia	3
2	Allocasuarina torulosa	3
3	Alphitonia excelsa	1
4	Parsonsia straminea	1
5	Rubus moluccanus tril.	3
6	Themeda triandra	3
7	Hibbertia scandens	2
8	Polyscias sambuc.	3
9	Imperata cyl. var. major	4
10	Breynia oblongif.	2
11	Euc. acmenoides	3
12	Euc. propinqua	3
13	Euc. carnea	3
14	Dianella caerulea	3
15	Euc. siderophloia	4
16	Oplismenus aemulus	3
17	Brunoniella pumil.	2
18	Desmodium rhytidophyllum	2
19	Allocas. torulosa	2
20	Entolasia marginata	3
21	Pandorea pandorana	2
22	Pimelea ligustrina	2
23	Desmodium varians	2
24	Hydrocotyle pedicellata	2
25	Geitonopl. cym.	2
26	Eustrephus latif.	2
27	Bidens pilosa	2
28	Paspalum orbiculare	2
29	Cheilanthes sieberi subsp sie	1
30	Glycine clandestina	2
	Adenostemma lavenia	2
	Oplismenus imbecillis	3

Total species	35
Total native species	35
Total exotic species	
% perennial native understorey cover*	85

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Cassytha glab.	1
Hardenbergia violac.	1
Callistemon salignus	1

Floristic datasheet – 20 m X 20 m quadrat

V2 4 (old quarry)

No.	Species	Cover/abundance Score (see table above)
1	*Andropogon virginicus	4
2	Euca. globoidea	3
3	Euca. carnea	3
4	Entdasia stricta	2
5	Platylobium formosum	2
6	Hardenbergia violacea	2
7	Daviesia ulicifolia	2
8	Dodonaea viscosa	1
9	Calotis (?) lappulacea	2
10	Melichrus urceolatus	2
11	Dianella caerulea	2
12	Desmodium rhytidophyllum	2
13	Entolasia marginata	2
14	*Gomphocarpus pinnatum	1
15	Eucalyptus propinqua	1
16	*Cyperus eragrostis	2
17	Cyperus umbellifer	2
18	Juncus usitatus	3
19	Schoenus apogon	2
20	Allocasuarina littoralis	2
21	Echinopogon ovatus	2
22	Phyllanthus lanuginosus	2
23	*Paspalum urvillei	3
24	Cassinia (?) uncata	1
25		
26		
27		
28		
29		
30		

Total species	24
Total native species	21
Total exotic species	3
% perennial native understorey cover*	15

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank **Proposal ID:** V2 4 **Date:** 1/12/15 **Recorder(s):** G. L.

Vegetation type: Quarry - regen **AMG Zone** _____ **Easting/Northing:** _____ **Photos:** _____

Native over-storey species list At 10 points along the 50-m transect	Regen-eration (√) (zone)	**Native mid-storey species list** (>1m to <over-storey) At 10 points along the 50-m transect	**Native ground cover (grasses) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (shrubs) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Native ground cover (other) species list** (ground stratum <1m) At 50 points along the 50-m transect	**Exotic plants species list** At 50 points along the 50-m transect	**Fallen logs** (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5 15		10	II 2	0	I I	I 1	
10 10		5	IIII 4	0	0	II 2	
15 5		0	~~IIII~~ 5	I 1	I 1	~~IIII~~ 5	
20 0		0	II 2	0	II 2	~~IIII~~ 5	
25 0		10	IIII 4	0	I 1	II 2	
30 10		10	III 3	I 1	0	III 3	
35 0		0	II 2	0	I 1	0	
40 0		0	IIII 4	II 2	III 3	I 1	
45 5		0	III 3	0	I 1	I 1	
50 10		0	II 2	0	I 1	III 3	1.5
55	2.0						

Total number of species =							
Foliage cover (%) =							
Benchmark value (%FC) =							
Average crown diameter =							
Average foliage cover (%) = 5.5							
Number of trees =							
Sample area = 20x50							
Whole zone							
Number of trees with hollows = 0							
Sample area =							
Benchmark value =		Total no of species = 21	Total no of species =	Total no of species =	Total no of species =	Total no of species = 23	Total (m) = 1.5
		Foliage cover (%) = 3.5	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

old quarry

VZ 4

Site value:
Transect plot data sheet

(Start a new sheet for each vegetation zone)

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern Ri.		C. Leonard	01/12

Proposal ID	Proposal name	Zone ID
VZ 4	Sancrox Quarry	VZ 4

Vegetation formation: Dry Sclerophyll Forests (Shrub/grass)

Vegetation class: Hunter-Macleay Dry Sclerophyll Forests

Vegetation type: White Stringybark - Tallowwood - Grey Gum

Condition (low or mod/good)	**Zone descriptor** (optional)	**Geographic/habitat features** (tick after printing step 2 of Credit Calculator)
Low		☐

Coordinates (GPS datum GDA94:)

Transect / plot number	P1	2	3	4	5	6	7	8	9	10
Easting										
Northing										
Zone AMG										

Transect 10 points along 50-m transect (see transect tally table for % foliage cover variables)

Native over-storey cover (%)	5.5									
Native mid-storey cover (%)	3.5									
Native ground cover (grasses) (%)	62									
Native ground cover (shrubs) (%)	8									
Native ground cover (other) (%)	22									
Exotic plant cover	46									

Larger sampling area

Native plant species richness [1]	21									
Number of trees with hollows [2]	0									
Over-storey regeneration [3]	0.7									
Total length of fallen logs (m) [2]	1.5									

Comments/additional conservation values (riparian areas, special features, geology, etc.):

[1] 20 x 20 m plot [2] 20 x 50 m plot [3] whole zone

Floristic datasheet – 20 m X 20 m quadrat

V25 (near office)

No.	Species	Cover/abundance Score (see table above)
1	Dodonaea triquetra	2
2	Corymbia maculata	5
3	Lophostemon confertus	3
4	Daviesia ulicifolia	2
5	Ozothamnus diosmif.	2
6	Euca. pilularis	3
7	Acacia floribunda	3
8	* Paspalum urvillei	2
9	* Gomphocarpus fruti.	2
10	Dianella caerulea	2
11	Pteridium esculentum	2
12	Platylobium formosum	2
13	Entolasia stricta	3
14	Imperata cylind. v major	3
15	Bidens pilosa	2
16	Euca. siderophloia	3
17	Euca. microcorys	3
18	Hardenbergia violacea	2
19	Brunoniella pumilo	2
20	Glycine clandestina	2
21	* Conyza bonariensis	2
22	* Hypochaeris radicata	2
23	Dichondra repens	2
24	Lomandra longifolia	2
25	Microlaena stip. var. stip.	2
26		
27		
28		
29		
30		

Total species	25
Total native species	21
Total exotic species	4
% perennial native understorey cover*	20

* Perennial understorey vegetation cover includes vascular plant species of the ground and shrub layers with a lifecycle of more than two growing seasons

VZ 5

Site value:
Transect plot data sheet

(Start a new sheet for each vegetation zone)

BioBanking
Biodiversity Banking and Offsets Scheme

CMA area	CMA subregion	Recorder	Date
Northern Ri.		J. Pepper	01/12

Proposal ID	Proposal name	Zone ID
VZ 5	Sancrox Quarry	VZ 5

Vegetation formation Dry Sclerophyll Forests

Vegetation class Hunter - Macleay Dry Sclerophyll

Vegetation type PMVC_35 Spotted Gum Grassy Dry Forest

Condition (low or mod/good)	**Zone descriptor** (optional)	**Geographic/habitat features** (tick after printing step 2 of Credit Calculator)
Low		☐

Coordinates (GPS datum GDA94:_____)

Transect / plot number	P1	2	3	4	5	6	7	8	9	10
Easting										
Northing										
Zone AMG										

Transect 10 points along 50-m transect (see transect tally table for % foliage cover variables)

Native over-storey cover (%)	13.5									
Native mid-storey cover (%)	3									
Native ground cover (grasses) (%)	46									
Native ground cover (shrubs) (%)	20									
Native ground cover (other) (%)	26									
Exotic plant cover	20									

Larger sampling area

Native plant species richness [1]	21									
Number of trees with hollows [2]	0									
Over-storey regeneration [3]	1.0									
Total length of fallen logs (m) [2]	36									

Comments/additional conservation values (riparian areas, special features, geology, etc.):

[1] 20 x 20 m plot [2] 20 x 50 m plot [3] whole zone

Transect plot worksheet

Full species IDs are not required for BioBanking, but may be useful for identification of correct vegetation type and for monitoring and audit purposes.

BioBanking
Biodiversity Banking and Offsets Scheme

Site type: Development / BioBank Proposal ID: V25 Date: 1/12/15 Recorder(s): GC

Vegetation type: Patch near office AMG Zone ____ Easting/Northing: ____ Photos: ____

Native over-storey species list At 10 points along the 50-m transect	Regeneration (√) (zone)	Native mid-storey species list (>1m to <over-storey) At 10 points along the 50-m transect	Native ground cover (grasses) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (shrubs) species list (ground stratum <1m) At 50 points along the 50-m transect	Native ground cover (other) species list (ground stratum <1m) At 50 points along the 50-m transect	Exotic plants species list At 50 points along the 50-m transect	Fallen logs (min. 10 cm diameter x 50 cm long) (20 x 50m plot)
5 35		5	11 2	1 1	0	1 1	
10 35		5	11 2	1 1	0	11 2	
15 10		0	1 1	0	11 2	11 2	2.5
20 0		5	0	1 1	11 2	111 3	
25 0		5	11 2	111 3	1 0	1 1	1.0
30 20		5	0	1 1		1 1	
35 30		0	1111 4	11 2	0	0 0	>30m
40 5		0	1111 4	0	11 2	0 0	
45 0		0	1111 4	1 1	111 3	0 0	
50 0		5	1111 4	0	111 3	0 0	
135	3.0						
Total number of species =							
Foliage cover (%) =							
Benchmark value (%FC) =							
Average crown diameter =							
Average foliage cover (%) = 13.5							
Number of trees =							
Sample area =							
Whole zone							
Number of trees with hollows =							
Sample area =							>33.5
Benchmark value =		Total no of species = 21	Total no of species =	Total no of species =	Total no of species =	Total no of species =	Total (m) =
		Foliage cover (%) = 3.0	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Foliage cover (%) =	Benchmark (m) =

SITE AND OTHER NOTES:

NB: Transects / plots should be placed randomly with the minimum number required for the zone in accordance with Table 4 of the Operational Manual.

APPENDIX D

Greater Sancrox Structure Plan Area (MAP

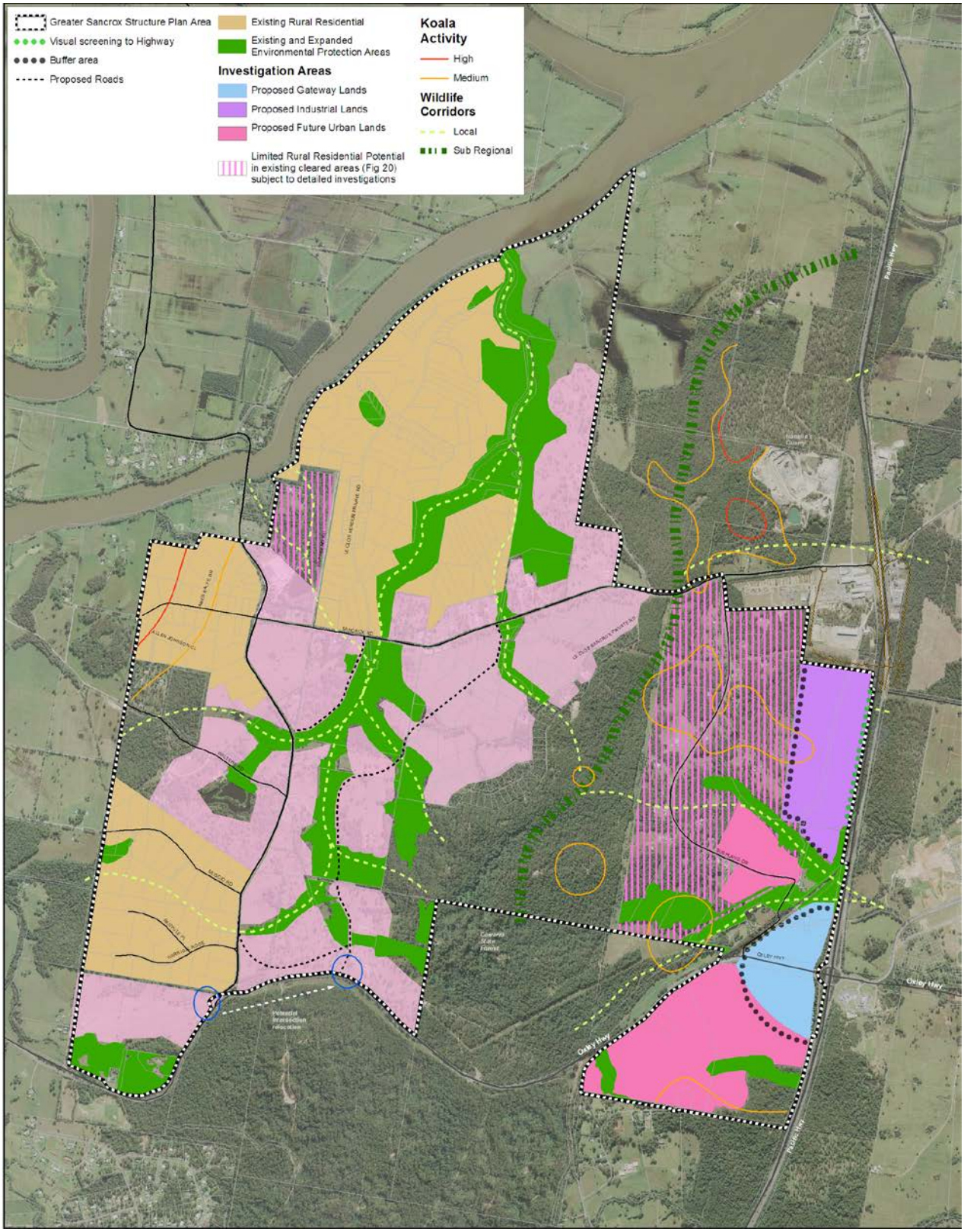
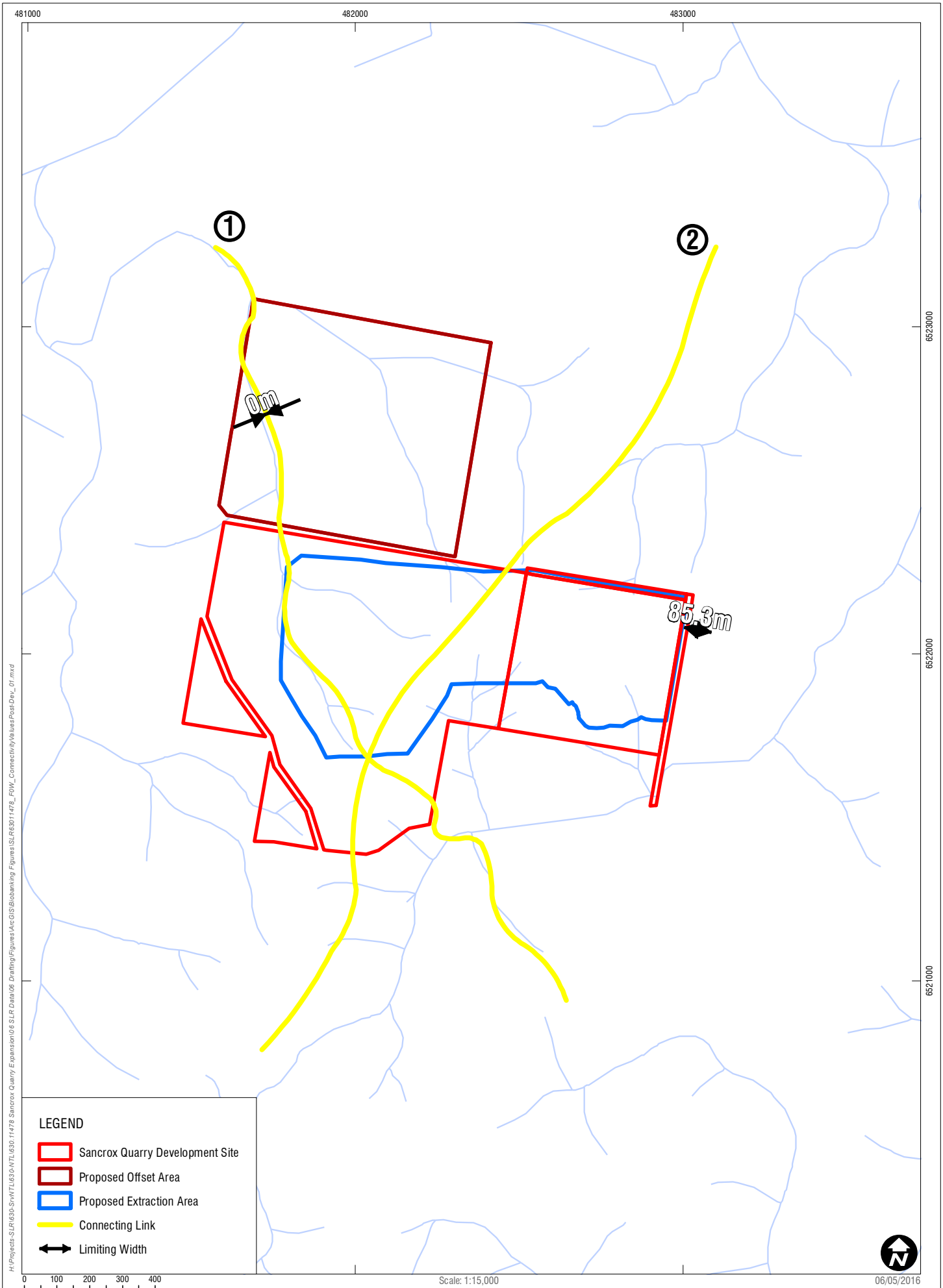


Figure 19 - Structure Plan map

APPENDIX E

Connectivity Maps



Sheet Size : A4

Connectivity Value - Post Development Site
Connecting Links
(Current linkage widths)

FIGURE X

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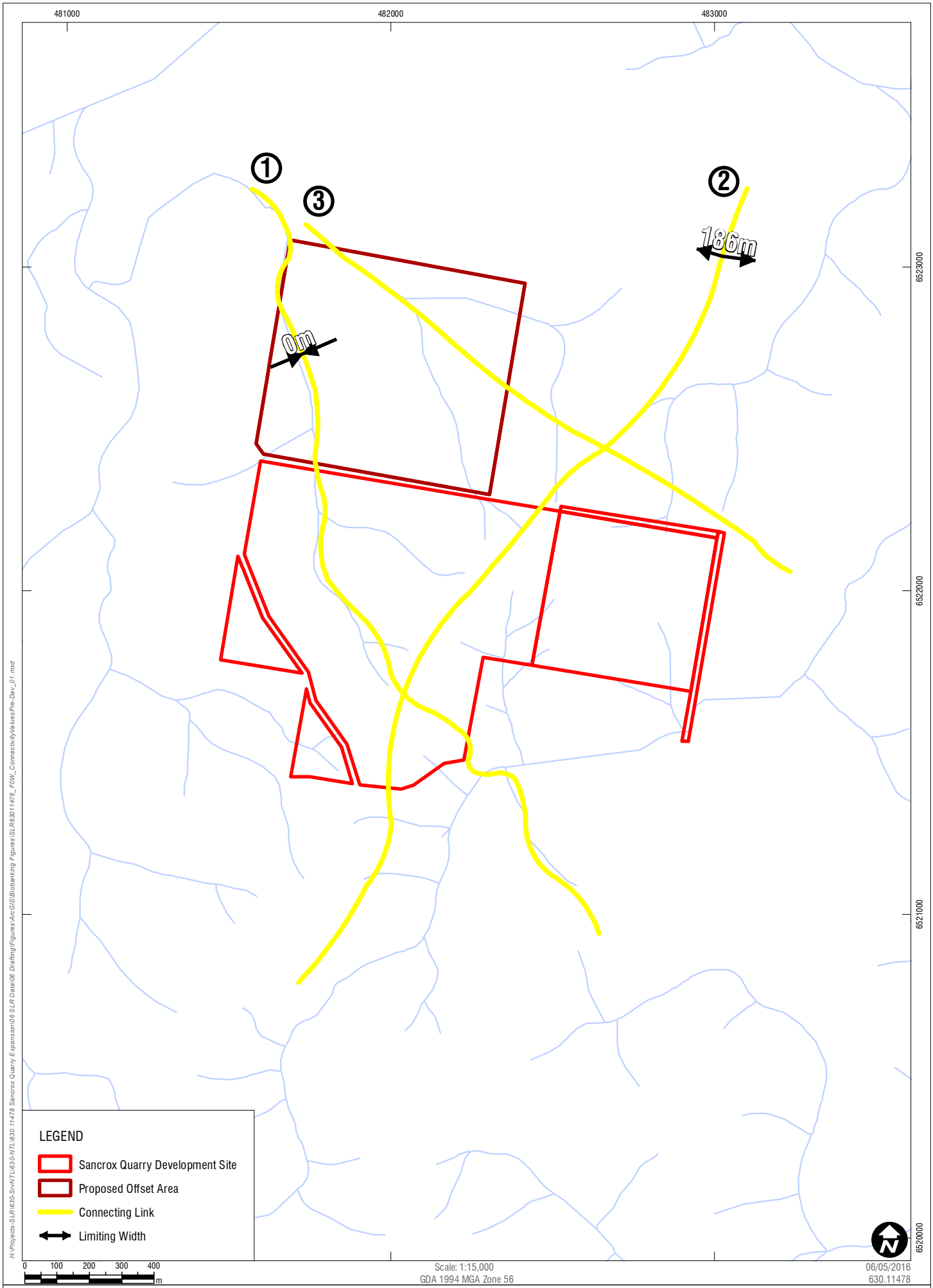

Sheet Size : A4

Connectivity Value -
Pre-Development Site Connecting Links
(Current linkage widths)

FIGURE X

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APPENDIX F

Council BVT Profiles

PMVC_035. Spotted Gum Grassy Dry Forest

Formation	Dry Sclerophyll Forests
Sub-formation	Shrub/Grass
Class	Hunter-Macleay Dry Sclerophyll Forests
EEC analog	na
No. field sites	16
Total area	569.36 ha

Floristic Type	*Corymbia citriodora*
Association	*Corymbia citriodora - Allocasuarina torulosa - Themeda australis*

Community description

Tallest stratum

A tall to extremely tall open forest dominated by Spotted Gum *Corymbia citriodora.* Common associates include Grey Ironbark *Eucalyptus siderophloia*, Broad-leaved White Mahogany *Eucalyptus carnea,* Tallowwood *Eucalyptus microcorys* and Grey Gum *Eucalyptus propinqua* with scattered Pink Bloodwood *Corymbia intermedia*, White Stringybark *Eucalyptus globoidea* and the occasional Blackbutt *Eucalyptus pilularis*.

Mid stratum

A low to mid-high open woodland dominated by Forest Oak *Allocasuarina torulosa.* Common associates include Blackwood *Acacia melanoxylon* Brushbox *Lophostemon confertus*, Turpentine *Syncarpia glomulifera* and other species.

Lowest stratum

A mid-high to tall open grassland or sedgeland dominated by Blady Grass *Imperata cylindrica*, Spiny-headed Mat-rush *Lomandra longifolia* or Kangaroo Grass *Themeda australis*. Common associates include Coffee Bush *Breynia oblongifolia* Blue Flax-lily *Dianella caerulea*, Wiry Panic *Entolasia stricta*, *Persoonia stradbrokensis, Ottochloa gracillima* and Tussock Grass *Poa labillardieri* and other species.

Climbers and epiphytes include Large-leaved Staff Vine *Celastrus subspicata*, Water Vine *Cissus hypoglauca*, Yaroong *Cissus sterculifolia*, Wombat Berry *Eustrephus latifolius*, Scrambling Lily *Geitonoplesium cymosum*, Purple Coral Pea *Hardenbergia violacea*, Climbing Guinea Flower *Hibbertia scandens*, Elkhorn Fern *Platycerium bifurcatum*, Lawyer Vine *Smilax australis* and Thin-leaved Tylophora *Tylophora paniculata.*

Community Distribution	**Additional Information**
	**NRCMA AG-ID**: na
	Soil landscape: to be detailed
	Occurs with or near: PMVC_026 & 037
	General Distribution: This community is restricted to the Cooperabung and Beechwood erosional soil landscapes at Red Hill and Sancrox.
	Recorded weeds: to be detailed

PMVC_035. Spotted Gum Grassy Dry Forest

Formation	Dry Sclerophyll Forests
Sub-formation	Shrub/Grass
Class	Hunter-Macleay Dry Sclerophyll Forests
EEC analog	na
No. field sites	16
Total area	569.36 ha

Floristic Type	*Corymbia citriodora*
Association	*Corymbia citriodora - Allocasuarina torulosa - Themeda australis*

Community description

Tallest stratum

A tall to extremely tall open forest dominated by Spotted Gum *Corymbia citriodora.* Common associates include Grey Ironbark *Eucalyptus siderophloia*, Broad-leaved White Mahogany *Eucalyptus carnea,* Tallowwood *Eucalyptus microcorys* and Grey Gum *Eucalyptus propinqua* with scattered Pink Bloodwood *Corymbia intermedia*, White Stringybark *Eucalyptus globoidea* and the occasional Blackbutt *Eucalyptus pilularis*.

Mid stratum

A low to mid-high open woodland dominated by Forest Oak *Allocasuarina torulosa.* Common associates include Blackwood *Acacia melanoxylon* Brushbox *Lophostemon confertus*, Turpentine *Syncarpia glomulifera* and other species.

Lowest stratum

A mid-high to tall open grassland or sedgeland dominated by Blady Grass *Imperata cylindrica*, Spiny-headed Mat-rush *Lomandra longifolia* or Kangaroo Grass *Themeda australis*. Common associates include Coffee Bush *Breynia oblongifolia* Blue Flax-lily *Dianella caerulea*, Wiry Panic *Entolasia stricta*, *Persoonia stradbrokensis, Ottochloa gracillima* and Tussock Grass *Poa labillardieri* and other species.

Climbers and epiphytes include Large-leaved Staff Vine *Celastrus subspicata*, Water Vine *Cissus hypoglauca*, Yaroong *Cissus sterculifolia*, Wombat Berry *Eustrephus latifolius*, Scrambling Lily *Geitonoplesium cymosum*, Purple Coral Pea *Hardenbergia violacea*, Climbing Guinea Flower *Hibbertia scandens*, Elkhorn Fern *Platycerium bifurcatum*, Lawyer Vine *Smilax australis* and Thin-leaved Tylophora *Tylophora paniculata.*

Community Distribution	**Additional Information**
	**NRCMA AG-ID**: na
	Soil landscape: to be detailed
	Occurs with or near: PMVC_026 & 037
	General Distribution: This community is restricted to the Cooperabung and Beechwood erosional soil landscapes at Red Hill and Sancrox.
	Recorded weeds: to be detailed

PMVC_037. White Stringybark – Tallowwood – Grey Gum Dry Forest

Formation	Dry Sclerophyll Forests
Sub-formation	Grassy
Class	Hunter-Macleay Dry Sclerophyll Forests
EEC analog	na
No. field sites	11
Total area	950.14 ha

Floristic Type	*Eucalyptus globoidea*
Association	*Eucalyptus globoidea - Allocasuarina torulosa - Themeda australis*

Community description

Tallest stratum

A tall to very tall open forest dominated by White Stringybark *Eucalyptus globoidea* growing in association with Tallowwood *Eucalyptus microcorys*. Common associates include Broad-leaved White Mahogany *Eucalyptus carnea*, which occurs occasionally as a sub-dominant, Grey Gum *Eucalyptus propinqua* and Turpentine *Syncarpia glomulifera*, less commonly Red Bloodwood *Corymbia gummifera* and Grey Ironbark *Eucalyptus siderophloia*.

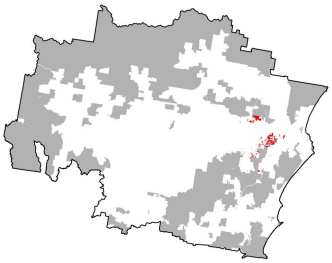
Mid stratum

A low to mid-high woodland dominated by Forest Oak *Allocasuarina torulosa* and to a lesser extent Black She-oak *Allocasuarina littoralis* growing in association with *Eucalyptus* saplings of the above species, Cheese Tree *Glochidion ferdinandi*, Large-leaf Hop-bush *Dodonaea triquetra*, Narrow-leaved Geebung *Persoonia linearis* and other species.

Lowest stratum

A mid-high to tall grassland and/or sedgeland dominated by Blady Grass *Imperata cylindrica* or Spiny-headed Mat-rush *Lomandra longifolia* growing in association with Common Bracken *Pteridium esculentum*, Kangaroo Grass *Themeda australis*, Wiry Panic *Entolasia stricta* and other species.

Climbers include Purple Coral Pea *Hardenbergia violacea*, Climbing Guinea Flower *Hibbertia scandens*, Dusky Coral Pea *Kennedia rubicunda* and Common Silkpod *Parsonsia straminea.*

Community Distribution	**Additional Information**
	**NRCMA AG-ID**: none applicable
	Soil landscape: to be detailed
	Occurs with or near: PMVC_028, 035 & 038
	General Distribution: coastal hinterland between Sancrox and Heron's Creek
	Recorded weeds: Introduced species recorded in this community include Lantana *Lantana camara*, Small Leaved Privet *Ligustrum sinense* and Jacaranda *Jacaranda mimosifolia.*

PMVC_073. Flax-leaved Paperbark – Mixed Eucalypt Coastal Floodplain Wetland Forest Complex

Formation	Forested Wetlands
Sub-formation	-
Class	Coastal Floodplain Wetlands
EEC analog	Subtropical Coastal Floodplain Forest of the NSW North Coast Bioregion
No. field sites	15
Total area	706.60 ha

Floristic Type	*Melaleuca linariifolia/styphelioides*
Association	*Eucalyptus spp. - Melaleuca linarifolia/styphelioides - Lomandra longifolia*

Community description

Tallest stratum

A tall to very tall emergent woodland of mixed *Eucalyptus* spp. including Flooded Gum *Eucalyptus grandis,* Tallowwood *Eucalyptus microcorys*, Grey Gum *Eucalyptus propinqua,* Grey Ironbark *Eucalyptus siderophloia* and Forest Red Gum *Eucalyptus tereticornis*.

Mid stratum

A mid-high open to closed forest co-dominated by Flax-leaved Paperbark *Melaleuca linariifolia* or Prickly-leaved Tea Tree *Melaleuca styphelioides* growing in association with Cheese Tree *Glochidion ferdinandi*, Willow Bottlebrush *Callistemon salignus,*Forest Oak *Allocasuarina torulosa* and other species.

Lowest stratum

Mid-high to tall sedgeland dominated by Spiny-headed Mat-rush *Lomandra longifolia*, *Lomandra hystrix* and/or Tall Saw-sedge *Gahnia clarkei* growing in association with Coffee Bush *Breynia oblongifolia*, Orange Thorn *Pittosporum multiflorum*, Prickly Rasp Fern *Doodia aspera*, Narrow-leaved Palm Lily *Cordyline stricta,* Coffee Bush *Breynia oblongifolia* and other species.

Climbers and epiphytes include Kangaroo Vine *Cissus antarctica,* Native Yam *Dioscorea transversa*, Climbing Guinea Flower *Hibbertia scandens*, Wonga Wonga Vine *Pandorea pandorana*, Common Silkpod *Parsonsia straminea* and Lawyer Vine *Smilax australis*.

Community Distribution	**Additional Information**
	**NRCMA AG-ID**: 700-634
	Soil landscape: to be detailed
	Occurs with or near: PMVC_037-038, 072.
	General Distribution: Occurs along drainage lines and is characterised by the presence of a relatively dense mid-stratum of *Melaleuca* spp. and a more open tallest stratum.
	Recorded weeds: to be detailed

PMVC_035. Spotted Gum Grassy Dry Forest

Formation	Dry Sclerophyll Forests
Sub-formation	Shrub/Grass
Class	Hunter-Macleay Dry Sclerophyll Forests
EEC analog	na
No. field sites	16
Total area	569.36 ha

Floristic Type	*Corymbia citriodora*
Association	*Corymbia citriodora - Allocasuarina torulosa - Themeda australis*

Community description

Tallest stratum

A tall to extremely tall open forest dominated by Spotted Gum *Corymbia citriodora.* Common associates include Grey Ironbark *Eucalyptus siderophloia*, Broad-leaved White Mahogany *Eucalyptus carnea,* Tallowwood *Eucalyptus microcorys* and Grey Gum *Eucalyptus propinqua* with scattered Pink Bloodwood *Corymbia intermedia*, White Stringybark *Eucalyptus globoidea* and the occasional Blackbutt *Eucalyptus pilularis*.

Mid stratum

A low to mid-high open woodland dominated by Forest Oak *Allocasuarina torulosa.* Common associates include Blackwood *Acacia melanoxylon* Brushbox *Lophostemon confertus*, Turpentine *Syncarpia glomulifera* and other species.

Lowest stratum

A mid-high to tall open grassland or sedgeland dominated by Blady Grass *Imperata cylindrica*, Spiny-headed Mat-rush *Lomandra longifolia* or Kangaroo Grass *Themeda australis*. Common associates include Coffee Bush *Breynia oblongifolia* Blue Flax-lily *Dianella caerulea*, Wiry Panic *Entolasia stricta*, *Persoonia stradbrokensis, Ottochloa gracillima* and Tussock Grass *Poa labillardieri* and other species.

Climbers and epiphytes include Large-leaved Staff Vine *Celastrus subspicata*, Water Vine *Cissus hypoglauca*, Yaroong *Cissus sterculifolia*, Wombat Berry *Eustrephus latifolius*, Scrambling Lily *Geitonoplesium cymosum*, Purple Coral Pea *Hardenbergia violacea*, Climbing Guinea Flower *Hibbertia scandens*, Elkhorn Fern *Platycerium bifurcatum*, Lawyer Vine *Smilax australis* and Thin-leaved Tylophora *Tylophora paniculata.*

Community Distribution	**Additional Information**
	**NRCMA AG-ID**: na
	Soil landscape: to be detailed
	Occurs with or near: PMVC_026 & 037
	General Distribution: This community is restricted to the Cooperabung and Beechwood erosional soil landscapes at Red Hill and Sancrox.
	Recorded weeds: to be detailed

PMVC_037. White Stringybark – Tallowwood – Grey Gum Dry Forest

Formation	Dry Sclerophyll Forests
Sub-formation	Grassy
Class	Hunter-Macleay Dry Sclerophyll Forests
EEC analog	na
No. field sites	11
Total area	950.14 ha

Floristic Type	*Eucalyptus globoidea*
Association	*Eucalyptus globoidea - Allocasuarina torulosa - Themeda australis*

Community description

Tallest stratum

A tall to very tall open forest dominated by White Stringybark *Eucalyptus globoidea* growing in association with Tallowwood *Eucalyptus microcorys*. Common associates include Broad-leaved White Mahogany *Eucalyptus carnea*, which occurs occasionally as a sub-dominant, Grey Gum *Eucalyptus propinqua* and Turpentine *Syncarpia glomulifera*, less commonly Red Bloodwood *Corymbia gummifera* and Grey Ironbark *Eucalyptus siderophloia*.

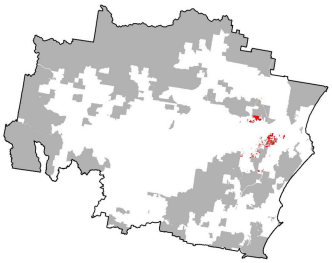
Mid stratum

A low to mid-high woodland dominated by Forest Oak *Allocasuarina torulosa* and to a lesser extent Black She-oak *Allocasuarina littoralis* growing in association with *Eucalyptus* saplings of the above species, Cheese Tree *Glochidion ferdinandi*, Large-leaf Hop-bush *Dodonaea triquetra*, Narrow-leaved Geebung *Persoonia linearis* and other species.

Lowest stratum

A mid-high to tall grassland and/or sedgeland dominated by Blady Grass *Imperata cylindrica* or Spiny-headed Mat-rush *Lomandra longifolia* growing in association with Common Bracken *Pteridium esculentum*, Kangaroo Grass *Themeda australis*, Wiry Panic *Entolasia stricta* and other species.

Climbers include Purple Coral Pea *Hardenbergia violacea*, Climbing Guinea Flower *Hibbertia scandens*, Dusky Coral Pea *Kennedia rubicunda* and Common Silkpod *Parsonsia straminea.*

Community Distribution	**Additional Information**
	**NRCMA AG-ID**: none applicable
	Soil landscape: to be detailed
	Occurs with or near: PMVC_028, 035 & 038
	General Distribution: coastal hinterland between Sancrox and Heron's Creek
	Recorded weeds: Introduced species recorded in this community include Lantana *Lantana camara*, Small Leaved Privet *Ligustrum sinense* and Jacaranda *Jacaranda mimosifolia.*

PMVC_073. Flax-leaved Paperbark – Mixed Eucalypt Coastal Floodplain Wetland Forest Complex

Formation	Forested Wetlands
Sub-formation	-
Class	Coastal Floodplain Wetlands
EEC analog	Subtropical Coastal Floodplain Forest of the NSW North Coast Bioregion
No. field sites	15
Total area	706.60 ha

Floristic Type	*Melaleuca linariifolia/styphelioides*
Association	*Eucalyptus spp. - Melaleuca linarifolia/styphelioides - Lomandra longifolia*

Community description

Tallest stratum

A tall to very tall emergent woodland of mixed *Eucalyptus* spp. including Flooded Gum *Eucalyptus grandis,* Tallowwood *Eucalyptus microcorys*, Grey Gum *Eucalyptus propinqua,* Grey Ironbark *Eucalyptus siderophloia* and Forest Red Gum *Eucalyptus tereticornis*.

Mid stratum

A mid-high open to closed forest co-dominated by Flax-leaved Paperbark *Melaleuca linariifolia* or Prickly-leaved Tea Tree *Melaleuca styphelioides* growing in association with Cheese Tree *Glochidion ferdinandi*, Willow Bottlebrush *Callistemon salignus,*Forest Oak *Allocasuarina torulosa* and other species.

Lowest stratum

Mid-high to tall sedgeland dominated by Spiny-headed Mat-rush *Lomandra longifolia*, *Lomandra hystrix* and/or Tall Saw-sedge *Gahnia clarkei* growing in association with Coffee Bush *Breynia oblongifolia*, Orange Thorn *Pittosporum multiflorum*, Prickly Rasp Fern *Doodia aspera*, Narrow-leaved Palm Lily *Cordyline stricta,* Coffee Bush *Breynia oblongifolia* and other species.

Climbers and epiphytes include Kangaroo Vine *Cissus antarctica,* Native Yam *Dioscorea transversa*, Climbing Guinea Flower *Hibbertia scandens*, Wonga Wonga Vine *Pandorea pandorana*, Common Silkpod *Parsonsia straminea* and Lawyer Vine *Smilax australis*.

Community Distribution	**Additional Information**
	**NRCMA AG-ID**: 700-634
	Soil landscape: to be detailed
	Occurs with or near: PMVC_037-038, 072.
	General Distribution: Occurs along drainage lines and is characterised by the presence of a relatively dense mid-stratum of *Melaleuca* spp. and a more open tallest stratum.
	Recorded weeds: to be detailed

APPENDIX G

VIS PCT Profiles

VIS Classification - Community Profile Report

Plant Community Type ID: 686 VCA ID: 0

Biometric Vegetation Type ID(s): NR117;

Plant Community List Status: Approved
Classification Confidence Level: Very Low
Common Name: Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion
Scientific Name (Taxon): *Eucalyptus pilularis , Corymbia intermedia , Eucalyptus resinifera subsp. resinifera / Breynia oblongifolia , Callistemon salignus , Glochidion ferdinandi , Melaleuca linariifolia / Entolasia marginata , Eustrephus latifolius , Lomandra longifolia , Oplismenus imbecillis*

Original Entry: System 27/06/2011

Characteristic Vegetation: ***Not Assessed***
Emergents : None
Trees (Upper Storey): Eucalyptus pilularis; Corymbia intermedia; Eucalyptus resinifera subsp. resinifera;
Shrubs/Vines/Epiphytes (Middle Storey): Breynia oblongifolia; Callistemon salignus; Glochidion ferdinandi; Melaleuca linariifolia; Rubus hillii;
Ground Cover: Entolasia marginata; Eustrephus latifolius; Lomandra longifolia; Oplismenus imbecillis; Pratia purpurascens; Pseuderanthemum variabile; Pteridium esculentum; Imperata cylindrica var. major; Viola hederacea;
Diagnostic Species: Not Assessed
Weed Species:
Weediness: Not Assessed
Threatened Plants: Not Assessed
Threatened Fauna: Not Assessed
Mean Species Richness:
RainForest Structure (Webb):
Structure (WH): Open Forest;
Height Class (WH): 7 - Range:12.01-20.00m (Tall),8 - Range:20.01-35.00m (Very tall)
Vegetation Description: Other Diagnostics Features: Tall to very tall open forest.; LandscapePosition: In low lying areas on the coast from Kendall north to Coffs Harbour.
Level Of Classification: Not Assessed
Formation Group: Not Assessed
State Veg Formation (Keith 2004): Wet Sclerophyll Forests (Shrubby sub-formation);
Vegetation Class (Keith 2004): North Coast Wet Sclerophyll Forests;
State Landscape (Mitchell 2002): Not Assessed
NVIS Major Veg Sub-Groups: Not Assessed
Forest Type (RN 17): Not Assessed
Authority(s):
Interstate Equivalent(s):
Pre European Extent Mapped/Modelled: Not Assessed
Current Extent Mapped/Modelled: Not Assessed
Plot Sampling: None ***Number Of Plots:*** Not Assessed
Mapping Info: Not Assessed
Climate Zone: Not Assessed
IBRA Bioregion: Not Assessed
IBRA Sub-Region: Not Assessed
Botanical Division: Not Assessed
Local Govt. Areas: Not Assessed
CMAs: Northern Rivers (1-30%);
MD Basin: No
Substrate Mass: Not Assessed
Lithology: Not Assessed
Great Soil Group: Not Assessed
Soil Texture: Not Assessed
Landform Patterns: Not Assessed
Landform Elements: Not Assessed
Land Use: Not Assessed

Impacts of European Settlement: Not Assessed
Pre-European Extent: Not Assessed
Pre-European Comments:
Current Extent: Not Assessed
Current Extent Comments:
Conservation Reserves: None.
Reserves Total Area: 0.0 ***No. Representatives in Reserves:*** 0
Protected Area Explanation:
Secure Property Agreements: None.
Secure PAs Total area: 0.0 ***No. Representatives in Secure Property Agreements:*** 0
Protected Current Extent: 0.000% 0.0 ha ±% ***No. Representatives in Protected Areas:*** 0
Protected Pre-European Extent: 0.000% ()
Common in 1750: ***Not Assessed***
Key Sites for Protection:
Degree of Fragmentation: Not Assessed
Recoverability: Not Assessed
Variations & Disturbance:
Fire Regime:
Adjoining Communities: Not Assessed
Threatening Processes:
Threatening Process List: Not Assessed
Threat Category: Not Assessed ***Threat/Protected Area Code:*** Not Assessed ***Threat Criteria:*** Not Assessed
Planning Controls: Not Assessed
Planning and Management: Not Assessed
TEC List: Listed TSC Act,E: River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Part) ; Listed TSC Act,E: Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion (Part) ;

Recovery Plan: Not Assessed
Citation List: (NPWS, 1999)
Reference List: (422;). NSW National Parks and Wildlife Service (1999) Forest Ecosystem Classification and Mapping for the Upper and Lower North East CRA regions. A project undertaken for the Joint Commonwealth NSW Regional Forest Agreement Steering Committee as part of the NSW Comprehensive Regional Assessments. Project number NA35/EH. CRA Unit, Northern Zone NPWS, Coffs Harbour;

TECComments:

VIS Classification - Community Profile Report

Plant Community Type ID: 1215 VCA ID: 0

Biometric Vegetation Type ID(s): NR247;

Plant Community List Status: Approved
Classification Confidence Level: Very Low
Common Name: Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion
Scientific Name (Taxon): *Eucalyptus microcorys , Eucalyptus siderophloia , Eucalyptus carnea , Eucalyptus moluccana / Acacia implexa , Allocasuarina littoralis , Allocasuarina torulosa , Jacksonia scoparia / Aristida vagans , Dianella caerulea , Entolasia stricta , Themeda australis*

Original Entry: System 27/06/2011

Characteristic Vegetation: ***Not Assessed***
Emergents : None
Trees (Upper Storey): Corymbia maculata; Eucalyptus siderophloia; Eucalyptus carnea; Eucalyptus tereticornis; Eucalyptus moluccana; Eucalyptus microcorys;
Shrubs/Vines/Epiphytes (Middle Storey): Acacia implexa; Allocasuarina littoralis; Allocasuarina torulosa; Jacksonia scoparia; Xanthorrhoea johnsonii;
Ground Cover: Aristida vagans; Dianella caerulea; Entolasia stricta; Themeda australis; Imperata cylindrica var. major;
Diagnostic Species: Not Assessed
Weed Species:
Weediness: Not Assessed
Threatened Plants: Not Assessed
Threatened Fauna: Not Assessed
Mean Species Richness:
RainForest Structure (Webb):
Structure (WH): Open Forest;
Height Class (WH): Not Assessed
Vegetation Description: Other Diagnostics Features: None; LandscapePosition: Occurs slopes and ridges of coastal foothills
Level Of Classification: Not Assessed
Formation Group: Not Assessed
State Veg Formation (Keith 2004): Dry Sclerophyll Forests (Shrub/grass sub-formation);
Vegetation Class (Keith 2004): Hunter-Macleay Dry Sclerophyll Forests;
State Landscape (Mitchell 2002): Not Assessed
NVIS Major Veg Sub-Groups: Not Assessed
Forest Type (RN 17): Not Assessed
Authority(s):
Interstate Equivalent(s):
Pre European Extent Mapped/Modelled: Not Assessed
Current Extent Mapped/Modelled: Not Assessed
Plot Sampling: None ***Number Of Plots:*** Not Assessed
Mapping Info: Not Assessed
Climate Zone: Not Assessed
IBRA Bioregion: Not Assessed
IBRA Sub-Region: Not Assessed
Botanical Division: Not Assessed
Local Govt. Areas: Not Assessed
CMAs: Northern Rivers (1-30%);
MD Basin: No
Substrate Mass: Not Assessed
Lithology: Not Assessed
Great Soil Group: Not Assessed
Soil Texture: Not Assessed
Landform Patterns: Not Assessed
Landform Elements: Not Assessed
Land Use: Not Assessed
Impacts of European Settlement: Not Assessed

Pre-European Extent: Not Assessed
Pre-European Comments:
Current Extent: Not Assessed
Current Extent Comments:
Conservation Reserves: None.
Reserves Total Area: 0.0 ***No. Representatives in Reserves:*** 0
Protected Area Explanation:
Secure Property Agreements: None.
Secure PAs Total area: 0.0 ***No. Representatives in Secure Property Agreements:*** 0
Protected Current Extent: 0.000% 0.0 ha ±% ***No. Representatives in Protected Areas:*** 0
Protected Pre-European Extent: 0.000% ()
Common in 1750: ***Not Assessed***
Key Sites for Protection:
Degree of Fragmentation: Not Assessed
Recoverability: Not Assessed
Variations & Disturbance:
Fire Regime:
Adjoining Communities: Not Assessed
Threatening Processes:
Threatening Process List: Not Assessed
Threat Category: Not Assessed ***Threat/Protected Area Code:*** Not Assessed ***Threat Criteria:*** Not Assessed
Planning Controls: Not Assessed
Planning and Management: Not Assessed
TEC List: Listed TSC Act,E: Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion (Part) ;

Recovery Plan: Not Assessed
Citation List: (Eco Logical Australia, 2005)
Reference List: (869;). Eco Logical Australia (2005). A vegetation map for the Northern Rivers CMA to support application of the BFT. DEC 2005.;

TECComments:

VIS Classification - Community Profile Report

Plant Community Type ID: 1262 VCA ID: 0

Biometric Vegetation Type ID(s): NR263;

Plant Community List Status: Approved
Classification Confidence Level: Very Low
Common Name: Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast
Scientific Name (Taxon): *Eucalyptus microcorys , Eucalyptus propinqua , Eucalyptus siderophloia , Eucalyptus carnea / Allocasuarina torulosa , Breynia oblongifolia / Desmodium rhytidophyllum , Desmodium varians , Dianella caerulea , Glycine clandestina*

Original Entry: System 27/06/2011

Characteristic Vegetation: ***Not Assessed***
Emergents : None
Trees (Upper Storey): Eucalyptus microcorys; Eucalyptus propinqua; Eucalyptus siderophloia; Eucalyptus carnea; Syncarpia glomulifera; Lophostemon confertus;
Shrubs/Vines/Epiphytes (Middle Storey): Allocasuarina torulosa; Breynia oblongifolia;
Ground Cover: Desmodium rhytidophyllum; Desmodium varians; Dianella caerulea; Glycine clandestina; Hibbertia scandens; Lomandra longifolia; Pseuderanthemum variabile; Themeda australis; Vernonia cinerea; Imperata cylindrica var. major;
Diagnostic Species: Not Assessed
Weed Species:
Weediness: Not Assessed
Threatened Plants: Not Assessed
Threatened Fauna: Not Assessed
Mean Species Richness:
RainForest Structure (Webb):
Structure (WH): Open Forest;
Height Class (WH): 7 - Range:12.01-20.00m (Tall),8 - Range:20.01-35.00m (Very tall)
Vegetation Description: Other Diagnostics Features: Tall to very tall open forest.; LandscapePosition: Occurs on the coastal lowlands and foothills of the southern parts of the North Coast.
Level Of Classification: Not Assessed
Formation Group: Not Assessed
State Veg Formation (Keith 2004): Wet Sclerophyll Forests (Grassy sub-formation);
Vegetation Class (Keith 2004): Northern Hinterland Wet Sclerophyll Forests;
State Landscape (Mitchell 2002): Not Assessed
NVIS Major Veg Sub-Groups: Not Assessed
Forest Type (RN 17): Not Assessed
Authority(s):
Interstate Equivalent(s):
Pre European Extent Mapped/Modelled: Not Assessed
Current Extent Mapped/Modelled: Not Assessed
Plot Sampling: None ***Number Of Plots:*** Not Assessed
Mapping Info: Not Assessed
Climate Zone: Not Assessed
IBRA Bioregion: Not Assessed
IBRA Sub-Region: Not Assessed
Botanical Division: Not Assessed
Local Govt. Areas: Not Assessed
CMAs: Northern Rivers (1-30%);
MD Basin: No
Substrate Mass: Not Assessed
Lithology: Not Assessed
Great Soil Group: Not Assessed
Soil Texture: Not Assessed
Landform Patterns: Not Assessed
Landform Elements: Not Assessed
Land Use: Not Assessed

Impacts of European Settlement: Not Assessed
Pre-European Extent: Not Assessed
Pre-European Comments:
Current Extent: Not Assessed
Current Extent Comments:
Conservation Reserves: None.
Reserves Total Area: 0.0 ***No. Representatives in Reserves:*** 0
Protected Area Explanation:
Secure Property Agreements: None.
Secure PAs Total area: 0.0 ***No. Representatives in Secure Property Agreements:*** 0
Protected Current Extent: 0.000% 0.0 ha ±% ***No. Representatives in Protected Areas:*** 0
Protected Pre-European Extent: 0.000% ()
Common in 1750: ***Not Assessed***
Key Sites for Protection:
Degree of Fragmentation: Not Assessed
Recoverability: Not Assessed
Variations & Disturbance:
Fire Regime:
Adjoining Communities: Not Assessed
Threatening Processes:
Threatening Process List: Not Assessed
Threat Category: Not Assessed ***Threat/Protected Area Code:*** Not Assessed ***Threat Criteria:*** Not Assessed
Planning Controls: Not Assessed
Planning and Management: Not Assessed
TEC List:

Recovery Plan: Not Assessed
Citation List: (NPWS, 1999)
Reference List: (422;). NSW National Parks and Wildlife Service (1999) Forest Ecosystem Classification and Mapping for the Upper and Lower North East CRA regions. A project undertaken for the Joint Commonwealth NSW Regional Forest Agreement Steering Committee as part of the NSW Comprehensive Regional Assessments. Project number NA35/EH. CRA Unit, Northern Zone NPWS, Coffs Harbour;

TECComments:

APPENDIX H

Threatened Species Likelihood of Occurrence

SLR

global environmental solutions

February2015

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

KEY	
Status	The "threatened species" listing in the *Threatened Species Conservation Act 1995* (TSC Act)
V	Species listed as "vulnerable", as defined under the TSC Act.
E1	Species listed as "endangered", as defined under the TSC Act.
E4A	Species listed as "critically endangered", as defined under the TSC Act.
E2	An "endangered population", as defined under the TSC Act.
Records	The number of records of the relevant "threatened species" listed in the search area
Likelihood of Occurrence	The likelihood of occurrence (LoO) of threatened species.
P	Present on the subject land
H	High potential occurrence
M	Moderate potential occurrence
L	Low potential occurrence
N	No relevance
Credit Type	According to Threatened Species Profile Database
Ecosystem	Ecosystem credit species
Species	Species credit species

NOTES

Species listed in the table below are derived from the BioBanking Credit Calculator (Proposal ID 0107/2015/2368MP) and the *Atlas of NSW Wildlife* website http://www.bionet.nsw.gov.au/. The following notes accompany this database:

- Data from the BioNet Atlas of NSW Wildlife website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions.
- Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1°; ^^ rounded to 0.01°).
- Copyright - the State of NSW through the Office of Environment & Heritage.
- Search criteria: Licensed Report of all Valid Records of Threatened (listed on TSC Act 1995) Entities in selected area [North: -31.36 West: 152.75 East: 152.98 South: -31.55] returned a total of 2,423 records of 80 species.
- Report generated on 15/10/2014 4:00 PM.

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Threatened Species of Plants

Species	Habitat Description	Habitat on site	Records	Credit Type	TSC Act Status	EPBC Act Status	Likelihood of Occurrence
Cryptostylis hunteriana Leafless Tongue Orchid	• Occurs in a range of communities, including swamp-heath and woodland • The larger populations typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*)	• Marginal potential habitat occurs on site in very restricted locations in paperbark swamp forest margins • No presence of species detected on site	_	Species	V	V	Low
Diuris disposita Willawarrin Doubletail	• Requires grassy open forest • Known only from Willawarrin near Kempsey, NSW, where it is rare	• Outside distribution range	_	Species	E	_	None
Cynanchum elegans White-flowered Wax Plant	• Typical habitat is rainforest and littoral rainforest	• Habitat does not occur on site	1	Species	E1,P	E	None
Allocasuarina defungens Dwarf Heath Casuarina	• Typical habitat is tall heath on sand	• Habitat does not occur on site	9	Species	E1,P	E	None
Maundia triglochinoides	• Grows in swamps, channels, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients.	• Marginal potential habitat occurs on site in very restricted locations in paperbark swamp forest margins • No presence of species detected on site	3	Species	V,P	_	Low

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	TSC Act Status	EPBC Act Status	Likelihood of Occurrence
Eucalyptus nicholii Narrow-leaved Black Peppermint	• Typical habitat is dry grassy woodland • Distribution range is NE tablelands	• Outside distribution range	3	Species	V	V	None
Marsdenia longiloba *Slender Marsdenia*	• Subtropical and warm temperate rainforest, lowland moist or open eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops • Scattered sites on the north coast of NSW north from Barrington Tops; also occurs in south-east Queensland • Associated species include Eucalyptus crebra, E. microcorys, E. acmenoides, E. saligna, E. propinqua, Corymbia intermedia, and Lophostemon confertus	• Marginal potential habitat occurs on site in very restricted locations in paperbark swamp forest margins • Not recorded on site during flora survey	_	Species	E	V	Low
Melaleuca groveana *Grove's Paperbark*	• Grows in heath and shrubland, often in exposed sites, in low coastal hills, escarpment ranges and tablelands on outcropping granite, rhyolite and sandstone on rocky outcrops and cliffs • Also occurs in dry scrubby open forest and woodlands • Widespread, scattered populations in coastal districts north of Yengo National Park (Southwest of Newcastle, NSW) to southeast Queensland	• Habitat does not occur on site	_	Species	V	_	Low
Melaleuca biconvexa Biconvex Paperbark	• Typically grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspect • Only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-	• Outside distribution range	27	Species	V	V	Low

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	TSC Act Status	EPBC Act Status	Likelihood of Occurrence
	• Wyong area in the north.						
Niemeyera whitei *Rusty Plum*	• Found in gullies of warm temperate or littoral rainforests and the adjacent understorey of moist eucalypt forest • Occurs on poorer soils in areas below 600 m above sea level • Rusty Plum occurs in the coast and adjacent ranges of northern NSW from the Macleay River into southern Queensland • Its distributional stronghold is on the mid north coast around Coffs Harbour	• Marginal potential habitat occurs on site in very restricted locations in paperbark swamp forest margins • Not recorded onsite during flora survey	_	Species	V	_	Low
Parsonsia dorrigoensis *Milky Silkpod*	• Found in subtropical and warm-temperature rainforest, on rainforest margins, and in moist eucalypt forest up to 800m, on brown clay soils • Found only within NSW, with scattered populations in the north coast region between Kendall and Woolgoolga	• Marginal potential habitat occurs on site in very restricted locations in paperbark swamp forest margins	_	Species	V	E	Low
Dendrobium melaleucaphilum Spider orchid	• Typical habitat is swamp – specifically parasitic on *Melaleuca styphelioides* • Flowers from July to October	• One specimen of an epiphytic *Dendrobium* orchid was recorded on an individual *Melaleuca styphelioides* near the western edge of the site • Identification to species level not possible until next flowering period July 2016	1	Species	E1	_	Low
Phaius australis Southern swamp orchid	• Typical habitat is Melaleuca quinquenervia swamps and sclerophyll forest on the coast. • Occurs in Queensland and north-east	• Moderate potential habitat occurs on site in the paperbark swamp forest and dry sclerophyll forest • One record within 10km of site	1	Species	E1	E	Moderate

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	TSC Act Status	EPBC Act Status	Likelihood of Occurrence
	NSW as far south as Coffs Harbour. Historically, it extended farther south, to Port Macquarie. • Flowers October-November	only • No occurrence detected during flora survey					
Pomaderris queenslandica Scant Pomaderris	• Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks • Widely scattered but not common in north-east NSW and in Queensland • Known from several locations on the NSW north coast and a few locations on the New England Tablelands and North West Slopes • Flowers during spring/summer	• Habitat does not occur on site	_	Species	E	_	Low
Senna acclinis Rainforest Cassia	• Grows on the margins of subtropical, littoral and dry rainforests • Occurs in coastal districts and adjacent tablelands of NSW from the Illawarra in NSW to Queensland • Flowering occurs in spring and summer; fruit is ripe summer and autumn	• Potential habitat occurs on site in the paperbark swamp forest • No occurrence detected during flora survey	_	Species	E	_	Low

Threatened Species of Animal

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
AMPHIBIANS							
Crinia tinnula	• Typical habitat is acidic swamps on	• Marginal potential habitat occurs	52	Species	V,P	_	Low

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
Wallum Froglet	coastal sand plains - sedgelands, wet heathlands, paperbark swamps and drainage lines • Also persist in disturbed areas • Breeding occurs in winter months and can occur in permanent water in swamps or more ephemeral habitats • Shelter under leaf litter, vegetation, other debris or in burrows of other species often located near the water's edge	on site in paperbark swamp forest and low lying areas • No occurrence detected on site during fauna survey (noting that rain fell during survey period)					
Litoria aurea Green & Golden Bell Frog	• Typical habitat includes marshes, dams and stream-sides – particularly with *Typha* and *Eleocharis* spp. • Prefers unshaded waterbodies, with a grassy area nearby and diurnal sheltering sites • Active by day and usually breeds in summer when conditions are warm and wet	• Suitable habitat may exist on site in paperbark swamp forest areas, quarry water dam and western farm dam • Presence of *Gambusia holbrooki* found in all ponds may prevent establishment on site • No occurrence detected on site during fauna survey (noting that rain fell during survey period)	2	Species	E1,P	V	Low
Litoria brevipalmata Green-thighed Frog	• Occurs in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath – typically in areas that pond after rain • Breeding occurs following heavy rainfall from spring to autumn • Isolated localities along the coast and ranges from just north of Wollongong to south-east Queensland	• Suitable habitat may exist on site in paperbark swamp areas and low lying areas • No occurrence detected on site during fauna survey (noting that rain fell during survey period)	20	Species	V,P	_	Low
Mixophyes iteratus	• Associated with flowing streams,	• No suitable habitat exists on site	1	Species	E1,P,	E	Low

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
Giant Barred Frog	often in rainforest or wet sclerophyll forest • Generally lives in large streams or rivers with a width of at least 5 metres	as it prefers flowing streams			2		
BIRDS							
Anthochaera phrygia Regent Honeyeater	• Mostly occur in Dry Box-Ironbark eucalypt woodland and dry sclerophyll forest associations in areas of low to moderate relief • Inhabit woodlands with significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. • In NSW, riparian forests containing River Oak *Casuarina cunninghamiana*, and with Needle-leaf Mistletoe *Amyema cambagei*, are important for feeding and breeding. • Known to breed in three areas, two of them in NSW - Capertee Valley and Bundarra-Barraba regions • Breeds between July and January in Box-Ironbark and other temperate woodlands and riparian gallery forest dominated by River Sheoak.	• Low breeding habitat potential onsite due to small number of mature trees, open canopy, and lack of preferred woodland tree species • May be suitable foraging habitat in winter	2	Species	E4A, P	CE	Low
Botaurus poiciloptilus Australasian Bittern	• Favours permanent freshwater wetlands with tall, dense vegetation, particularly bull rushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.). • Nests in secluded places in densely-	• Limited habitat occurs on site around fringes of freshwater dams • Not recorded on site during fauna	4	Species	E1,P	E	Low

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	vegetated wetlands on a platform of reeds	survey					
Burhinus grallarius Bush Stone-curlew	• Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. • Nests on ground in scrape or small bare patch. Lays two eggs in spring or early summer • Largely nocturnal, being especially active on moonlit nights. • Feed on insects and small vertebrates, such as frogs, lizards and snakes	• Potential habitat occurs on site in Spotted Gum Grassy Dry Forest • Low breeding habitat potential as dense shrubs for nesting are predominantly absent	2	Ecosystem	E1, P	_	Low
Calyptorhynchus lathami Glossy Black Cockatoo	• Highly dependent on the distribution of *Allocasuarina* species, and is found in woodland dominated by *Allocasuarina* and in open forests where it forms a substantial middle layer. • Requires tree-hollows for breeding.	• Suitable potential habitat exists on site with presence of mid-canopy species *Allocasuarina lilttoralis* and *Allocasuarina torulosa* • Limited number of tree hollows available may limit breeding potential • Not recorded on site during fauna survey	65	Ecosystem	V,P,2	_	Moderate
Charadrius mongolus Lesser Sand-plover	• Coastal, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats	• Habitat does not occur on site	56	Species	V,P	C,J,K	None
Circus assimilis Spotted Harrier	• A widely dispersing species that prefers more open habitats, such as grassy open woodland, inland riparian woodland, grassland and shrub steppe	• Habitat available on site, largely vagrant - unlikely to occur apart from possible foraging activity • Found most commonly in native grassland.	2	Ecosystem	V,P	_	Low

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
Climacteris picumnus victoriae Brown Treecreeper (Eastern subspecies)	• Typical habitat is dry open forests and woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species. • Hollows >6cm in live trees or in dead standing or fallen timber necessary for breeding • Up to 80% of the diet is comprised of ants, then other invertebrates and nectar	• Potential habitat (White stringybark-Tallowood-Grey Gum dry forest) occurs on site • Limited number of tree hollows available may limit breeding potential • Not recorded on site during fauna survey	3	Ecosystem	V,P	_	Low
Coracina lineata Barred Cuckoo-shrike	• Typical habitat is rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses. • Occur in coastal eastern Australia from Cape York to the Manning River in NSW; Generally uncommon in their range, and are rare in NSW.	• Mixed eucalypt woodland habitat occurs on site • Not recorded on site during fauna survey	1	Ecosystem	V,P	_	Moderate
Daphoenositta chrysoptera Varied Sittella	• Found in eucalypt woodlands and forests throughout their range • Prefer rough-barked trees (like Stringybarks and Ironbarks) or mature trees with hollows or dead branches • Usually seen in flocks, moving swiftly between trees or foraging busily over branches or the trunk • Often quite noisy while feeding	• Moderate potential habitat occurs throughout site • Limited number of tree hollows available may limit breeding potential	23	Ecosystem	V,P	_	Moderate
Carterornis leucotis	• Occur in littoral rainforest, wet and	• Potential habitat occurs	_	Species	V	_	Moderate

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
White-eared Monarch	dry sclerophyll forests, swamp forest, and regrowth forest • In NSW, White-eared Monarchs are generally found from the Queensland border south to Iluka at the mouth of the Clarence River, and inland as far as the Richmond Range. There are occasional records south of the Clarence River, near Woolgoolga and around Port Macquarie • Breed from Sept to March and nest high in the canopy	throughout site in mixed eucalypt woodland and paperbark swamp forest areas • Not recorded on site during fauna survey					
Dromaius novaehollandiae Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	• The populations in NSW occur in a range of predominantly open lowland habitats - grasslands, heathland, shrubland, open and shrubby woodlands, forest, and swamp and sedgeland communities	• No suitable habitat occurs on site	1	Species	E2	_	None
Ephippiorhynchus asiaticus Black-necked Stork	• Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat • Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.	• No suitable habitat occurs on site	45	Species	E1,P	_	Low
Esacus magnirostris Beach Stone-curlew	• Restricted to coastal habitats including beaches, islands, reefs and in estuaries	• No suitable habitat occurs on site	1	Species	E4A, P	_	None
Glossopsitta pusilla Little Lorikeet	• Forages primarily in the canopy of open *Eucalyptus* forest and woodland, yet also finds food in *Angophora, Melaleuca* and other tree	• Potential habitat (Eucalyptus woodland) occurs throughout the site • Not recorded on site during fauna	16	Ecosystem	V,P	_	Moderate

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	species • Roosts in treetops, often distant from feeding areas • Nesting season extends from May to September • Distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. NSW provides a large portion of the species' core habitat, with lorikeets found westward as far as Dubbo and Albury • Nomadic movements are common, influenced by season and food availability	survey					
Haematopus fuliginosus Sooty Oystercatcher	• Typical habitat is rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries	• No suitable habitat occurs on site	3	Species	V,P	_	None
Haematopus longirostris Pied Oystercatcher	• Typical habitat is intertidal flats of inlets and bays, open beaches and sandbanks	• No suitable habitat occurs on site	13	Species	E1,P	_	None
Hieraaetus morphnoides Little Eagle	• A wide-ranging species that occurs in a variety of habitats, but mainly occupies open eucalypt forest, woodland or open woodland • Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter	• Potential habitat occurs in eucalypt woodland areas throughout site • Not recorded on site during fauna survey • One record of occurrence within 10km of site	1	Ecosystem	V,P	_	Moderate
Irediparra gallinacean Comb-crested Jacana	• Inhabit permanent freshwater wetlands that are either still or slow-flowing, with a good surface cover of	• No suitable habitat occurs on site	1	Species	V,P	_	None

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	floating vegetation, especially water-lilies, or fringing and aquatic vegetation						
Bxobrychus flavicollis Black Bittern	• Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation • Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves	• No suitable habitat occurs on site	1	Species	V,P	_	None
Lathamus discolour Swift Parrot	• Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes • Favoured feed trees include winter flowering species such as Eucalyptus robusta, Corymbia maculata, C. gummifera, East of the Divide; E. sideroxylon, and E. albens West of the Divide	• Potential but limited foraging habitat occurs on site- *Corymbia maculata* and *Corymbia gummifera* occur as secondary canopy species	4	Ecosystem	E1,P, 3	E	Low
Lowophoictinia isura Square-tailed Kite	• This wide-ranging species is found in a variety of habitats including dry woodlands and open forests • Prefers timbered watercourses, particularly for nesting sites • Occupies large home range over 100km^2	• Theoretical habitat availability due to large home ranges • Low quality nesting habitat (preferred near to watercourses)	33	Ecosystem	V,P,3	_	Moderate

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
Melanodryas cucullata cucullata Hooded Robin	• Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas • Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses • Found from Brisbane to Adelaide and throughout much of inland NSW, with the exception of the extreme north-west	• Limited potential habitat • Eucalyptus woodland occurs on site but is lacking structural diversity based on past logging history	_	Ecosystem	V	_	Low
Ninox connivens Barking Owl	• Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland • Flexible in its habitat use and hunting can extend in to closed forest and more open areas • Larger trees and hollow trees facilitate more abundant prey base for hunting and bredding success • Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile soils	• Moderate potential habitat occurs on site but large nesting hollows are scarce • Given a large home range, unlikely to occur apart from foraging activity	2	Ecosystem	V,P,3	_	Moderate
Ninox strenua Powerful Owl	• Found in open forests and woodlands, as well as along sheltered gullies in wet forests with dense understoreys, especially along watercourses. Will sometimes be found in open areas near forests	• Moderate quality habitat occurs on site but large nesting hollows are scarce • Given a large home range, unlikely to occur apart from	12	Ecosystem	V,P,3	_	Low

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	such as farmland, parks and suburban areas, as well as in remnant bushland patches • Needs old growth trees to nest. • Occupies very large home ranges	foraging activity					
Oxyura Australis Blue-billed Duck	• Completely aquatic species, preferring deep water in large permanent wetlands and swamps with dense aquatic vegetation • Semi-migratory, dispersing up to 300km to breed in deep swamps • Most common in the southern Murray-Darling Basin area - generally only in coastal areas during summer or dry years	• Potential habitat availability in large quarry dams (in disturbed quarry area), prefers dense aquatic vegetation • No habitat occurs in proposed expansion area	1	Ecosystem	V,P	_	Low
Pandion cristatus Eastern Osprey	• Favour coastal areas, especially the mouths of large rivers, lagoons and lakes	• No suitable habitat occurs on site	44	Species	V,P,3	_	Low
Petroica boodang Scarlet Robin	• Lives in open forests and woodlands • Active throughout the day • During winter, it will visit more open habitats such as grasslands and farmland	• Potential habitat (mixed eucalypt woodland) occurs on site • Not recorded on site during fauna survey	1	Ecosystem	V,P	_	Moderate
Ptilinopus magnificus Wompoo Fruit-Dove	• Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests • Occurs along the coast and coastal ranges from the Hunter River in NSW to Cape York Peninsula, though rare south of Coffs Harbour	• No suitable habitat occurs on site	_	Ecosystem	V	_	Low
Ptilinopus regina	• Sub-tropical and dry rainforest and	• No habitat availability, prefers	1	Ecosystem	V,P	_	None

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
Rose-crowned Fruit-Dove	occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful • Numbers increase in Spring and Summer in response to food availability in NE NSW	rainforest and occasionally moist eucalypt forest, unlikely to occur					
Stagonopleura guttata Diamond Firetail	• Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum *Eucalyptus pauciflora* Woodlands • Endemic to south-eastern Australia, extending from central Queensland to the Eyre Peninsula in South Australia • Not commonly found in coastal districts	• Potential habitat (Spotted Gum Grassy Dry-Forest) occurs on site, dense shrubs for nesting predominantly absent	_	Ecosystem	V	_	Low
Sternula albifrons Little Tern	• Typical habitat is coastal, preferring sheltered environments • Nests in low dunes or on sandy beaches near estuary mouths, lakes and islands	• No habitat available on the site	12	Species	E1,P	C,J,K	None
Turnix maculosus Red-backed Button Quail	• Mainly a species of coastal and subcoastal regions • In NSW, occurs in grasslands, heath and crops. Prefers sites close to water, especially when breeding. • The species has been observed associated with the following grasses (in various vegetation formations): speargrass *Heteropogon*, Blady Grass *Imperata cylindrica*, *Triodia*, *Sorghum*, and Buffel Grass	• No suitable habitat occurs on site, prefers grasslands, heath and crops	_	Species	V	_	None

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	Cenchrus ciliaris						
Tyto longimembris Eastern Grass Owl	• Typical habitat is tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains	• Low habitat availability, prefers areas with tall grass, including tussocks, grassy plains, swampy areas or sedges on floodplains	22	Ecosystem	V,P,3	_	Low
Tyto novaehollandiae Masked Owl	• Typical habitat is dry eucalypt forest and woodland • Roosts and breeds in moist eucalypt forested gullies • Large home-range of 500 to 1000 hectares	• Habitat available on site, large hollow nesting habitat scarce, nearby records to site (within 2km). Unlikely to occur apart from foraging activity	18	Ecosystem	V,P,3	_	Moderate
Tyto tenebricosa Sooty Owl	• Typical habitat is rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests • Requires very large tree-hollows for nesting	• Low habitat availability, large hollow nesting habitat scarce, prefers rainforest or moister forest types	3	Ecosystem	V,P,3	_	Low
Xenus cinereus Terek Sandpiper	• Typical habitat includes coastal mudflats, lagoons, creeks and estuaries	• No habitat available on the site	3	Species	V,P	C,J,K	None
MAMMALS							
Aepyprymnus rufescens Rufous Bettong	• Inhabit a variety of forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey. A dense cover of tall native grasses is the preferred shelter • They sleep during the day in cone-shaped nests constructed of grass in a shallow depression at the base of a	• Potential habitat in woodland areas, native grasses in ground layer unlikely tall or dense enough for favourable habitat	1	Species	V,P	_	Moderate

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	tussock or fallen log						
Dasyurus maculatus Spotted-tailed Quoll	• Found in a range of forest habitats, from rainforest to open woodland but seem to prefer moist forests such as rainforests and closed eucalypt forest • Requires forest with suitable den sites such as rock crevices, caves, hollow logs, burrows and tree-hollows	• Potential habitat availability on site , more so in gullies. Foraging habitat available although den opportunities are scarce. Large home ranges.	32	Ecosystem	V,P	E	Low
Cercartetus nanus Eastern Pygmy Possum	• Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath • Found in south-eastern Australia, from southern Queensland to eastern South Australia and Tasmania • In Northern NSW, most often found in rainforest • Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes • Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum dreys or thickets of vegetation.	• Possible habitat availability in woodland areas although lack of understorey and sparsity of trees may be a deterrent. Flowering shrubs are very sparse on the site and shelter habitat such as tree hollows is limited.	None	Species	V	_	Low
Chalinolobus nigrogriseus Hoary Wattled Bat	• Occurs in dry open eucalypt forests, favouring forests dominated by Spotted Gum, boxes and ironbarks, and heathy coastal forests where Red Bloodwood and Scribbly Gum	• Foraging habitat available on site. Limited roosting habitat available due to scarcity of hollow-bearing trees or rock	1	Ecosystem	V,P	_	Moderate

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	are common. Because it flies fast below the canopy level, forests with naturally sparse understorey layers may provide the best habitat.	crevices.					
Falsistrellus tasmaniensis Eastern False Pipistrelle	• Prefers moist habitats, with trees taller than 20 m. • Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	• Foraging habitat available on site, roosting habitat (hollow-bearing trees) are scarce. Recorded on site as possible identification (Anabat data likely to be confused with calls with those of other bat species)	2	Ecosystem	V,P	_	Present (AnaBat record, possible confidence)
Kerivoula papuensis Golden-tipped Bat	• Typical habitat is rainforest and adjacent wet and dry sclerophyll forest • Roosts on small steams in rainforest gullies – roosting in small in abandoned hanging bird nests, tree hollows, dense foliage and epiphytes • Specialist feeder on small web-building spiders	• Moderate habitat availability, prefers rainforest or forest adjacent to rainforest. Roosts mainly in rainforest gullies - unlikely to occur apart from foraging activity.	5	Ecosystem	V,P	_	Moderate
Miniopterus australis Little Bentwing-bat	• Moist environments where it roosts in large numbers in caves, old mines, stormwater tunnels and occasionally buildings. • Forages in forests and woodlands and grassland.	• Foraging habitat available on site. Breeding and roosting habitat absent due to scarcity of caves or similar habitat. Recorded on site by Anabat detection.	68	Species	V,P	_	Present (AnaBat record, Confident confidence)
Miniopterus schreibersii oceanensis Eastern Bentwing-bat	• Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. • Hunt in forested areas, catching moths and other flying insects above	• Foraging habitat available on site. Breeding and roosting habitat absent due to scarcity of caves or similar habitat. Recorded on site by Anabat detection as probable Identification. (Some possibility of	28	Ecosystem & Species	V,P	_	Present (AnaBat record, Probable confidence)

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	the tree tops	confusion of calls with those of other bat species).					
Mormopterus norfolkensis Eastern Freetail Bat	• Can be found in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. • Roost mainly in tree-hollows, but will also roost under bark or in man-made structure. • Most active in summer months, just after dusk and during the night.	• Foraging habitat available on site. Limited roosting habitat available due to scarcity of hollow-bearing trees. Recorded on site by Anabat detection.	20	Ecosystem	V,P	_	Present (AnaBat record, Confident confidence)
Myotis macropus Southern Myotis	• Often roosts in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. • Forages over streams and pools. • Most active in summer months, just after dusk and during the night.	• Foraging habitat available on site particularly near larger waterbodies in quarry area. Roosting habitat such as caves, mine shafts or hollow-bearing trees is rare or absent.	18	Ecosystem & Species	V,P	_	Moderate
Petaurus australis Yellow-bellied Glider	• Found in mature eucalypt forests in temperate to subtropical regions of eastern Australia. • Inhabits a wide range of forest types but prefers resource rich forests where mature trees provide nesting hollows. • Winter-flowering eucalypts provide nectar and pollen, and some eucalypts are suitable for tapping sap.	• Limited potential habitat occurs in woodland areas throughout site • Foraging habitat is available but large hollow bearing trees for nesting are scarce	9	Ecosystem	V,P	_	Low
Petaurus norfolcensis	• Typical habitat in coastal areas is Blackbutt-Bloodwood forest with	• Potential habitat in woodland areas but lack of understorey for	24	Species	V,P	_	Moderate

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
Squirrel Glider	heath understorey. • Prefers mixed species stands with a shrub or Acacia midstorey.	foraging and tree hollows for shelter would likely be a deterrent					
Phascogale tapoatafa Brush-tailed Phascogale	• Typical habitat is dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. • Also inhabit heath, swamps, rainforest and wet sclerophyll forest.	• Moderate potential habitat in woodland areas throughout site • Not recorded on site during fauna survey	5	Species	V,P	_	Moderate
Phascolarctos cinereus Koala	• Lives in eucalypt woodlands and forests. • Home range size varies according to quality of habitat, ranging from less than two hectares to several hundred hectares. • Most active in summer months during breeding season	• Potential koala habitat according to Clause 7 of SEPP 44 present on site. • No breeding population present (meaning no core koala habitat). • One group of old scats observed on ridgetop of site, numerous possible koala scratches (old) observed on Grey Gum trunks across the site	805	Species	V,P	V	Present (historical indirect evidence)
Potorous tridactylus Long-nosed Potoroo	• Inhabits coastal heaths and dry and wet sclerophyll forests; sandy loam soil is a common feature. • Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. • In NSW, generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760 mm	• Limited potential habitat occurs on site although lack of dense understory would likely be a deterrent for this species	_	Ecosystem	V	V	Low

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
Planigale maculate Common Planigale	• Typical habitat is rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water • Shelters and breeds in hollow logs, under bark, rocks, cracks in soil, grass tussocks or building debris • Distribution is Coastal north-eastern NSW, coastal east Queensland and Arnhem Land	• Potential habitat occurs in woodland areas and paperbark swamp forest areas • Not detected on site during fauna survey	4	Species	V,P	_	Moderate
Pseudomys gracilicaudatus Eastern Chestnut Mouse	• Typical habitat is heathland mainly in dense, wet heath and swamps • Mainly occurs north from the Hawkesbury River area as scattered records along to coast and eastern fall of the Great Dividing Range extending north into Queensland	• Marginal potential habitat in paperbark swamp forest areas • Not detected on site during fauna survey	14	Species	V,P	_	Low
Pteropus poliocephalus Grey-headed Flying Fox	• Utilises vegetation communities including rainforests, open forests, closed and open woodlands. • Roost sites are typically located near water, such as lakes, rivers or the coast • Forages primarily for eucalypt blossom and related genera but in some areas it also utilises a wide range of rainforest and cultivated fruits.	• Foraging habitat available in flowering eucalypts on site • Species were detected during spotlight survey • No camps detected on site or adjacent survey	121	Ecosystem & Species	V,P	V	Present (foraging individuals observed and heard)
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	• Forages in most habitats (with and without trees) across its very wide range,	• Foraging habitat available on site • Limited roosting habitat available due to scarcity of hollow-bearing	2	Ecosystem	V,P	_	Present (AnaBat record,

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	• Roost in groups in tree hollows and buildings - also known to utilise mammal burrows	trees • Recorded on site by Anabat detection as a *possible* Identification (likely to be confused with calls with those of other bat species).					Confident confidence)
Scoteanax rueppellii Greater Broad-nosed Bat	• Rainforest, wet and dry sclerophyll and woodland. • Usually roosts in tree-hollows. • Forages over streams and pools. • Most active in summer months, just after dusk and during the night.	• Foraging habitat available on site. Limited roosting habitat available due to scarcity of hollow-bearing trees. Recorded on site by Anabat detection.	18	Ecosystem	V,P	_	Present (AnaBat record, Probable confidence)
Thylogale stigmatica *Red-legged Pademelon*	• Inhabits forest with a dense understorey and ground cover, including rainforest, moist eucalypt forest and vine scrub. • Patchily distributed along coastal and subcoastal eastern Australia from Cape York to the Hunter Valley in NSW	• Limited potential habitat on site although lack of dense understory would likely be a deterrent for this species.	_	Ecosystem	V	_	Low
Vespadelus troughtoni Eastern Cave Bat	• A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.	• Foraging habitat available on the site • Roosting habitat (caves) is absent.	10	Ecosystem & Species	V,P	_	Low
Syconycteris australis Common Blossom-bat	• Often roost in littoral rainforest and feed on nectar and pollen from flowers in adjacent heathland and paperbark swamps • Also recorded in subtropical	• Low habitat availability, prefers littoral rainforest for roosting and feeds in heath or paperbark swamps • Occasionally occurs in wet	1	Ecosystem	V,P	_	Low

Threatened species – likelihood of occurrence on Development Site (Credit Calculator and OEH Wildlife Atlas search)

Species	Habitat Description	Habitat on site	Records	Credit Type	NSW Status	EPBC Act	LoO
	rainforest, wet sclerophyll forest and other coastal forests	sclerophyll forests					
REPTILES							
Coeranoscincus reticulatis *Three-toed Snake-tooth Skink*	• Rainforest and occasionally moist eucalypt forest, on loamy or sandy soils • Occurs on the coast and ranges from the Macleay valley in NSW to south-eastern Queensland. • Very uncommon south of Grafton.	• Low habitat availability, prefers rainforest and occasionally moist eucalypt forest, on loamy or sandy soils. • Outside normal distribution range	_	Species	V	V	Low
Hoplocephalus bitorquatus *Pale-headed Snake*	• Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest • Patchy distribution from NE Queensland to NE quarter of NSW • Highly cryptic tree dwelling species that can spend weeks at a time hidden in tree hollows	• Potential habitat available though low occurrence of tree hollows would likely be a deterrent for this species	–	Species	V	_	Moderate
Hoplocephalus stephensii *Stephens Banded Snake*	• Occurs in rainforest and eucalypt forests and rocky areas up to 950 m in altitude • Coast and ranges from Southern Queensland to Gosford in NSW	• Low habitat availability, prefers rainforest and moist eucalypt forests and rocky areas	–	Species	V	_	Low

APPENDIX I

Credit Reports

Biodiversity credit report

This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 4/07/2017 Time: 4:02:00PM Calculator version: v4.0

Major Project details

Proposal ID:	0107/2015/2368MP
Proposal name:	Sancrox Quarry Expansion (SSD)
Proposal address:	Sancrox Road Sancrox NSW 2446
Proponent name:	Hanson Construction Materials Pty Ltd
Proponent address:	Locked Bag 5260 Parramatta NSW 2124
Proponent phone:	61 2 9354 2638
Assessor name:	Jeremy Pepper
Assessor address:	Level 3 10 Kings Road New Lambton NSW 2305
Assessor phone:	02 4037 3200
Assessor accreditation:	0107

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	0.55	33.00
Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	10.86	490.12
Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast	31.69	1,926.00
Total	43.10	2,449

Credit profiles

1. Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast, (NR263)

Number of ecosystem credits created	1,926
IBRA sub-region	Macleay Hastings - Northern Rivers

Offset options - Plant Community types	Offset options - IBRA sub-regions
Tallowwood - Small-fruited Grey Gum dry grassy open forest of the foothills of the NSW North Coast, (NR263) Blackbutt - Tallowwood dry grassy open forest of the central parts NSW North Coast Bioregion, (NR119) Blackbutt - Turpentine open forest of the foothills of the NSW North Coast Bioregion, (NR124) Blackbutt grassy open forest of the lower Clarence Valley of the NSW North Coast Bioregion, (NR125) Brush Box tall moist forest of the northern ranges of the NSW North Coast Bioregion, (NR144) Red Mahogany open forest of the coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion, (NR222) Tallowwood dry grassy forest of the far northern ranges of the NSW North Coast Bioregion, (NR267)	Macleay Hastings - Northern Rivers and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion, (NR117)

Number of ecosystem credits created	33
IBRA sub-region	Macleay Hastings - Northern Rivers

Offset options - Plant Community types	Offset options - IBRA sub-regions
Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion, (NR117) Flooded Gum - Brush Box moist forest of the coastal ranges of the North Coast, (NR159) Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast, (NR160) Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion, (NR219) Spotted Gum - Brush Box moist forest of ranges of the southern Clarence Valley of the NSW North Coast Bioregion, (NR243) Spotted Gum - Grey Ironbark shrubby open forest of the Richmond Range of the NSW North Coast, (NR248) Sydney Blue Gum open forest on coastal foothills and escarpment of the North Coast, (NR258) Tallowwood - Brush Box moist open forest of the coastal ranges of the central NSW North Coast, (NR260) Tallowwood - Narrow-leaved White Mahogany - Spotted Gum moist open forest in the Washpool area of the NSW North Coast, (NR261) Turpentine moist open forest of the coastal hills and ranges of the NSW North Coast Bioregion, (NR274)	Macleay Hastings - Northern Rivers and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

3. Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion, (NR247)

Number of ecosystem credits created	490
IBRA sub-region	Macleay Hastings - Northern Rivers

Offset options - Plant Community types	Offset options - IBRA sub-regions
Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion, (NR247)	Macleay Hastings - Northern Rivers and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Summary of species credits required

APPENDIX J

Orchid Reports

15 January 2016

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Hanson Heidelberg Cement Group
Level 10, 35 Clarence Street
SYDNEY NSW 2000

Attention: Pip Cox

Dear Pip

Sancrox Quarry Expansion
State Significant Development Application
Targeted Orchid Survey - Final Report

Please find enclosed our final report describing the methods and results of our survey for threatened orchids on the proposed Quarry Expansion Area.

Please don't hesitate to call should you wish to discuss the results or recommendations at any convenient time.

Yours sincerely

JEREMY PEPPER
Technical Discipline Manager, Ecology

Checked/ G Leonard
Authorised by: JP

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(PO Box 447 New Lambton NSW 2305 Australia) T: +61 2 4037 3200 F: +61 2 4037 3201
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ABN 29 001 584 612

1 Introduction

Sancrox Quarry (the 'site') is located 8 kilometres (km) west of Port Macquarie, within the Port Macquarie Hastings local government area. The site compromises Lot 1 in DP 704890, Lot 1 in DP 720807, Lot 2 in DP 574308, Lot 353 in DP 754434 and an area of Crown land.

Hanson proposes to extend the life of the quarry by expanding the approved extraction boundary to facilitate the extraction and distribution of construction materials. The current annual extraction limit will be increased from 455,000 tonnes per annum (tpa) to 750,000 tpa. This will involve an expansion of the quarry footprint in a westerly direction into Lot 2, DP 574308. Construction of a concrete batching plant, asphalt plant and pug mil is also proposed. The project qualifies as State Significant Development pursuant to the NSW *Environmental Planning & Assessment Act 1979* (EP&A Act) and as such, an environmental impact statement (EIS) must accompany the project application.

In preparation for the forthcoming EIS, Hanson engaged SLR Consulting Australia Pty Ltd (SLR) to conduct threatened flora surveys, as the timing of surveys for some species is critical for their detection. In particular, there are several orchids and other cryptic plant species previously recorded in the Sancrox/Port Macquarie locality that can only be detected when in flower, and their flowering times fall generally in the August to October period. Details on these species and the survey techniques employed are provided in the following sections.

2 Scope and Aims

The primary aim of the current investigation was to conduct targeted searches for subject plant species during their known flowering periods. The specific objectives of the survey were to determine the presence (or likely occurrence) of cryptic threatened plant species within the proposed quarry expansion area and to identify recommendations for avoidance or management of threatened plants (where present).

The scope of the investigation was limited to the subject threatened plant species within those parts of the site that contain suitable habitat for these species within the timeframes specified.

3 Methods

The current investigation involved three main tasks:

- Desktop research
- Consultation
- Field survey

The methods and results of the investigation are described in detail in the following sections.

3.1 Desktop Research

Previous records of threatened species within 10 kilometres of the site were retrieved from the OEH BioNet *Atlas of NSW Wildlife* database. Threatened flora species previously recorded within 10 kilometres (km) of the site are listed in **Table 1**. A total of seven threatened species are listed, of which two species are 'cryptic', in that they must be in flower to enable detection: *Dendrobium melaleucaphilum* and *Phaius australis*.

Table 1 Threatened plant species recorded within the locality of Sancrox

Scientific Name	Common Name	NSW Status	EPBC Act	Flowering period	Habitat
Cynanchum elegans	White-flowered Wax Plant	E1,P	E	summer	Rainforest; littoral rainforest
Allocasuarina defungens	Dwarf Heath Casuarina	E1,P	E	N/A	Coastal heath
Maundia triglochinoides		V,P		spring/summer	Coastal wetlands
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V,P	V	N/A	New England Tablelands
Melaleuca biconvexa	Biconvex Paperbark	V,P	V	N/A	Swampy ground; swamp forest
Dendrobium melaleucaphilum	Spider Orchid	E1,P,2		July – October	Swampy ground; swamp forest; Melaleuca swamp (esp. *M. styphelioides*)
Phaius australis	Southern Swamp Orchid	E1,P,2	E	September – October	Swampy ground; swamp forest; Melaleuca swamp

A copy of the full BioNet search results for threatened species within 10 kilometres of the site is attached in **Appendix A**.

Additionally, analysis of regional vegetation mapping data indicated that the site contained potential habitat for *Melaleuca biconvexa* and *Cynanchum elegans*, although these two species can be detected without flowering parts and therefore at any time of year. These species, along with the orchids *Dendrobium melaleucaphilum* and *Phaius australis*, were the 'subject species' for the investigation. The flowering periods for both orchid species overlap and are generally between August and October. Targeted surveys were therefore required before the end of October to allow detection of these orchid species and address recommended survey guidelines (Bishop 2000, Jones 2000, DoE 2013).

Conversely, the site does not provide suitable habitat for *Allocasuarina defungens*, *Maundia triglochinoides* or *Eucalyptus nicholii*.

3.2 Consultation (Reference Sites)

As part of the desktop research phase, SLR investigated potential 'reference sites' for the two orchid species, in order to determine the current flowering status and therefore assist in their detection on the site. SLR contacted the NSW Office of Environment and Heritage (OEH) Coffs harbour office and Tinonee Native Orchid Nursery. OEH were able to advise on the flowering status of a local population of *D. melaleucaphilum* in the Mid-north Coast region. An OEH officer inspected a known location of *D. melaleucaphilum* and advised that, as of 16 October, the population had already flowered and no flowering parts remained. The OEH advice (D Young, OEH, email dated 16 October 2015) is provided below:

> *"An officer from the OEH visited two sites west of Urunga this morning where Dendrobium melaleucaphilum is known to occur. Each site contains a mix of both D. melaleucaphilum and D. tetragonum. The officer advised that at each site, a small proportion of plants had already flowered for this year (maybe about 5-10% of plants). The officer was unable to tell if it had been D. melaleucaphilum, D. tetragonum or both species that had flowered - the flowers were too old and shrivelled to tell (see attached)."*

OEH were not in a position to offer advice on reference sites for *P. australis*.

Contact was made with a Tinonee Native Orchids, a local nursery known for propagating local (and rare) native orchid species. Potted specimens of *P. australis* and other *Phaius* species were inspected on 16 October 2015 (the day of the survey) and were observed to be in flower in the nursery. Potted specimens of *D. melaleucaphilum* and the closely related *D. tetragonum* were observed to have already flowered.

3.3 Field Survey

The field survey was completed by Jeremy Pepper, Principal Ecologist (SLR) and Pip Cox, Environmental Scientist (Hanson) on 16 October 2015. The survey involved walked transects through areas of potential habitat for the subject plant species, according to the random meander technique (Cropper 1993). A total of 14 person hours were employed in the targeted searches over the course of one day. The random meander transects are mapped in **Figure 1**.

4 Results

4.1 Species Profiles

4.1.1 Spider Orchid *Dendrobium melaleucaphilum*

The Spider Orchid *D. melaleucaphilum* (Family Orchidaceae) is an orchid which grows on other plants (ie epiphytic) and sometimes on rocks (ie epilithic) and occurs in coastal districts and nearby ranges, extending from Queensland to its southern distributional limit in the lower Blue Mountains in New South Wales (NSW). In NSW, it is currently known from seven recent collections (OEH 2012). Stems are spreading to drooping, thin and wiry in the basal half, succulent, swollen and square in cross section in the upper half, tapering towards the tip, rooting only at the base. Leaves are spreading to erect, elliptic, 4.5–9 cm long, 15–25 mm wide, conduplicate, acuminate, thin and smooth. Inflorescences are 0.7–4 cm long and 2–8-flowered. Sepals and lateral petals are green to deep dull yellow with reddish margins or other markings; dorsal sepals are 38–60 mm long, 2–5 mm wide. The labellum is cream with reddish striations, 10–16 mm long and 7–9 mm wide (PlantNET 2015a).

This species grows frequently as an arboreal epiphyte of Prickly-leaved Paperbark *Melaleuca styphelioides*, less commonly on rainforest trees or on rocks. Flowering occurs between July and October. It is listed as 'endangered' under the NSW *Threatened Species Conservation Act 1995* (TSC Act), but is not listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In terms of identification and morphology, *D. melaleucaphilum* is very similar to the closely related Tree Spider Orchid *D. tetragonum*, which has shorter dorsal sepals (19 – 30 mm long) and shorter labellum (up to 10 mm long). *D. melaleucaphilum* was previously known as the 'large-flowered paperbark form' of *D. tetragonum* (PlantNET 2015a). Hence, these two species cannot, strictly speaking, be distinguished unless in flower.

4.1.2 Southern Swamp-orchid *Phaius australis*

The Southern Swamp-orchid *Phaius australis* (Family Orchidaceae) is a terrestrial (ground dwelling) orchid and produces the largest flowers of any Australian orchid (TSSC 2014). Each plant has 4–8 large, pleated leaves and 1–2 flower stalks. The leaves are long (approx. 70 cm) and narrow, in relation to width (3–10 cm wide). The flowers are red-brown with yellow veins inside the flower and grow in spikes on stalks that are 70–110 cm long (TSSC 2014).

P. australis grows in *Melaleuca quinquenervia* swamps and in sclerophyll forest, on the coast, at or near sea level (PlantNET 2015b). It has been reported north from Lake Cathie, but chiefly north from the Evans Head district (PlantNET 2015b). OEH (2014) notes that the species "Occurs in Queensland and north-east NSW as far south as Coffs Harbour". Historically, it extended farther south, to Port Macquarie". On this basis, the site at Sancrox is outside of the range limit of this species.

4.2 Survey Results

Survey results are listed in **Table 2**. A total of two orchid specimens were recorded during the survey, as follows:

- One specimen of Climbing Orchid *Erythrorchis cassythoides* was recorded on the northeastern portion of the site
- One specimen of a Spider Orchid *Dendrobium* sp. was recorded growing on the trunk of a Prickly-leaved Paperbark *Melaleuca styphelioides* (see **Photo 1**) located on the western margin of the quarry expansion area. The specimen is likely to be the threatened species *D. melaleucaphilum* (for reasons outlined below) but could also possibly be the closely related *D. tetragonum*.

The locations of the orchid records are displayed in **Figure 2**.

Table 2 Threatened plant survey results

Common Name	Species Name	TSC Act Status	EPBC Act	No. Stems
Climbing Orchid	*Erythrorchis cassythoides*	(not listed)	(not listed)	1
Spider Orchid	*Dendrobium* (?)* *melaleucaphilum*	E		1

* Identification to species level not possible until next flowering period.

No other threatened plant species were recorded during the survey. Notably, no evidence for the Southern Swamp-orchid *P australis* was recorded during the survey, despite the presence of 'marginal' habitat (in very restricted locations) and the timing of the survey during the flowering period for this orchid species. The quarry expansion area does not contain the primary habitat type being "*Melaleuca quinquenervia* swamps", for this species. There are, however, small stands of Flax-leaved Paperbark *Melaleuca linariifolia* occurring as a mid-canopy layer in small stands of mixed eucalypt forest in the far south of the site and in the far west of the site. These areas, whilst not ideal habitat for *P. australis*, were searched thoroughly during the survey and no individuals of this species were recorded.

The identity of the *Dendrobium* remains uncertain as the specimen recorded was not in flower and *D. melaleucaphilum* cannot be distinguished from *D. tetragonum* unless in flower. A positive identification of the *Dendrobium* specimen will not be possible until the next flowering period, which is likely to be July-August 2016. However, it is highly likely that the specimen is *D. melaleucaphilum*, rather than the closely related *D. tetragonum* given that:

- the specimen was recorded growing on *Melaleuca styphelioides*, the most common host species for *D. melaleucaphilum*, rather than a rainforest tree (the preferred habitat for *D. tetragonum*)
- the stems aren't pendulous (as with *D. tetragonum*)
- the site is not particularly shady (the location of the record is at the edge of a forest stand, with exposure to western sun)

Accordingly, future site planning and impact assessments for the EIS should be conducted on the assumption that the specimen is the threatened species *D. melaleucaphilum*, until such time as the specimen can be confidently identified to species level.

5 Discussion and Recommendations

Two orchid species were recorded during the current investigation. Of these, one specimen of an epiphytic *Dendrobium* orchid was recorded on an individual *Melaleuca styphelioides* near the western edge of the proposed quarry footprint. Until a positive identification can be made, it is recommended that the specimen be treated as the threatened species *D. melaleucaphilum*, which is listed as endangered in NSW under the TSC Act.

No other threatened plant species, notably *Melaleuca biconvexa* or *Cynanchum elegans*, or any other threatened plants previously recorded within the locality of the site, were recorded.

Further targeted surveys for threatened orchids are recommended during the known flowering period of *D. melaleucaphilum* (being approximately July-September). In this regard, confirmation of flowering of *D. melaleucaphilum* at a local reference population should be obtained from OEH and/or local nurseries, then inspection of the *Dendrobium* specimen recorded on the site should be conducted promptly to confirm flowering of the individual and then confirm species identity. To assist in identification, we recommend that high resolution photographs of the flowering parts and stems be taken and sent to the NSW Herbarium of the Royal Botanic Gardens, Sydney, for confirmation. No voucher samples (e.g. of flowering parts) should be physically removed from the plant, given its potential conservation status under the TSC Act and given the presence of only one individual on the site.

Additionally, opportunistic searches for threatened orchids should be conducted as part of any future ecological surveys within the proposed quarry expansion area as part of the investigation for the EIS.

Photo 1 Specimen of *Dendrobium* (?) *melaleucaphilum* recorded in western portion of site

6 References

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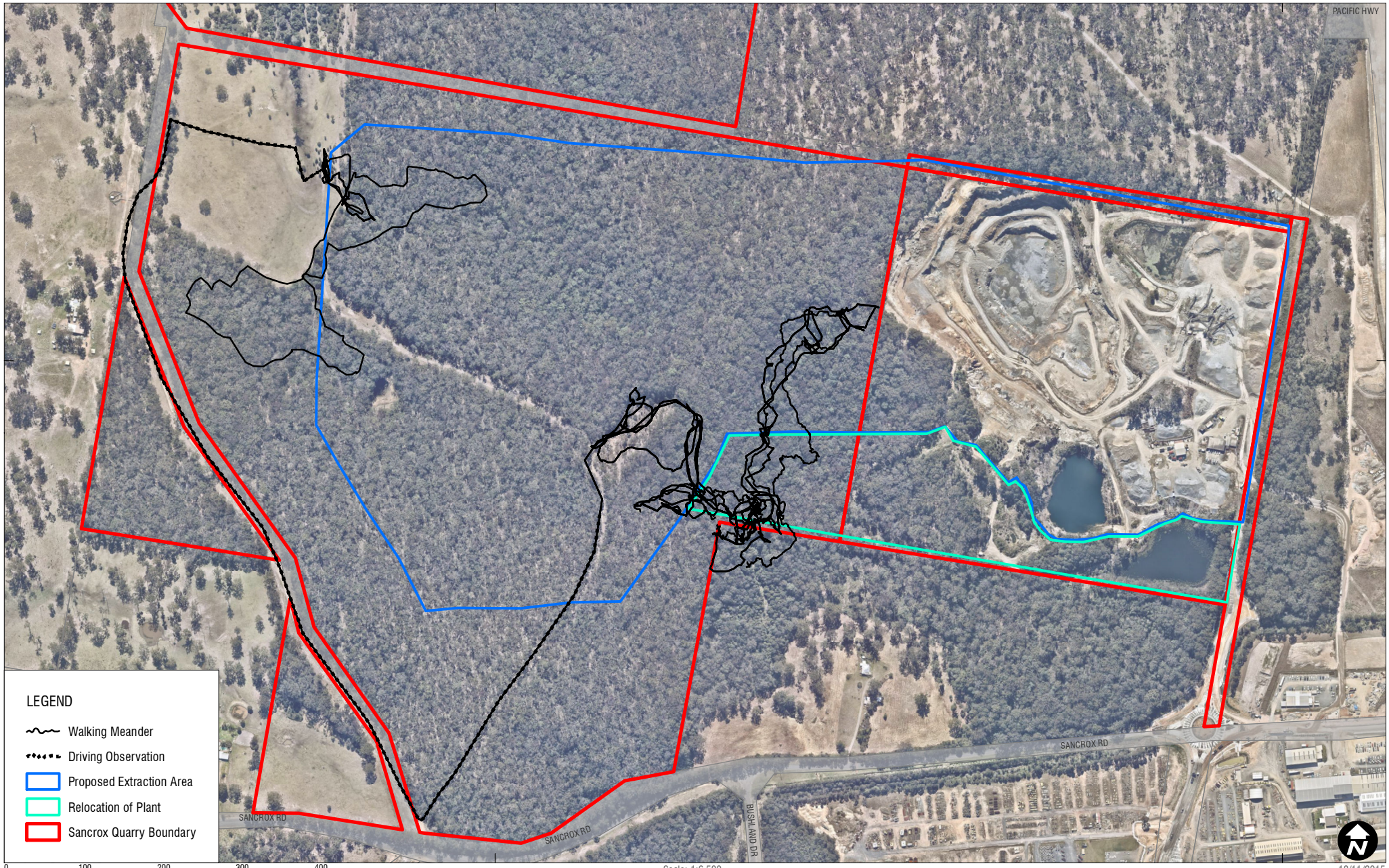

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SLR

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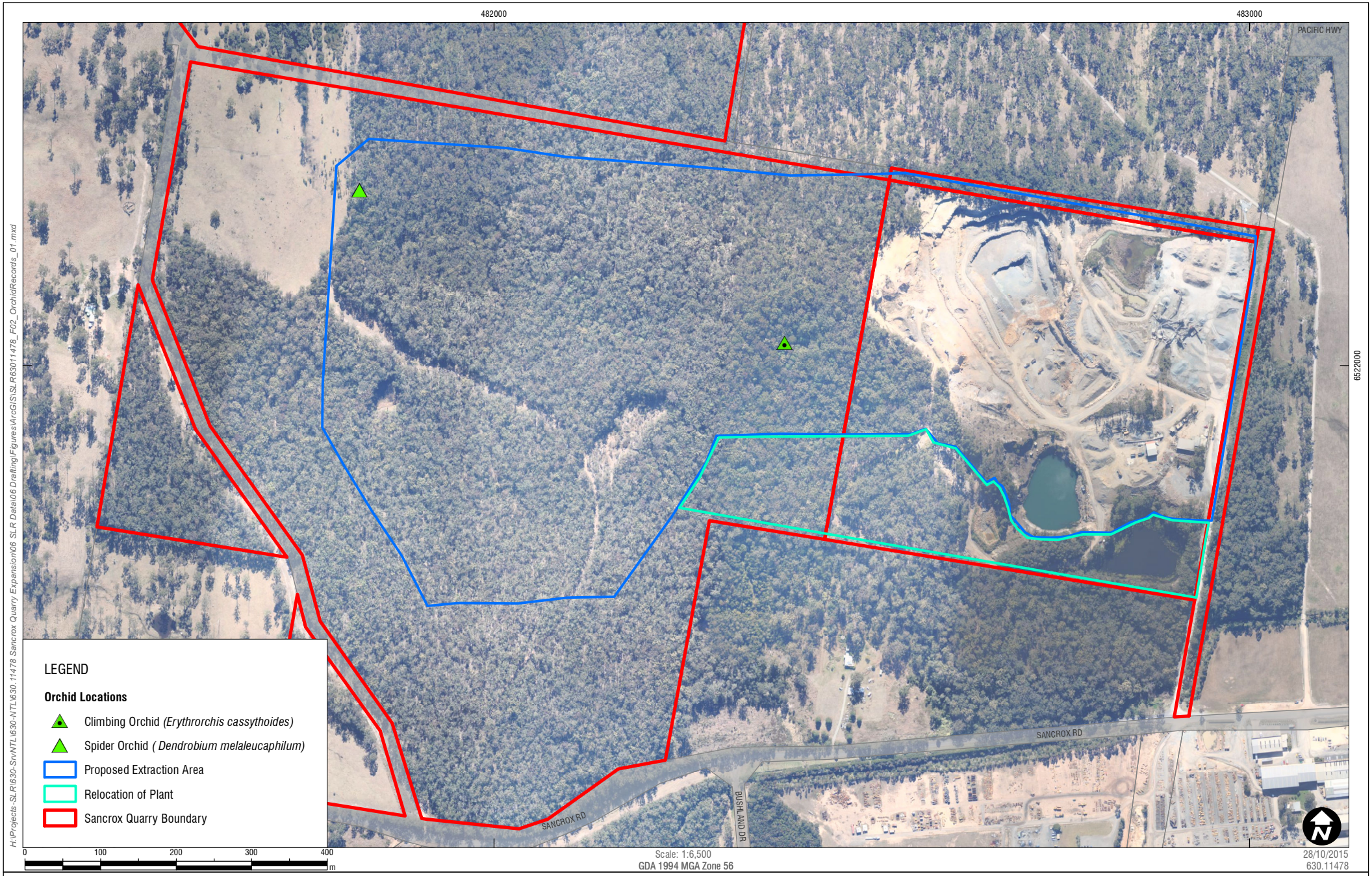
Threatened Orchid Survey
Survey Sites

FIGURE 1



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Threatened Orchid Survey
Orchid Records

FIGURE 2

Threatened Species Database Search Results (BioNet 10 km)

Data from the BioNet Atlas of NSW Wildlife website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions. Species listed under the Sensitive Species Data Policy may have their locations denatured (^ round to 0.1Â°; ^^ rounded to 0.01Â°). Copyright the State of NSW through the Office of Environment and Heritage. Search criteria : Licensed Report of all Valid Records o Threatened (listed on TSC Act 1995) Entities in selected area [North: -31.34 West: 152.71 East: 152.91 South: -31.52] returned a total of 1,705 records of 63 species. Report generated on 29/09/2015 11:56 AM

Kingdom	Class	Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records
Animalia	Amphibia	Myobatrachidae	3137	*Crinia tinnula*		Wallum Froglet	V,P		52
Animalia	Amphibia	Myobatrachidae	3075	*^^Mixophyes iteratus*		Giant Barred Frog	E1,P,2	E	1
Animalia	Amphibia	Hylidae	3166	*Litoria aurea*		Green and Golden Bell Frog	E1,P	V	2
Animalia	Amphibia	Hylidae	3169	*Litoria brevipalmata*		Green-thighed Frog	V,P		20
Animalia	Aves	Casuariidae	0001	*Dromaius novaehollandiae*		Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	E2,P		1
Animalia	Aves	Anatidae	0216	*Oxyura australis*		Blue-billed Duck	V,P		1
Animalia	Aves	Columbidae	0021	*Ptilinopus regina*		Rose-crowned Fruit-Dove	V,P		1
Animalia	Aves	Ciconiidae	0183	*Ephippiorhynchus asiaticus*		Black-necked Stork	E1,P		45
Animalia	Aves	Ardeidae	0197	*Botaurus poiciloptilus*		Australasian Bittern	E1,P	E	4
Animalia	Aves	Ardeidae	0196	*Ixobrychus flavicollis*		Black Bittern	V,P		1
Animalia	Aves	Accipitridae	0218	*Circus assimilis*		Spotted Harrier	V,P		2
Animalia	Aves	Accipitridae	0225	*Hieraaetus morphnoides*		Little Eagle	V,P		1
Animalia	Aves	Accipitridae	0230	*Lophoictinia isura*		Square-tailed Kite	V,P,3		33
Animalia	Aves	Accipitridae	8739	*Pandion cristatus*		Eastern Osprey	V,P,3		44
Animalia	Aves	Burhinidae	0174	*Burhinus grallarius*		Bush Stone-curlew	E1,P		2
Animalia	Aves	Burhinidae	0175	*Esacus magnirostris*		Beach Stone-curlew	E4A,P		1
Animalia	Aves	Haematopodidae	0131	*Haematopus fuliginosus*		Sooty Oystercatcher	V,P		3
Animalia	Aves	Haematopodidae	0130	*Haematopus longirostris*		Pied Oystercatcher	E1,P		13
Animalia	Aves	Charadriidae	0139	*Charadrius mongolus*		Lesser Sand-plover	V,P	C,J,K	55
Animalia	Aves	Jacanidae	0171	*Irediparra gallinacea*		Comb-crested Jacana	V,P		1
Animalia	Aves	Scolopacidae	0160	*Xenus cinereus*		Terek Sandpiper	V,P	C,J,K	3
Animalia	Aves	Laridae	0117	*Sternula albifrons*		Little Tern	E1,P	C,J,K	12
Animalia	Aves	Cacatuidae	0265	*^^Calyptorhynchus lathami*		Glossy Black-Cockatoo	V,P,2		65
Animalia	Aves	Psittacidae	0260	*Glossopsitta pusilla*		Little Lorikeet	V,P		16
Animalia	Aves	Psittacidae	0309	*Lathamus discolor*		Swift Parrot	E1,P,3	E	4
Animalia	Aves	Strigidae	0246	*Ninox connivens*		Barking Owl	V,P,3		2
Animalia	Aves	Strigidae	0248	*Ninox strenua*		Powerful Owl	V,P,3		12
Animalia	Aves	Tytonidae	0252	*Tyto longimembris*		Eastern Grass Owl	V,P,3		22
Animalia	Aves	Tytonidae	0250	*Tyto novaehollandiae*		Masked Owl	V,P,3		18
Animalia	Aves	Tytonidae	9924	*Tyto tenebricosa*		Sooty Owl	V,P,3		3
Animalia	Aves	Climacteridae	8127	*Climacteris picumnus victoriae*		Brown Treecreeper (eastern subspecies)	V,P		3
Animalia	Aves	Meliphagidae	0603	*Anthochaera phrygia*		Regent Honeyeater	E4A,P	CE	2
Animalia	Aves	Neosittidae	0549	*Daphoenositta chrysoptera*		Varied Sittella	V,P		23
Animalia	Aves	Campephagidae	0428	*Coracina lineata*		Barred Cuckoo-shrike	V,P		1
Animalia	Aves	Petroicidae	0380	*Petroica boodang*		Scarlet Robin	V,P		1
Animalia	Mammalia	Dasyuridae	1008	*Dasyurus maculatus*		Spotted-tailed Quoll	V,P	E	32
Animalia	Mammalia	Dasyuridae	1017	*Phascogale tapoatafa*		Brush-tailed Phascogale	V,P		5
Animalia	Mammalia	Dasyuridae	1045	*Planigale maculata*		Common Planigale	V,P		4
Animalia	Mammalia	Phascolarctidae	1162	*Phascolarctos cinereus*		Koala	V,P	V	805
Animalia	Mammalia	Petauridae	1136	*Petaurus australis*		Yellow-bellied Glider	V,P		9
Animalia	Mammalia	Petauridae	1137	*Petaurus norfolcensis*		Squirrel Glider	V,P		24
Animalia	Mammalia	Potoroidae	1187	*Aepyprymnus rufescens*		Rufous Bettong	V,P		1
Animalia	Mammalia	Pteropodidae	1280	*Pteropus poliocephalus*		Grey-headed Flying-fox	V,P	V	121
Animalia	Mammalia	Pteropodidae	1294	*Syconycteris australis*		Common Blossom-bat	V,P		1
Animalia	Mammalia	Emballonuridae	1321	*Saccolaimus flaviventris*		Yellow-bellied Sheathtail-bat	V,P		2
Animalia	Mammalia	Molossidae	1329	*Mormopterus norfolkensis*		Eastern Freetail-bat	V,P		20
Animalia	Mammalia	Vespertilionidae	1354	*Chalinolobus nigrogriseus*		Hoary Wattled Bat	V,P		1
Animalia	Mammalia	Vespertilionidae	1372	*Falsistrellus tasmaniensis*		Eastern False Pipistrelle	V,P		2
Animalia	Mammalia	Vespertilionidae	1369	*Kerivoula papuensis*		Golden-tipped Bat	V,P		5
Animalia	Mammalia	Vespertilionidae	1346	*Miniopterus australis*		Little Bentwing-bat	V,P		68

Kingdom	Class	Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records
Animalia	Mammalia	Vespertilionidae	1834	*Miniopterus schreibersii oceanensis*		Eastern Bentwing-bat	V,P		28
Animalia	Mammalia	Vespertilionidae	1357	*Myotis macropus*		Southern Myotis	V,P		18
Animalia	Mammalia	Vespertilionidae	1361	*Scoteanax rueppellii*		Greater Broad-nosed Bat	V,P		18
Animalia	Mammalia	Vespertilionidae	1025	*Vespadelus troughtoni*		Eastern Cave Bat	V,P		10
Animalia	Mammalia	Muridae	1466	*Pseudomys gracilicaudatus*		Eastern Chestnut Mouse	V,P		14
Animalia	Mammalia	Dugongidae	1558	*Dugong dugon*		Dugong	E1,P		2
Plantae	Flora	Apocynaceae	1226	*Cynanchum elegans*		White-flowered Wax Plant	E1,P	E	1
Plantae	Flora	Casuarinaceae	8980	*Allocasuarina defungens*		Dwarf Heath Casuarina	E1,P	E	9
Plantae	Flora	Juncaginaceae	3363	*Maundia triglochinoides*			V,P		3
Plantae	Flora	Myrtaceae	4134	*Eucalyptus nicholii*		Narrow-leaved Black Peppermint	V,P	V	3
Plantae	Flora	Myrtaceae	6809	*Melaleuca biconvexa*		Biconvex Paperbark	V,P	V	27
Plantae	Flora	Orchidaceae	6630	*^^Dendrobium melaleucaphilum*		Spider orchid	E1,P,2		1
Plantae	Flora	Orchidaceae	4480	*^^Phaius australis*		Southern Swamp Orchid	E1,P,2	E	1

APPENDIX K

EPBC Act PMST Search Results

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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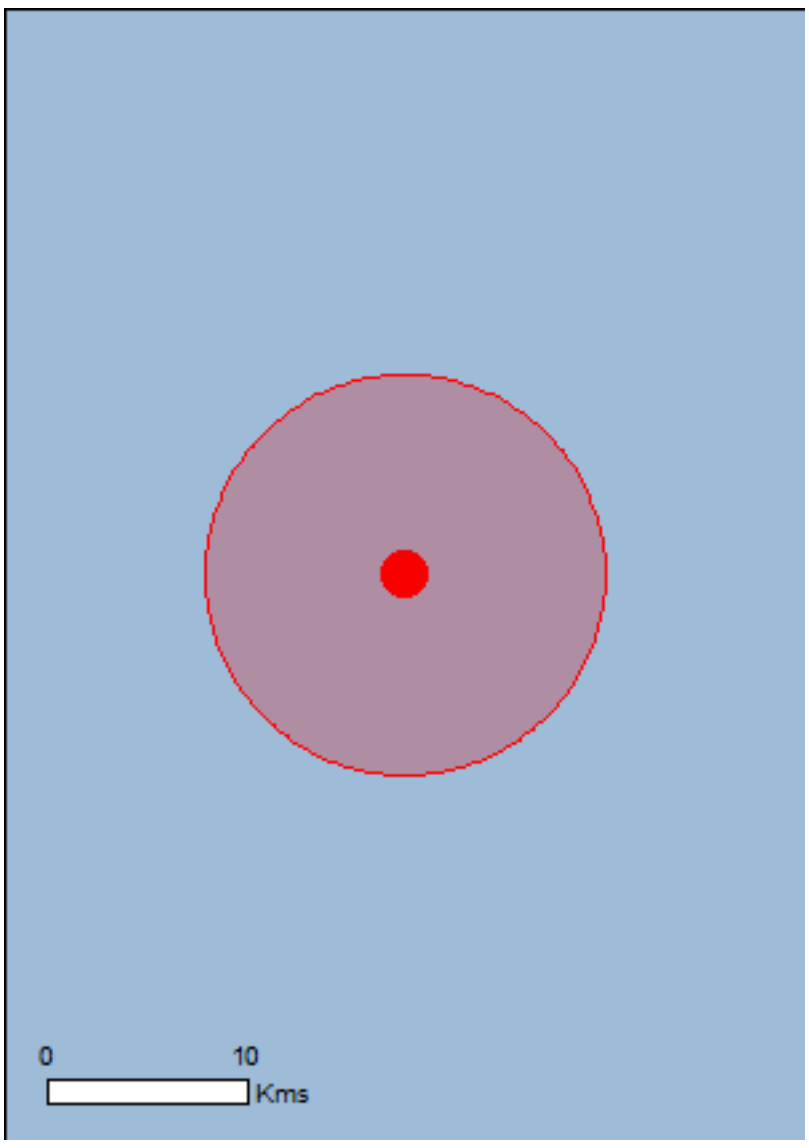

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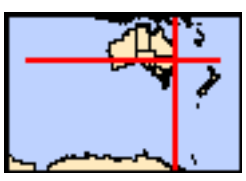

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	62
Listed Migratory Species:	56

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	5
Commonwealth Heritage Places:	None
Listed Marine Species:	61
Whales and Other Cetaceans:	1
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	8
Regional Forest Agreements:	1
Invasive Species:	36
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community likely to occur within area
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely

Name	Status	Type of Presence
		to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Fish		
Epinephelus daemelii Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Frogs		
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat known to occur within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
Mixophyes iteratus Giant Barred Frog, Southern Barred Frog [1944]	Endangered	Species or species habitat likely to occur within area
Insects		
Argynnis hyperbius inconstans Australian Fritillary [88056]	Critically Endangered	Species or species habitat likely to occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat likely to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Acronychia littoralis Scented Acronychia [8582]	Endangered	Species or species habitat likely to occur within area
Allocasuarina defungens Dwarf Heath Casuarina [21924]	Endangered	Species or species habitat known to occur within area
Allocasuarina thalassoscopica [21927]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Arthraxon hispidus Hairy-joint Grass [9338]	Vulnerable	Species or species habitat may occur within area
Asperula asthenes Trailing Woodruff [14004]	Vulnerable	Species or species habitat known to occur within area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur within area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat known to occur within area
Euphrasia arguta [4325]	Critically Endangered	Species or species habitat may occur within area
Hakea archaeoides [66702]	Vulnerable	Species or species habitat likely to occur within area
Macadamia integrifolia Macadamia Nut, Queensland Nut Tree, Smooth-shelled Macadamia, Bush Nut, Nut Oak [7326]	Vulnerable	Species or species habitat may occur within area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat known to occur within area
Parsonsia dorrigoensis Milky Silkpod [64684]	Endangered	Species or species habitat likely to occur within area
Phaius australis Lesser Swamp-orchid [5872]	Endangered	Species or species habitat may occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Migratory Marine Species		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Dugong dugon Dugong [28]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur

Name	Threatened	Type of Presence
		within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting may occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Postal Corporation
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Defence Service Homes Corporation
Commonwealth Land - Telstra Corporation Limited

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur

Name	Threatened	Type of Presence
		within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting may occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche sp. nov. Pacific Albatross [66511]	Vulnerable*	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or

Name	Threatened	Type of Presence
		related behaviour likely to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Xenus cinereus		
Terek Sandpiper [59300]		Roosting known to occur within area
Mammals		
Dugong dugon		
Dugong [28]		Species or species habitat may occur within area
Reptiles		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Sousa chinensis		
Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Forestry Management Areas in Wauchope	NSW
LNE Special Management Zone No1	NSW
Lake Innes	NSW
Lake Innes	NSW
Limeburners Creek	NSW
Queens Lake	NSW
Rawdon Creek	NSW
Woregore	NSW

Regional Forest Agreements	[Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
North East NSW RFA	New South Wales

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		

Name	Status	Type of Presence
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar		Species or species

Name	Status	Type of Presence
Groundsel [2624]		habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-31.43601 152.81544

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX L

Updated Quarry Layout


HAYDONS CREEK
Existing Quarry
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
Legend
Site Boundary
Final Pit (RL-40m)
Watercourses
Source:
DFSI DCDB/DTDB, 2018
Nearmap Imagery December 2017
Study Area
F 2.1
Drawing No: 0418291s_HRA_G007_R0.mxd
Sancrox Quarry Expansion Project
Date: 26/07/2018
Drawing Size: A4
Drawn By: GC / GR
Reviewed By: ME
Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56
0 100 200 300m
N
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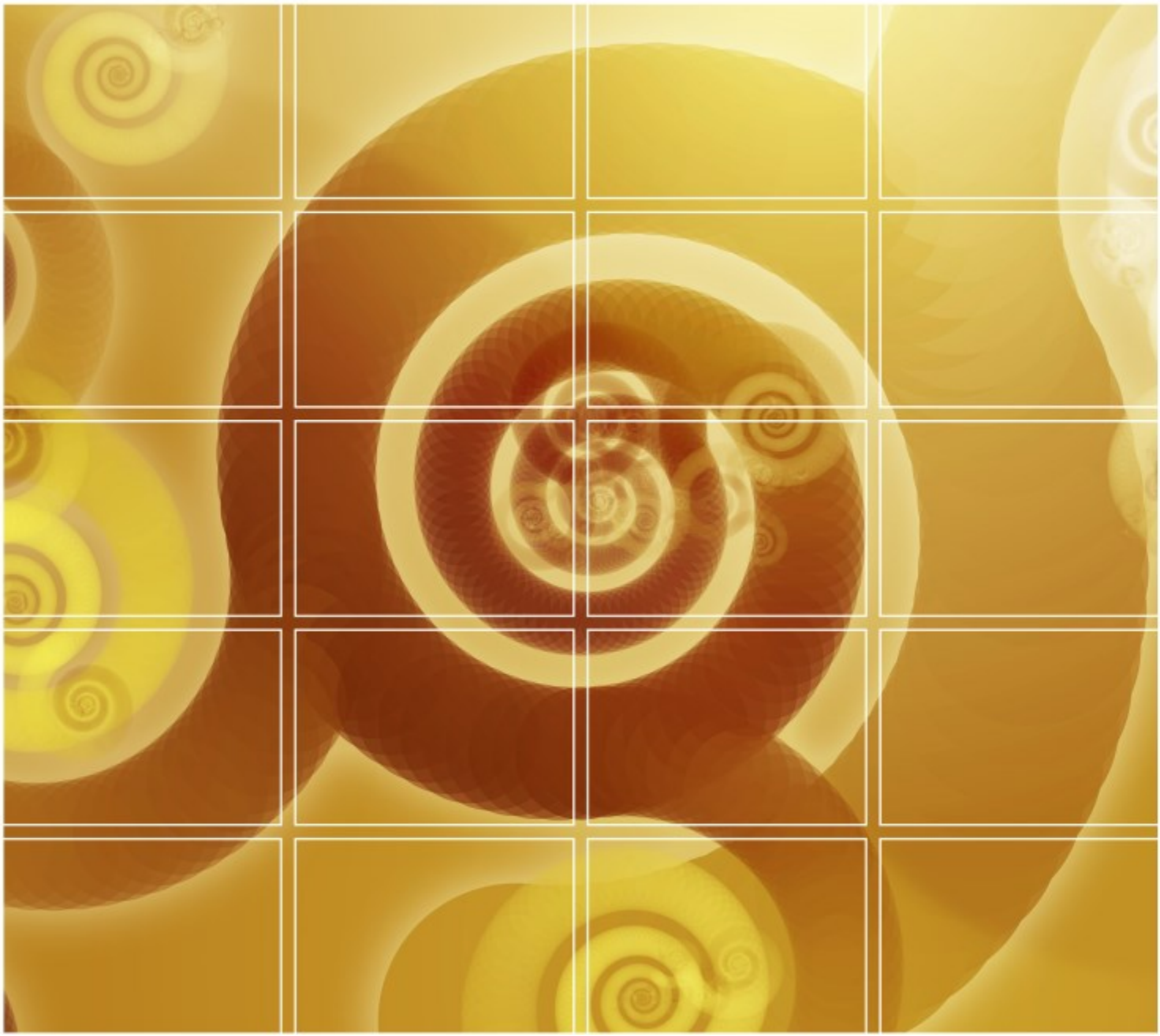
Annex D

Heritage Assessment



Sancrox Quarry
Heritage Assessment

Hanson Construction Materials Pty Ltd

August 2019

0418291

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The business of sustainability

ERM

Approved by:	*Thomas Buchan*
Position:	Project Manager
Signed:	
Date:	*28 August, 2019*
Approved by:	*Murray Curtis*
Position:	Partner Director
Signed:	
Date:	*28 August 2019*

Environmental Resources Management Australia Pty Ltd

Sancrox Quarry
Heritage Assessment_Final

Hanson Construction Materials Pty Ltd (Hanson)

August 2019

0418291_Final

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TERMS, DEFINITIONS & ABBREVIATIONS

ABBREVIATION	DEFINITION
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
BLALC	Birpai Local Aboriginal Land Council
CHL	Commonwealth Heritage List
DECCW	Department of Environment and Climate Change and Water
DoE	Department of Environment (now Department of Environment and Energy)
DP&E	Department of Planning and Environment
EIS	Environmental Impact Statement
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ERM	Environmental Resources Management Australia Pty Ltd
Hanson	Hanson Construction Materials Pty Ltd
HIS	Heritage Impact Statement
IBRA	Interim Biogeographic Regionalisation for Australia
IHO	Interim Heritage Orders
LGA	Local Government Area
NNTT	National Native Title Tribunal
NPW Act	National Parks and Wildlife Act 1974
NPWS	NSW National Parks and Wildlife Services
NTS Corp	Native Title Services Corporation
OEH	Office of Environment and Heritage (NSW)
ORALRA	Office of The Registrar, Aboriginal Land Rights Act
PAD	Potential Archaeological Deposit
PMHC	Port Macquarie Hastings Council
QA	Quality Assurance
RAP	Registered Aboriginal Party
RNE	Register of the National Estate
RPS HSO	RPS Harper Somers O'Sullivan
SEARS	Secretary's Environmental Assessment Requirement's
SHR	State Heritage Register
SSD	State Significant Development #7293
tpa	Tonnes per annum

TERM	DEFINITION
Aboriginal Heritage Impact Permit	a permit issued by the Director General of the Office of Environment and Heritage (OEH) (or their delegate) allowing a person to desecrate or harm an Aboriginal Place or Aboriginal objects. Not required for SSD.
Aboriginal object (as defined in the *NPW Act*)	any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises NSW, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains.
Aboriginal Place (as defined in the *NPW Act*)	a place declared under s.84 of the *National Parks and Wildlife Act 1974 (NPW Act*) that, in the opinion of the Minister, is or was of special significance to Aboriginal culture. Information about the location of Aboriginal Places in NSW can be found on the OEH website at www.environment.nsw.gov.au/nswcultureheritage/PlacesOfSignificance.htm.
Aboriginal culturally modified tree (as defined in the NPW Regulation)	a tree that, before or concurrent with (or both) the occupation of the area in which the tree is located by persons of non-Aboriginal extraction, has been scarred, carved or modified by an Aboriginal person by: • the deliberate removal, by traditional methods, of bark or wood from the tree, or • the deliberate modification, by traditional methods, of the wood of the tree.
activity	a project, development, activity or work (this term is used in its ordinary meaning, and does not just refer to an activity as defined by Part 5 of the *Environmental Planning and Assessment Act* 1979 (*EP&A Act*)).
disturbed land or land already disturbed by previous activity	land is disturbed if it has been the subject of a human activity that has changed the land's surface, being changes that remain clear and observable. Examples include ploughing, construction of rural infrastructure (such as dams and fences), construction of roads, trails and tracks (including fire trails and tracks and walking tracks), clearing vegetation, construction of buildings and the erection of other structures, construction or installation of utilities and other similar services (such as above or below ground electrical infrastructure, water or sewerage pipelines, stormwater drainage and other similar infrastructure) and construction of earthworks.
due diligence	taking reasonable and practical steps to determine whether a person's actions will harm an Aboriginal object and, if so, what measures can be taken to avoid that harm:
harm an Aboriginal object (as defined in the *NPW Act*)	• destroy, deface, damage an object • move an object from the land on which it is situated • cause or permit an object to be harmed.
Burra Charter	Australian best heritage practice reference that provides guidance for the conservation and management of places of cultural significance (cultural heritage places)
Minister	Minister administering the *NPW Act*
Source: DECCW (2010). Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales.	

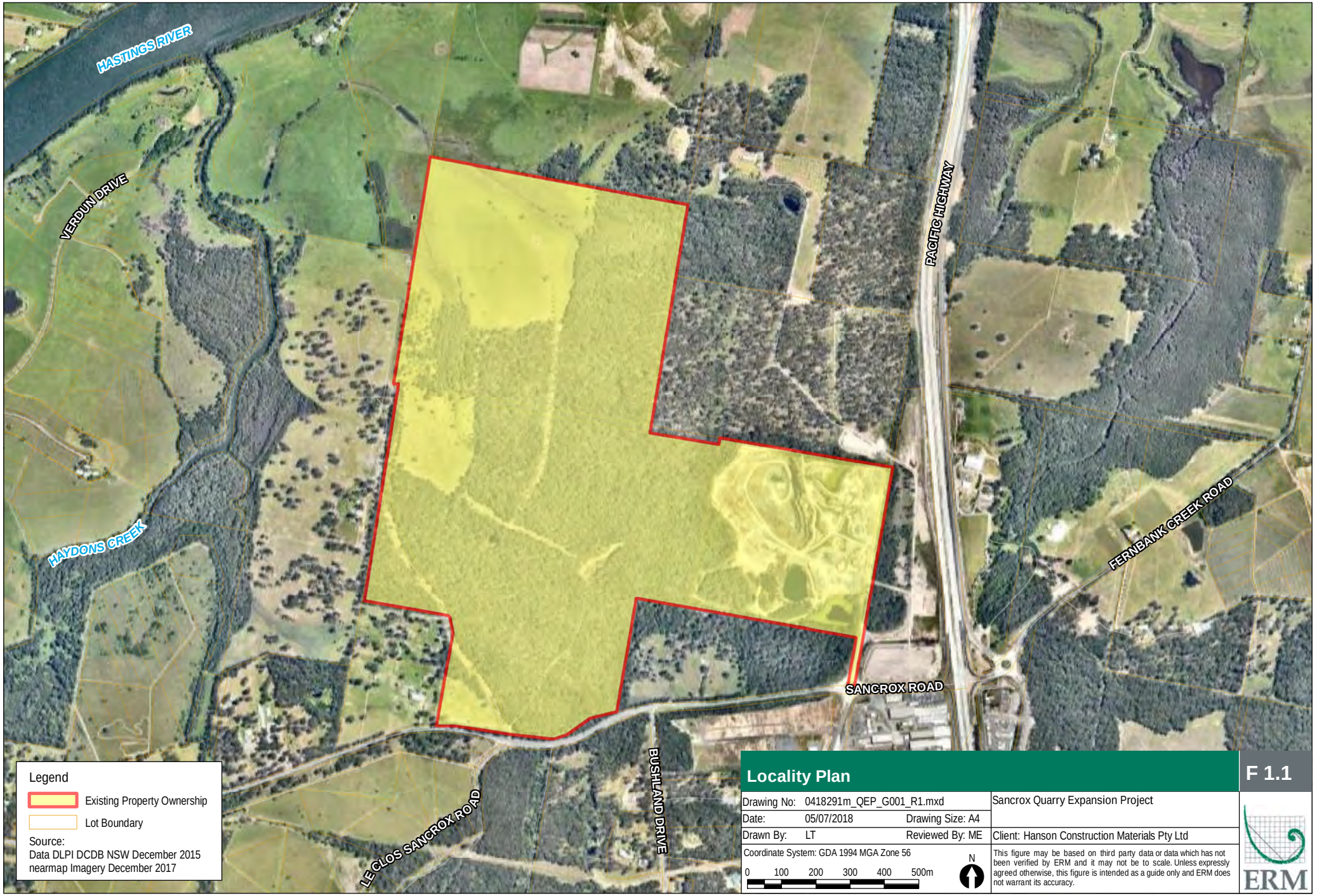
1 INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by Hanson Construction Materials Pty Ltd (Hanson) to undertake a Heritage Assessment to inform the Environmental Impact Statement (EIS) for the Sancrox Quarry Expansion Project (the Project). The proposed Project is a State Significant Development (SSD #7293) and therefore the planning approvals process is regulated under Part 4 of the *Environmental Planning and Assessment Act 1979* (the EP&A Act), which requires Department of Planning and Environment (DP&E) approval for development consent, supported by an EIS.

1.1 DESCRIPTION OF THE PROPOSED DEVELOPMENT

Hanson currently operates a hard rock quarry, known as Sancrox Quarry, on Sancrox Road, Sancrox, located approximately 8 kilometres (km) west of Port Macquarie, within the Port Macquarie Hastings Council (PMHC) local government area (LGA) (*Figure 1.1*). The quarry has been owned and operated by Hanson since 1998, and is considered a major economic resource for regional and state development. The proposed Project will extend the life of the quarry by expanding the approved extraction boundary to facilitate the extraction and distribution of high quality construction materials for the use in civil infrastructure and road construction projects.

Hanson is proposing to increase the current annual maximum extraction limit from approximately 455,000 tonnes per annum (tpa) to 750,000 tpa. This will involve an expansion of the quarry footprint in a westerly direction into Lot 2, DP 574308 (*Figure 1.2*). Additionally, the proposed Project includes the construction of a new concrete batching plant and recycling facility, asphalt production plant and pug mill at the quarry site (*Figure 1.3*).


HASTINGS RIVER
VERDUN DRIVE
HAYDONS CREEK
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
SANCROX ROAD
BUSHLAND DRIVE
LE CLOS SANCROX ROAD
Legend
Existing Property Ownership
Lot Boundary
Source:
Data DLPI DCDB NSW December 2015
nearmap Imagery December 2017
Locality Plan
F 1.1
Drawing No: 0418291m_QEP_G001_R1.mxd
Sancrox Quarry Expansion Project
Date: 05/07/2018
Drawing Size: A4
Drawn By: LT
Reviewed By: ME
Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56
0 100 200 300 400 500m
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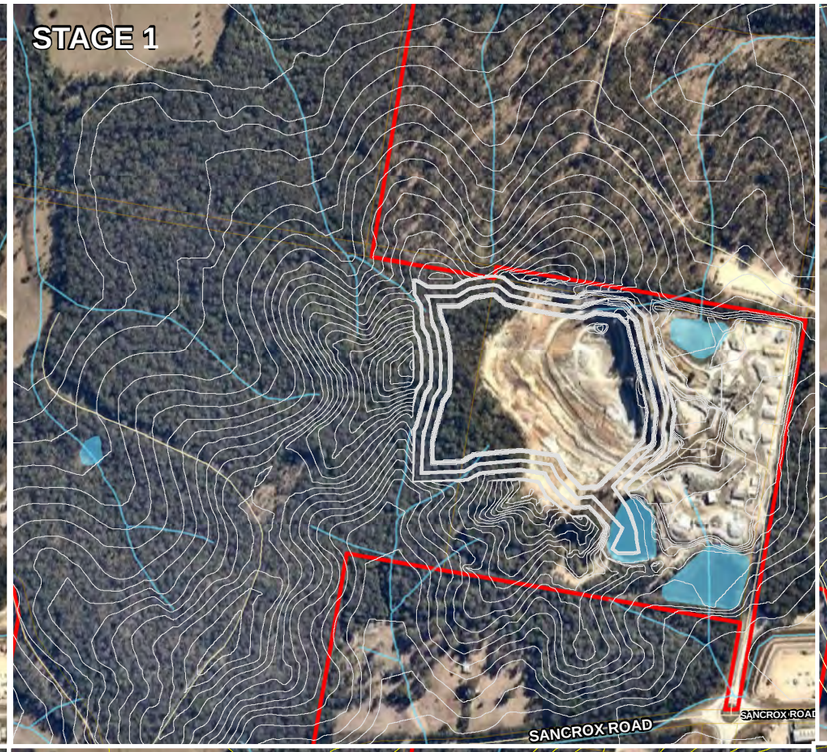

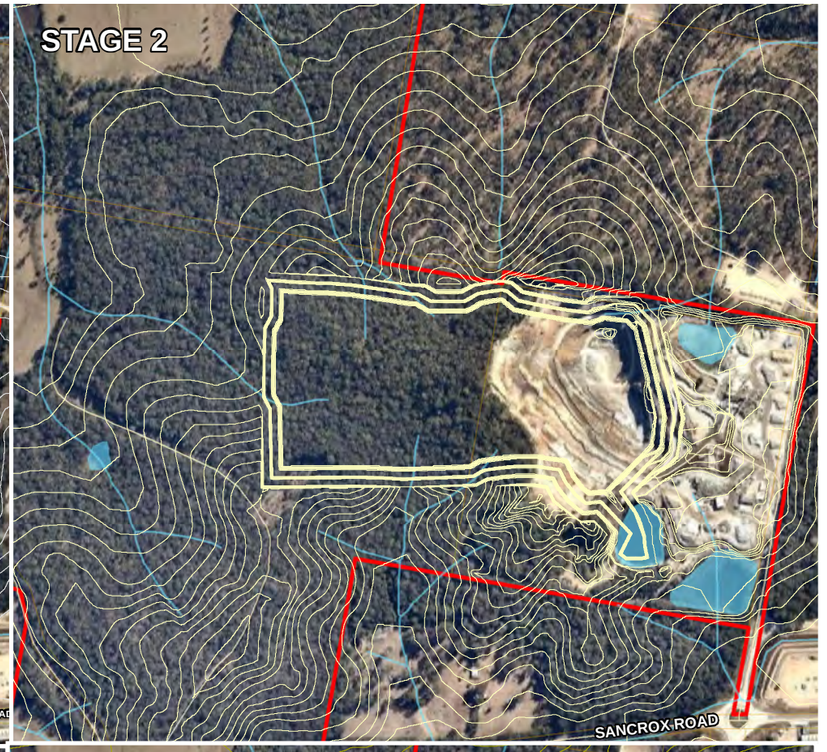

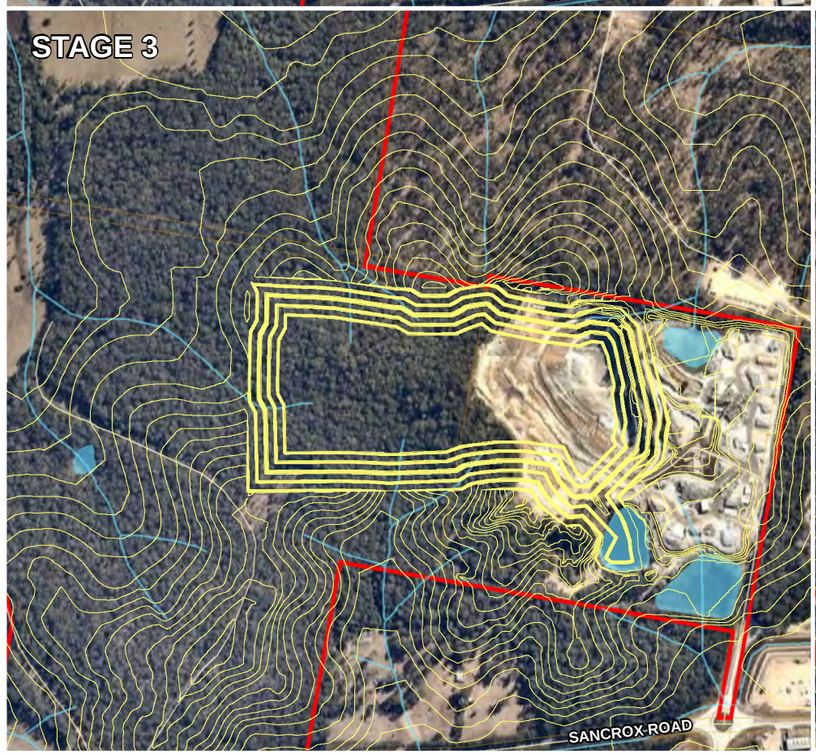

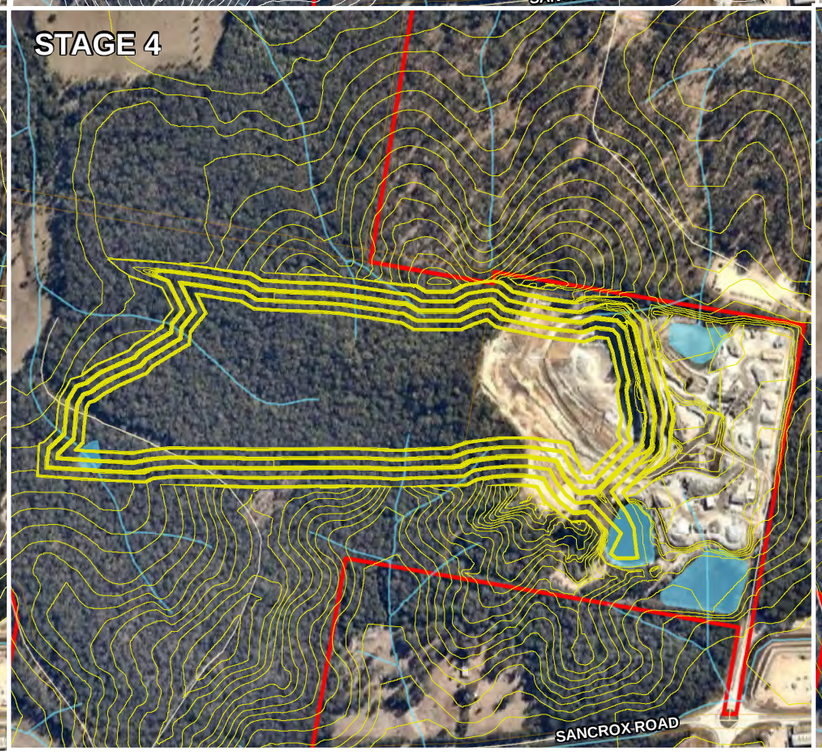

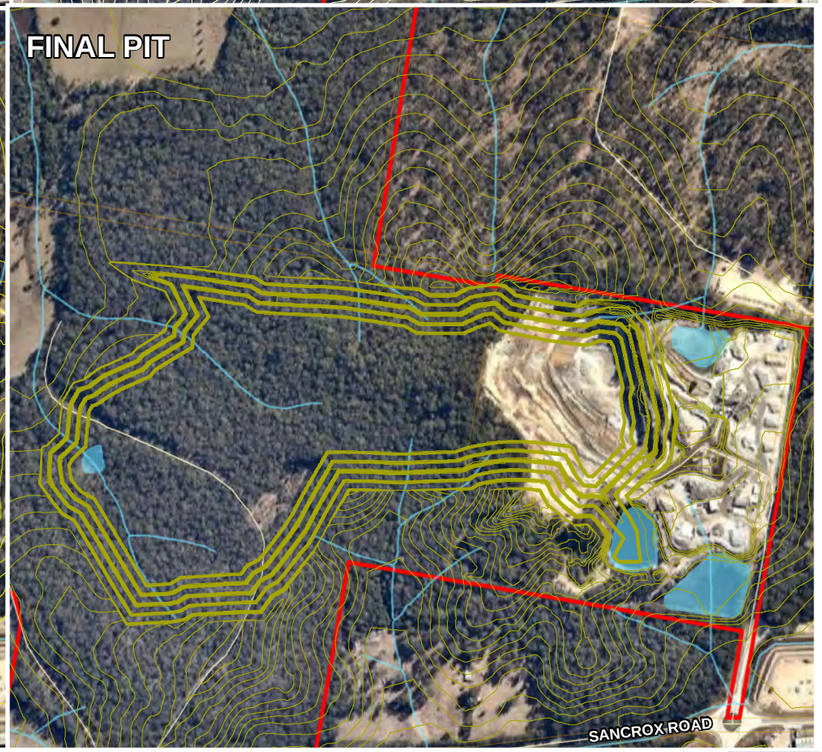

Legend

- Existing Property Ownership
- Lot Boundary
- Road Network
- Watercourses

Quarry Staging:

- Stage 1 (RL-14m)
- Stage 2 (RL-14m)
- Stage 3 (RL-40m)
- Stage 4 (RL-40m)
- Final Pit (RL-40m)

Source:
Spatial Data: DFSI DCDB, DTDB 2017
Imagery Data: nearmap August 2017

Quarry Staging

F 1.2

Drawing No:	0418291s_EIS_G002_R2.mxd		Sancrox Quarry Expansion Project
Date:	05/07/2018	Drawing Size: A4	
Drawn By:	LT	Reviewed By: ME	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 100 200m

N

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Quarry sump

Silt Retention Dam

Concrete Batching Plant & Recycling Facility

Three tier sediment treatment train

Pit Floor

Old Processing Plant (to be relocated)

New Processing Plant

New Asphalt Production Plant

New Stockpile Area

Existing Site Office, Weightbridge & Workshop

Water Holding Dam 1 (WHD1)

Water Holding Dam (WHD2)

Noise Bund

Legend

- Existing Property Ownership
- Lot Boundary
- Infrastructure
- Haul Road
- Road Network

Source:
Spatial Data: DFSI DCDB/DTDB 2017
Imagery Data: nearmap August 2017

Ancillary Infrastructure

F 1.3

Drawing No:	0418291s_HRA_G002_R3.mxd		Sancrox Quarry Expansion Project **Heritage** Assessment Report
Date:	30/09/2019	Drawing Size: A4	
Drawn By:	GC	Reviewed By: ME	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

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1.2 *OBJECTIVES AND SCOPE*

This work has been conducted to conform to the Secretary's Environmental Assessment Requirement's (SEARs) for the Project and has been undertaken in accordance with the following current legislation, regulations and best practice guidelines:

- *National Parks and Wildlife Act 1974;*
- *Heritage Act 1977*;
- Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW 2010a) (Consultation Guidelines);
- Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW (DECCW 2010b);
- Code of practice for archaeological investigation of Aboriginal objects in NSW (DECCW 2010c);
- Guide to investigating, assessing; and reporting on Aboriginal cultural heritage in NSW (OEH 2011); and
- the Australia ICOMOS Burra Charter 2013 (Burra Charter).

This report provides a combined assessment of the tangible and intangible cultural heritage values relating to the Project area as defined during desk based and field surveys undertaken during November 2017.

1.3 *SEARS AND AGENCY COMMENTS*

With specific reference to Heritage, the SEARS require:

SEARs	**Where addressed**
An assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including evidence of appropriate consultation with relevant Aboriginal communities/parties and documentation of the views of these stakeholders regarding the likely impact of the development on their cultural heritage; and	*Section 3* *Annex A*
Identification of historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items, having regard to the relevant policies and guidelines.	*Section 5* *Section 6.4*

The Heritage Council of NSW (the Heritage Council) submission for the revised SEARs notes that that an early grave is identified from the National Trust Register in the suburb of Sancrox. In this regard the area may have other historical archaeological potential associated with the development of the settlement of PMHC LGA which requires consideration and management.

The Heritage Council recommends that:

Heritage Council Requirements	Where addressed
The EIS should identify if there are any potential heritage items within the proposed Project area including historical archaeological potential. If any potential heritage items are likely to be affected, a Heritage Impact Statement (HIS) must be prepared in accordance with the guidelines in the NSW Heritage Manual 1996. The HIS should assess how the development would impact on any places of heritage significance in or surrounding the SSD site.	*Section 5* *Section 6.4* *No historical heritage items were found during the field survey, and there are no known non-Aboriginal heritage items located within the Project area.*
A historical archaeological assessment should be prepared by a suitably qualified historical archaeologist in accordance with the Heritage Division, Office of Environment and Heritage Guidelines 'Assessing Significance for Historical Archaeological Sites and 'Relics' 2009. This assessment should identify what relics, if any, are likely to be present, assess their significance and consider the impacts from the proposal on this potential resource. Where harm is likely to occur, it is recommended that the significance of the relics be considered in determining an appropriate mitigation strategy. If harm cannot be avoided in whole or part, an appropriate Research Design and Excavation Methodology should also be prepared to guide any proposed excavations.	

The NSW Office of Environment and Heritage (OEH) submission for the revised SEARs includes the following standard requirements:

OEH Standard Requirements	Where addressed
The EIS must identify and describe the Aboriginal cultural heritage values that exist across the whole area that will be affected by the project and document these in the EIS. This may include the need for surface survey and test excavation. The identification of cultural heritage values should be guided by the Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW (DECCW, 2011) and consultation with OEH regional officers.	*Section 4* *Section 6*
Where Aboriginal cultural heritage values are identified, consultation with Aboriginal people must be undertaken and documented in accordance with the Aboriginal cultural heritage consultation requirements for proponents 2010 (DECCW). The significance of cultural heritage values for Aboriginal people who have a cultural association with the land must be documented in the EIS.	*Section 3* *Annex A*
Impacts on Aboriginal cultural heritage values are to be assessed and documented in the EIS. The EIS must demonstrate attempts to avoid impact upon cultural heritage values and identify any conservation outcomes. Where impacts are unavoidable, the EIS must outline measures proposed to mitigate impacts. Any objects recorded as part of the assessment must be documented and notified to OEH.	*Section 8* *Section 9*
The EIS must provide a heritage assessment including but not limited to an assessment of impacts to State and local heritage including conservation areas, natural heritage areas, places of Aboriginal heritage value, buildings, works, relics, gardens, landscapes, views, trees should be assessed. Where impacts to State or locally significant heritage items are identified, the assessment shall:	*Section 5* *Section 6.4* *No historical heritage items were found during the field survey, and there are no known*

OEH Standard Requirements	Where addressed
outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) generally consistent with the NSW Heritage Manual (1996), a. be undertaken by a suitably qualified heritage consultant(s) (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria), b. include a statement of heritage impact for all heritage items (including significance assessment), c. consider impacts including, but not limited to, vibration, demolition, archaeological disturbance , altered historical arrangements and access, landscape and vistas, and architectural noise treatment (as relevant), and d. where potential archaeological impacts have been identified develop an appropriate archaeological assessment methodology, including research design, to guide physical archaeological test excavations (terrestrial and maritime as relevant) and include the results of these test excavations.	*non-Aboriginal heritage items located within the impact area.*

The OEH submission for the revised SEARs includes the following project-specific requirements:

OEH Project-Specific Requirements	Where addressed
The assessment of cultural heritage values must include a surface survey undertaken by a qualified archaeologist in areas with potential for subsurface Aboriginal deposits. The result of the surface survey is to inform the need for targeted test excavation to better assess the integrity, extent, distribution, nature and overall significance of the archaeological record. The results of surface surveys and test excavations are to be documented in the EIS.	*Section 6*
The EIS must outline procedures to be followed if Aboriginal objects are found at any stage of the life of the proposal to formulate appropriate measures to manage unforeseen impacts.	*Section 9.2.1*
The EIS must outline procedures to be followed in the event Aboriginal burials or skeletal material is uncovered during construction to formulate appropriate measures to manage the impacts to this material.	*Section 9.2.1*

1.4 AUTHORSHIP

Katherine Deverson (ERM Heritage Consultant) conducted the field survey on Wednesday 15 November and Thursday 16 November 2017. Joanne Woodhouse (ERM Senior Consultant) authored the report and Katherine Deverson (ERM Heritage Consultant) undertook a technical review. Matthew Errington (ERM Project Manager) and Paul Douglass (ERM Partner) undertook quality assurance (QA) reviews of the report.

1.5 REPORT STRUCTURE

This report is structured in the following way:

Chapter 2 Legislative framework;

Chapter 3 Aboriginal community consultation undertaken for the heritage assessment;

Chapter 4 Background - Environmental and landscape background, archaeological context and Aboriginal heritage predictive model;

Chapter 5 Historical background relating to the Project area;

Chapter 6 Survey methodology and results;

Chapter 7 Significance assessment of sites located within the Project area;

Chapter 8 Impact assessment; and

Chapter 9 Heritage management and impact mitigation recommendations.

In addition, there are three annexes, including:

Annex A Log of the Stakeholder consultation undertaken for the project

Annex B Heritage Database Searches

Annex C Parish Maps

2 *RELEVANT LEGISLATION*

Approval for the Project is sought under Division 4.1 (SSD) of Part 4 of the EP&A Act. Several conditions relating to the heritage matters of the Project were provided as part of the SEARs. These are discussed in *Section 1.2*.

Aboriginal cultural heritage in NSW is protected by the *National Parks and Wildlife Act 1974 (NPW Act)*. Land managers are required to consider the effects of their activities or proposed development on the environment under several pieces of legislation, principally the EP&A Act. Cultural heritage, which includes Indigenous heritage, is subsumed within the definition of "environment". Commonwealth legislation protecting Indigenous heritage may also apply to Indigenous heritage places in NSW in certain circumstances. Key legislation is summarised in *Table 2.1* below.

Table 2.1 Key Legislation

State Legislation
Environmental Planning and Assessment Act 1979 (NSW)
The *Environmental Planning and Assessment Act* 1979 (EP&A Act) and the *Environmental Planning and Assessment Regulation* 2000 (EP&A Regulation) provide the statutory framework for the assessment of the activity. Section 79C of the EP&A Act requires the consent authority to take into consideration a range of matters when undertaking an assessment of a DA. The EP&A Act requires that environmental impacts are considered in land use planning, including impacts on Aboriginal and non-Aboriginal heritage. Various planning instruments prepared under the Act identify permissible land use and development constraints. The NSW National Parks and Wildlife Services (NPWS) provide guidelines for Aboriginal heritage assessment, including those conducted under the EP&A Act. Where Aboriginal heritage assessment is conducted under the Integrated Development Approval process, a more detailed set of NPWS guidelines applies. Part 4 of the EP&A Act 1979 lays the foundation for the legislative scheme. It contains the major concepts and addresses the major matters of principle. The regulations under Part 4 contain much of the detail of the various processes that, having regard to the nature of the proposed development, lead to the granting of development consent. They also largely determine whether development is designated development. Part 4 Division 4.1 of the Act provides a process for the assessment and approval of SSD and are subject to environmental assessment requirements, prepared by the Director General. Under Schedule 2(3) (4) of the Environmental Planning and Assessment Regulation 2000, the Director General is required to 'consult relevant public authorities and have regard to the need for the requirements to assess any key issues raised by those public authorities'. The SEARs for the Project were issued on 18 September 2017.
National Parks and Wildlife Act 1974 (NSW)
All Indigenous objects within the State of New South Wales are protected under Part 6, and particularly Section 90, of the NPW Act. Under section 5 of the Act, "Aboriginal Object" means any deposit, object or material evidence (not being a handicraft made for sale) relating to the Indigenous habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains. Sites of traditional significance that do not necessarily contain archaeological materials may be gazetted as 'Aboriginal places' and are protected under section 84 of the Act. This protection applies to all sites, regardless of their significance or land tenure. Under section 90, a person who, without first obtaining the consent of the Director-General, knowingly destroys, defaces

State Legislation
or damages, or knowingly causes or permits the destruction or defacement of or damage to, an Aboriginal object or Aboriginal place is guilty of an offence. It is required that an Aboriginal Heritage Impact Permit (AHIP) be obtained for any impact to an Aboriginal object or place. The OEH is the responsible authority, with the Director General of that department the consent authority. However, as this Project is being assessed as a SSD, the OEH will not be the relevant consent authority and AHIPs will not be required for impacts to Aboriginal heritage objects or places. Consent approval will be required to be obtained from the DP&E.
Heritage Act 1977 (NSW)
The NSW *Heritage Act 1977* establishes the NSW Heritage Council and the State Heritage Register (SHR). The aim of the Act is to conserve the heritage of New South Wales. The aim of heritage management is not to prevent change and development, but to ensure that the heritage significance of recognised heritage items is not harmed by changes. The SHR is a separate listing to the State Heritage Inventory and includes items which are accorded SHR listing through gazettal in the NSW Government Gazette. Nominated items are considered by the NSW Heritage Council which then makes a recommendation to the Minister for Heritage. The Minister is empowered to place Interim Heritage Orders (IHO) on an item of potential State significance on the basis of advice received from the Heritage Council : **a.** An item is important in the course, or pattern, of NSW's cultural or natural history. **b.** An item has strong or special association with the life or works of a person, or group of persons of importance in NSW's cultural or natural history. **c.** An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW. **d.** An item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons. **e.** An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history. **f.** An item possesses uncommon, rare, or endangered, aspects of NSW's cultural or natural history. **g.** An item is important in demonstrating the principal characteristics of a class of NSW's a) cultural or natural places: or b) cultural or natural environments.
Commonwealth Legislation
Environment Protection And Biodiversity Conservation Act 1999 (Commonwealth)
The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the Act as matters of national environmental significance. The EPBC Act focuses on the protection of matters of national environmental significance, with the states and territories having responsibility for matters of state and local significance. The Commonwealth Heritage List (CHL) is established under the EPBC Act and comprises places on Commonwealth land or owned by Commonwealth Agencies that are determined to have "significant" heritage value to Australia. The Act also establishes the National Heritage List, comprising places considered to be of "outstanding" heritage value to Australia.
Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Commonwealth)
The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* protects areas and/or objects which are of significance to Aboriginal people and which are under threat of destruction. The Act can, in certain circumstances override state and territory provisions, or it can be implemented in circumstances where state or territory provisions are lacking or are not enforced. A significant area or object is defined as one that is of particular importance to Aboriginal people according to Aboriginal tradition. The Act must be invoked by or on behalf of an Aboriginal or Torres Strait Islander or organisation.

3 *COMMUNITY CONSULTATION*

This chapter contains a summary of the Aboriginal community consultation undertaken in regard to the Aboriginal cultural heritage of the Project area. Consultation with the Aboriginal community has been undertaken in accordance with the Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW 2010). A full record of this consultation process is provided in Annex A.

On behalf of the Proponent, ERM has actively sought to identify stakeholder groups or people wishing to be consulted about the Project and has invited them to register their interest as follows:

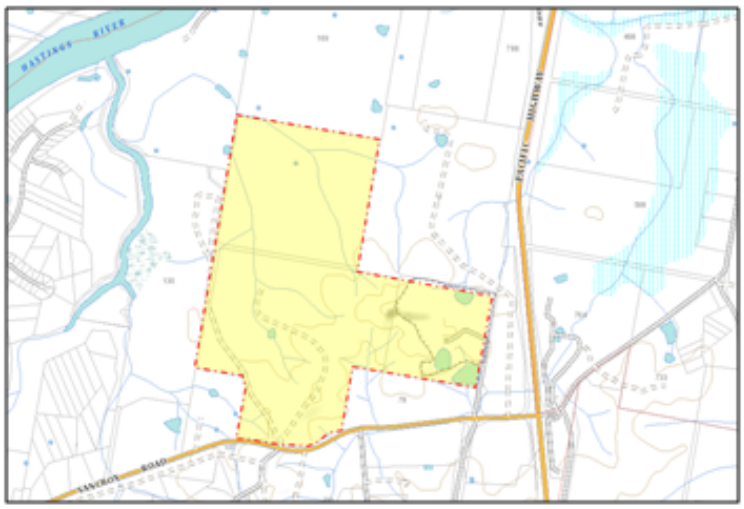
To identify relevant stakeholders, letters about the proposed activity were supplied to the following bodies on 30 August 2017:

- Birpai Local Aboriginal Land Council (BLALC);
- NSW OEH;
- Local Land Services (North Coast);
- National Native Title Tribunal (NNTT);
- Native Title Services Corporation (NTS Corp);
- Office of the Registrar, Aboriginal Land Rights Act (ORALRA); and
- Port Macquarie-Hastings Council (PMHC).

A local press advertisement requesting Aboriginal party participation was placed in the Port News on Wednesday 6 September 2017. The response period for Aboriginal parties to register an interest in the Project was open for two consecutive weeks.

NOTICE OF ABORIGINAL CONSULTATION- SANCROX

Environmental Resources Management Pty Ltd, on behalf of Hanson Construction Materials Pty Ltd, is proposing to undertake an Indigenous Cultural Heritage Assessment associated with the proposed expansion of the Sancrox Quarry, located off Sancrox Road, Sancrox NSW, within the Port Macquarie Hastings Council (PMHC) local government area.



Local Aboriginal parties wishing to be consulted for this assessment are invited to register a written expression of their interest by 20 September 2017. Please respond in writing to:

Attn: Joanne Woodhouse
Environmental Resources Management Australia
PO Box 803
Newcastle NSW 2300
Or email to joanne.woodhouse@erm.com

Figure 3.1 *Newspaper Advertisement in the Port News*

Four Aboriginal parties registered an interest in being consulted:

- Birpai Traditional Owners Indigenous Corporation;
- BLALC;
- Yanggaay; and
- Norm Archibald.

On 17 October 2017, each registered Aboriginal stakeholder group was provided an outline of the scope and a proposed survey methodology. No comments were received on the proposed methodology from any of the Aboriginal stakeholders.

The Project area is situated within the BLALC boundaries. Accordingly, a representative of this land council (Jason Holten; also representing Birpai Traditional Owners Indigenous Corporation) participated in the field assessment.

A draft copy of this Heritage Assessment was provided to all registered Aboriginal parties on 19 January 2018, for the purposes of receiving comments on the cultural significance of the Project area. A response was received on 14 March 2018 from the Birpai Local Aboriginal Land Council confirming that they are satisfied with the assessment, methodology and the protocols and do not wish to make any further comments.

4 BACKGROUND

4.1 ENVIRONMENTAL CONTEXT

Interactions between people and their surroundings are of integral importance in both the initial formation and the subsequent preservation of the archaeological record. The nature and availability of resources, including water, flora, fauna, and stone materials had (and continues to have) a significant influence over the way in which people use the landscape.

Alterations to the natural environment also impact upon the preservation and integrity of cultural materials within that environment. Current vegetation and erosional regimes also affect the visibility and detectability of Aboriginal sites and objects. For these reasons, it is essential to consider environmental factors as a component in any heritage assessment.

4.1.1 *Bioregion*

Bioregions and sub-bioregions are large, geographically distinct areas of land with common characteristics such as geology, landform patterns, climate, ecological features and plant and animal communities. The Interim Biogeographic Regionalisation for Australia (IBRA; Department of the Environment (DoE) 2014) provides a regional and national planning framework for the systematic development of a comprehensive, adequate and representative National Reserve System. Bioregions delineate salient environmental characteristics, which can highlight patterns in Aboriginal site patterning.

NSW has 17 identified bioregions. The Project area is located within the NSW North Coast bioregion, which extends along the coast from Tea Gardens north to just over the Queensland border. It is bordered by the Sydney Basin bioregion to the south, and the New England Tableland bioregion to the west. The total area of this bioregion is 5,924,130 ha, and the NSW portion is 5,692,351.6 ha; it occupies 7.11% of NSW (OEH 2016). A summary of the main attributes of the bioregion are provided in *Table 4.1*.

Table 4.1 Summary of Attributes for the South Eastern Highlands Bioregion

Characteristic	Description
Geology	The North Coast Bioregion is one of the most diverse in NSW. It has Devonian and Permian bedrocks that are part of the New England Fold Belt and have been closely faulted as they were thrust over the northern margin of the Sydney Basin. Small bodies of granite and granodiorite have intruded the sedimentary rocks and there are three centres of Tertiary basalt eruption.
Landforms	The region overlies dissected ranges and plateau of the Great Dividing Range, extending to the Great Escarpment in the east and the western slopes of inland drainage basins. The region covers a variety of landforms such as steep to gentle slopes, ridges and valley floors.

Characteristic	Description
Soils	The soil and vegetation patterns in the bioregion are very complex because of the different substrates, the topographic variation and the climatic differences encountered across and along the bioregion.
Vegetation	The region contains a diverse range of vegetation communities such as yellow box, red box, Blakely's red gum, white box and white gum to the west of the region, brown barrel to the east, river oak along streams, grey gum and Blaxland's Stringybark in lower areas and brown barrel, mountain gum, narrow-leaved peppermint and ribbon gum on elevated areas.
Source: OEH 2016	

4.1.2 Topography and Landforms

The topography surrounding the Project area is characterised by flood plains and low lying hills up to approximately 60m Australian Height Datum (AHD) which is the highest point of the Project area. The eastern portion of the Project area has been disturbed by active quarrying activities while, the west and northwest portions of the Project area are characterised by remnant and regenerating woodland vegetation and some smaller isolated sections of cleared pasture.

Speight (1990) describes categories of landform divisions, including ten morphological types of landform element units. For archaeological investigations they divide the landscape into standardised elements that can be used for comparative purposes and predictive modelling. The Project area is predominantly slopes, ridges and flats. Aboriginal site types most likely to occur on these landforms are stone artefact sites (scatters and isolated finds).

4.1.3 Geology and Soils

The 1:250,000 Hastings Geological Map Series SH 56-14 indicates that the Project area is situated over the Byabbara Beds Formation of the Carboniferous Period and Palaeozoic Era. The Byabbara Beds are characterised by lithic sandstone, siltstone, tuff, shale and limestone.

The soils at the quarry site have predominately been removed prior to the excavation of the quarry in search of 'hard rock'. The highly disturbed extraction area is characterised by exposed rock.

4.1.4 Hydrology

The availability of water has significant implications for the range of resources present and the suitability of an area for human occupation. The Project area is bordered to the north and west by the alluvial flood plains of the Hastings River and Haydons Creek.

4.1.5 Flora and Fauna

The flora and fauna of the Project area would have supported a rich and diverse resource base. Large trees were available for bark and fibres in order to make tools and containers. Resinous saps would have been used in the hafting process. Grasses would also have been twisted to produce twines that would then be woven into baskets or used in traps. The vegetation as a whole supported extensive faunal resources. These included wallabies, possums, snakes, lizards, and birds, which would all have been utilised as sources of food. Faunal resources were also utilised as the source of such things as clothing and bedding (skins and furs), hafting tools (sinews and twisted fur fibres), decorative items (feathers) and utilitarian items such as twine (twisted fur fibres and soft barks). Resources gathered in the area may also have been traded with neighbouring tribes for items not readily available.

The resources provided in the riparian/wetland habitats would have provided food for Indigenous communities and predators such as snakes and lizards. Both the Hastings River and Haydons Creek would have provided abundant aquatic resources.

4.1.6 Land Use and Disturbance

Land use and associated disturbances impact upon the archaeological record in terms of both the presence or absence of cultural materials and the integrity of any remaining deposits.

The existing hard rock quarry provides the most dramatic and obvious land disturbance within the Project area. The remaining portions of the Project area have been logged and used for cattle grazing/agriculture. The environment surrounding the existing quarry includes remnant and in most cases regenerating woodland vegetation to the north, west and south. Farm dams, stock yards and abandoned farm machinery scattered within isolated clearings through the Project area provide further evidence of previous land use disturbance (refer to *Photographs 1 to 8*).

Photograph 1 - View of existing quarry, view to south-east (ERM 2017)

Photograph 2 - View of existing quarry, view to north-east (ERM 2017)

Photograph 3 - Old quarry site, approx. 300 m south-west of current quarry (ERM 2017)

Photograph 4 - Regenerating woodland, west of current quarry (ERM 2017)

Photograph 5 - Regenerating woodland, west of current quarry (ERM 2017)

Photograph 6 - Evidence of previous land use and farming activities *(these items are not of any local heritage significance),* approx. 750 m north-west of current quarry (ERM 2017)

Photograph 7 - Evidence of land use and stock yards, approx. 750 m north-west of current quarry (ERM 2017)

Photograph 8 - Cleared floodplain, north-west of current quarry (ERM 2017)

4.1.7 *Implications for Archaeology*

The environmental context outlined above has a number of implications for archaeology in the Project area. Previous disturbance caused by intensive extraction, logging and farming activities indicates that much of the evidence of Aboriginal land use and occupation would no longer be visible. Few trees of suitable age to bear cultural scars remain within the Project area.

4.2 *ARCHAEOLOGICAL CONTEXT*

The following information provides the context in which Aboriginal cultural heritage in the Project area can be understood and assessed. It includes a review of early historic records relating to Aboriginal people within the region.

4.3 *ETHNOGRAPHIC CONTEXT*

Early historic records provide information about Aboriginal occupation along the northern NSW coastline during the period of early European settlement. Ethnographic accounts (historical accounts relating to Aboriginal people) can be used to obtain information about the way in which Aboriginal people in the area lived at the time of early European contact and may be used to make inferences regarding the pre-contact period.

As reported by ERM (2002), information relating specifically to the Aboriginal inhabitants of the Port Macquarie region is sporadic at best and in general, information regarding pre-contact Aboriginal lifestyle and culture are extrapolated from early European explorers to the area and archaeological evidence. However, some cultural information is still passed orally through the generations. For example, as reported by HSO (2008), Birpai men married Murrawon women (from Macleay River area), and Birpai women married Murrawon men (Hastings Writers, 2003:11). Conflicting opinion over the language groupings of the area has also confused the issue. Tindale, in his mapping of language groups, identified the Ngamba tribe in the Camden Haven/Port Macquarie region, with the Birpai occupying lands to the south and west of the Ngamba (1940). It is now generally accepted that the Ngamba

were located further north, around the Macleay and Nambucca estuaries, with the Birpai occupying the region around Port Macquarie (Collins, 1998).

Population estimates for the Macleay Valley (north of the Project area) suggest a prehistoric Aboriginal population of between 3 and 6 people per 2 km² of coastal lands (Coleman, 1981 as cited in Collins, 1998). It appears that the local area has a comparably rich resource base and therefore it is inferred that similar population figures exist for the Port Macquarie region. Due to the level of available resources, it is thought that the local population occupied the region continuously, rather than undertaking seasonal migrations between the coast and inland areas (Collins, 1998).

During his exploratory journey in the spring of 1818, John Oxley observed "abundant signs" of Aborigines and their camps along the full length of the Hastings Valley, and Parker King reported an encampment of 25 natives on Blackmans Point in the late autumn of 1819 (Parker King, 1822 as cited in Collins, 2004). A reasonably sedentary lifestyle is also indicated by the solid construction methods used for the waterproof paperbark huts discovered by Oxley on the Camden Haven. The huts had domed roofs, an entry on the sheltered side away from sea winds, and were capable of holding 8-10 people (Rogers, 1982 as cited in Collins, 2004).

Base camps were established in areas protected from the elements by dense vegetation (McFarlane, 1934-5 as cited in Collins, 2004) and would have been situated in sheltered areas offering suitable conditions, with a large number of small resource-specific sites scattered between. The location of these non-occupation sites was dependent on various factors relating to site function. For example, grinding grooves only occur where there is appropriate outcropping sandstone, but as close to the occupation site as possible. Scarred trees were variably located with no obvious patterning, other than proximity to watercourses, where occupation sites were more frequently located.

Many of the region's material items were made from the bark or wood of various trees. These include spears, boomerangs, clubs, shields, digging sticks, containers and canoes. Aboriginal people controlled the natural fracture properties of fine-grained stones to produce a variety of cutting and scraping tools, many of which were used to manufacture and maintain these types of wooden items. Large uni-facially and bi-facially flaked and/or ground stone axes, characteristic of NSW coastal regions, featured prominently in the Birpai toolkit. The axe heads were usually hafted to a handle fashioned from a pliable vine (Collins, 2004).

As reported by Elaine Van Kempen (2003), Indigenous Australians in this area had experienced considerable loss of life from the early waves of smallpox, and had barely recovered when the British arrived to establish the settlement for recalcitrant convicts at Port Macquarie 1821. In 1840 the local Aboriginal people endeavoured to fight back, enlisting the help of the neighbouring Thungutti Nation but, as a result of the superior weaponry of the new arrivals, many were

killed near a place subsequently known as Blackman's Point (Van Kempen 2003).

Thomas Dick of Port Macquarie took many hundreds of photographs of Indigenous people during the early years of the twentieth century. Dick hoped that his work would 'produce scenes described by the early explorers such as Oxley' and his concern for the losses sustained by these people through European usurpation is evident in the photographs and their captions (Van Kempen 2003). Many of the photographs, which depict Aboriginal lifestyle, are thought to have been taken around the Lake Innes area. There are also references of Aboriginal occupation in this area in the journals of Major Innes' niece (NSW National Parks and Wildlife Service, 1999) and is located approximately 5 km to the south east of the Project area.

4.4 *LOCAL ARCHAEOLOGICAL CONTEXT*

A number of archaeological investigations have been undertaken in the Project area and broader Port Macquarie area. The results of these investigations provide an indication of the range, nature and distribution of archaeological sites within the local area and therefore provide essential background information for this study.

4.4.1 *OEH AHIMS Register*

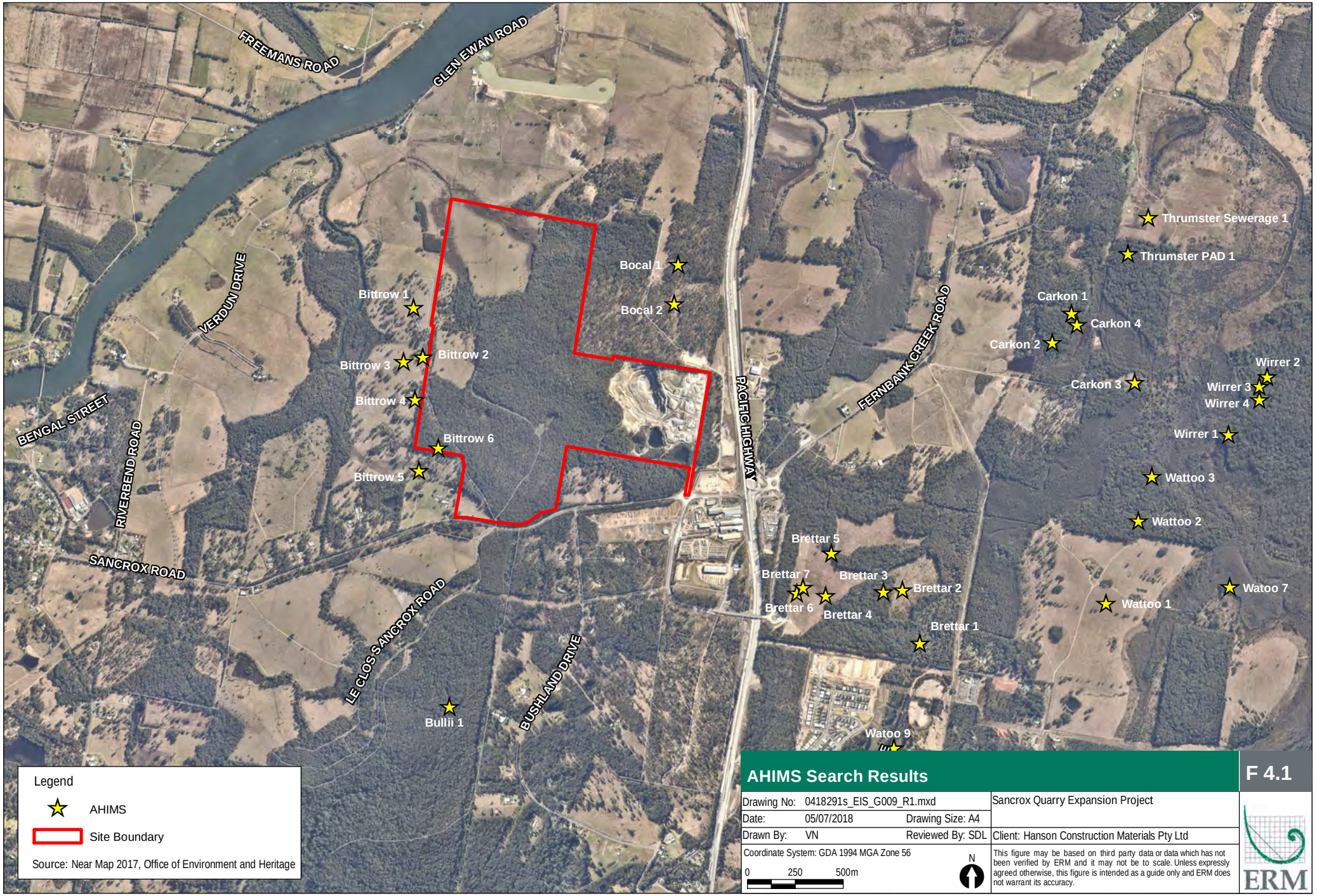
Aboriginal heritage sites recorded in NSW are generally reported to the OEH and registered on the Aboriginal Heritage Information Management System (AHIMS) database. A search of the AHIMS database revealed that 92 sites have been recorded within a 10 square kilometre area (from Lat, Long: -31.4664, 152.7767 - Lat, Long To: -31.4117, 152.8634 with a Buffer of 1000 meters) surrounding the Project area (refer to *Annex B*). The numbers of recorded sites by site type are shown in *Table 4.2.*

Table 4.2 Results from AHIMS Search - Count by Site Types

Site Types	Number of Sites	Percentage
Restricted	4	5%
Isolated Artefact	23	28%
Middens	1	1.5%
Artefacts with Potential Archaeological Deposit	4	5%
Open Camp Site	47	56%
Stone Quarry	1	1.5%
TRE (Scarred or Carved Tree)	3	3%
Total	83	100.00%

The most common site features are artefact scatters or isolated artefacts making up 84% of the sites found in the search. Scarred or carved trees make up 3% of site types found, PADs being 5% and quarries and middens just 1.5% of the site types found.

The location of the restricted sites is not disclosed in this report, although they are noted to be greater than 2 km from the Project Area.


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
Bittrow 1
Bittrow 2
Bittrow 3
Bittrow 4
Bittrow 5
Bittrow 6
Bocal 1
Bocal 2
Bullii 1
Brettar 1
Brettar 2
Brettar 3
Brettar 4
Brettar 5
Brettar 6
Brettar 7
Watoo 9
Wattoo 1
Wattoo 2
Wattoo 3
Watoo 7
Carkon 1
Carkon 2
Carkon 3
Carkon 4
Thrumster PAD 1
Thrumster Sewerage 1
Wirrer 1
Wirrer 2
Wirrer 3
Wirrer 4
Legend
AHIMS
Site Boundary
Source: Near Map 2017, Office of Environment and Heritage
AHIMS Search Results
F 4.1
Drawing No: 0418291s_EIS_G009_R1.mxd
Sancrox Quarry Expansion Project
Date: 05/07/2018
Drawing Size: A4
Drawn By: VN
Reviewed By: SDL
Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

4.4.2 Previous Archaeological Investigations

A number of archaeological investigations have been conducted in the Port Macquarie region over the last twenty years. The available studies give a broad picture of the wider cultural landscape and the site types, frequencies and distribution patterns that have contributed to the current understanding of the archaeological record in the region. The findings from these investigations echo those of the regional studies and define the archaeological context of the Project area. Studies most relevant to the Project are briefly summarised in *Table 4.3*.

As noted by Collins (1995) Area 13, which includes the current Project area, is on the whole very well-watered, with all parts of it being within easy walking distance of a potential water source. Access to fresh water is reported to be important for site placement, with no cultural materials being detected further than 350 m from either a perennial or seasonal water source. Swamps appear to have been the most favoured source, although they do represent the most common source type in the area. There also appears to have been a strong preference for sites along elevated sections of the Hastings River bank, on footslopes near water sources, and along spur crests and saddles. There is an overall trend toward a greater number of site locations with decreased elevation, with the larger and most complex sites all occurring below 10 m AHD.

Slope also appears to have been an important criterion in site placement, with an outstanding preference shown for low-gradient land. No cultural materials were found on slopes greater than 10°, and the vast majority of sites were found on slopes of 5° or less. All of the larger and more complex sites had been established on very gentle grades. Sites were found in all aspect contexts, although there is a strong preference for sites to face N.N.W.-N.E. (316°- 45°). Given that cold winter winds blow from the west and south west and that cool summer breezes blow from the north east, this land use preference may well have been a direct response to the need to seek both protection from adverse weather conditions and relief from summer heat (Collins, 1995).

Although site locations were recorded across all geological units, there does appear to have been a significant preference for occupation of lands based on the Touchwood Formation and Fault Zone Complex rocks which are sandwiched between faults in the south eastern section of Area 13. The higher incidence of artefacts on these substrates may be related to the superior flaking qualities exhibited by their constituent rocks.

Table 4.3 Summary of Previous Archaeological Investigations

Author of Report	Relation to Project area	Details of sites recorded/recommendations
Appleton 1996	Archaeological Investigation of the current Project area for the proposed quarry operations.	Archaeological Investigation of the site of proposed quarry operations at Sancrox Road, Wauchope, NSW This report was commissioned by Anthony Thorne & Associates pursuant to information received from the local Aboriginal community that a ceremonial site once existed at the site of a proposed quarry. Appleton found that there was no evidence to support the existence of a ceremonial site, however, he theorised that any such evidence may have been removed earlier in the process during the removal of overburden at the site. Appleton also identified a single artefact, but believed that it was in a secondary context.
Appleton 2005	Immediately to the west of current Project area.	As reported by Appleton (2013), in 2005 ASR was engaged to undertake an investigation of property on Sancrox Road in which Collins had recorded five artefact sites (Bittrow site complex) nearly ten years previously. However none of the sites were relocated and no additional sites were found.
Appleton 2007	Immediately to the north, east and south of current Project area.	As reported by Appleton (2013), in 2007 ASR was engaged to investigate areas to the north, east and south of Sancrox Quarry. No sites were found, and nor were the two sites previously recorded in that area by Collins in 1995.
Appleton 2013	Survey area immediately east of the current Project area.	Archaeological Assessment Fernbank Creek Road, Port Macquarie This assessment was performed for King & Campbell Pty Ltd to facilitate a Proposed rezoning of the Cassegrain Winery, Fernbank Creek Road, Port Macquarie. In the absence of any archaeological or cultural remains in the project site and no cultural information that might pose a constraint to the proposed development ASR recommends that there are no constraints on either cultural or archaeological grounds to the proposed development.
Kuskie 2006	Includes reference to the current Project area	Pacific Highway Upgrade: Oxley Highway to Kempsey – Supplementary Indigenous Heritage Impact Assessment Report – Areas of Cultural Sensitivity This report was commissioned by GHD on behalf of the Roads & Traffic Authority. Three (3) main sites of cultural sensitivity were identified. The first was the Sancrox Quarry ceremonial site, the second is the land

Author of Report	Relation to Project area	Details of sites recorded/recommendations
		surrounding the Hastings River, as it was the site of frequent battles between the Birpai and the Dunghutti. The third was an area near Maria Creek. Other information provided by the Aboriginal representatives include: • Native resources included the wild apple (giving rise to the name Kundabung), and Cobra grubs (giving rise to the name Copperabung, later corrupted to Cooperabung); • Birpai people lived in the mountains in summer and the coast in winter; and • Known Aboriginal camps in historic times are on the south side of the Hastings River, especially in the area between the Pacific Highway and Haydons Creek (to the immediate west of the current Project area).
RPS Harper Somers O'Sullivan 2008	Survey area west of the current Project area.	<u>Aboriginal & European Cultural Heritage Assessment For Le Clos Verdun At Sancrox NSW</u> RPS Harper Somers O'Sullivan (RPS HSO) was commissioned by Hopkins Consultants to provide an Aboriginal and European Cultural Heritage Assessment for the land known as "Le Clos Verdun" at Sancrox, near Port Macquarie, New South Wales. No Aboriginal heritage sites were identified. With regards European cultural heritage HSO shows that the Sancrox area was the location of one of the early government farms of nearby Port Macquarie. The exact location of the farm is not known. No remnant of that farm was located and it is considered highly unlikely given the temporary nature of the farm and the changing landscape of the Hastings River that any record would remain if it was in the vicinity of the study area.
Haglund 1997	Survey area south of the current Project area, extending over 10 km to the south.	<u>Archaeological investigations along the Pacific Highway: south of Innes Drive, near Port Macquarie</u> The section of Pacific Highway reserve from Herons Creek to approximately one kilometre south of the Oxley Highway interchange was surveyed by Brayshaw and Haglund (1996), resulting in the detection of an isolated artefact and four small scatters of between three and eight artefacts, all made on locally occurring quartz. The sites were situated on the crests and slopes of ridges and spurs. The least disturbed of the scatters (RRID-3) was subsequently investigated and interpreted as a quartz extraction site. Site use appeared to have been low-key only, centring on the extraction of vein quartz from weathered surface rock or its mantle of soil. Given their similarity to RRID-3, it was concluded that two of the other scatters recorded during the original survey (RRID-1 and RRID-2), and the only sites found on slopes of over 10°, were also associated with low-key quartz extraction.

Author of Report	Relation to Project area	Details of sites recorded/recommendations
Collins, J.P. 1995	Includes the current Project area	<u>Aboriginal Archaeological survey Area 13 (Thrumster), Port Macquarie</u> The most wide-ranging archaeological survey so far completed for the lower Hastings hinterland is that done by Collins (1995) as part of an environmental study for Hastings Council's urban investigation 'Area 13'. The Area 13 Project area encompassed 4,200ha of land between the Hastings River and Lake Innes west of Lindfield Park Road. 17 isolated artefacts, 30 artefact scatters, 3 scarred trees 1 shell midden, two traditional cultural significant sites and 1 Aboriginal historical significant site were recorded. With specific reference to the current study area, Collins reports that a Corroboree/ceremonial ground lies west of the Pacific Highway and north of Sancrox Road and is thought to have occupied the hill crest now being worked as a hard rock quarry. Aboriginal informants were told of the site many years ago by elderly European residents who described hearing the music and chanting and seeing the many large campfires. The closest recorded sites were the Bittrow site complex located approximately 100m to the south and west of the current Project area comprising a large and complex open campsite, three isolated artefacts and two small campsites. It is considered highly likely that further materials will occur across hillslopes and associated with Haydons Creek. Subsequent surveys by Appleton in 2005 and 2007 have not relocated these sites. The survey identified that site locations were associated with certain landforms. Sites identified were all located within 350m of water, and tended to be on decreased elevation with low gradient slopes facing NNW and NE. Management recommendations included: • any floodplain excavation works which will be greater than 80cm in depth to be monitored by a representative of the BLALC in case archaeological materials are unearthed. • Any urban rezoning proposal for any non-floodplain area which has not already been substantially impacted, and which was not covered during the present survey or during any past archaeological survey in Area 13 should be subject of a separate archaeological survey of all slopes of 10° and less which are within 350m of any existing or former permanent or semipermanent water source (including drained swamps). • Any rezoning proposal for any land which does not encompass slopes of 10° and less within 350m of a present or former permanent or semi-permanent water source is unlikely to threaten archaeological materials and an archaeological survey is not considered warranted in such areas.

Author of Report	Relation to Project area	Details of sites recorded/recommendations
Collins, J 2005	Located 1.5km south east of the Project area.	Area 13 Structure Plan: Aboriginal Heritage Assessment A further survey of a 780ha portion of the 1995 Area 13 Study Area resulted in the recording of four isolated stone artefacts and three small artefact scatters on footslopes and valley flats adjacent to swamps and streams. Two extensive campsites were also recorded, both on the terminal ends of low spurs extending into swamps. Re-inspection of previously registered sites revealed several of those south of the upgrading corridor, including the Site #30-3-169 scarred tree, to have been destroyed by land clearing since 1995.
GHD 2010	Covers the north western portion of the current Project area	Oxley Highway to Kempsey Pacific Highway Upgrade – Aboriginal Heritage Working Paper The Aboriginal heritage assessment for the Oxley Highway to Kempsey Pacific Highway Upgrade has been undertaken in two phases, an initial predictive study to assist with selection of feasible route options (Kuskie 2005), followed by a comprehensive field survey and sub-surface investigations undertaken in 2007 by South East Archaeology . Five areas of cultural sensitivity, ten archaeological sites and six PADs were identified as potentially impacted. Archaeological test excavation was undertaken at two locations. No Aboriginal sites were recorded within the current Project area although an Ochre Sites were mapped approximately 800 m to the south east of the current Project area. This ochre vein was exposed by road construction in about 1968.
Kelleher Nightingale Consulting 2012	Immediately east of the current Project area	Artefact Salvage Methodology and Cultural Heritage Assessment Oxley Highway to Kempsey Upgrade. This report provides a detailed methodology for archaeological excavation of the identified sites and PADs along the Oxley Highway to Kempsey upgrade (GHD 2010) to obtain a representative sample of the archaeology that will be impact by the project. A series of management policies for the management and conservation of Aboriginal heritage were provided. With relevance to the Project area, the seam of ochre site was confirmed along the highway, approximately 800 m to the south east of the current Project area. This ochre vein was exposed by road construction in about 1968.

4.4.3 Implications for the Project area – Predictive Model

It is important to note that the level of archaeological potential relates to the likelihood of discovering an Aboriginal object or site, within a location. Further description should then be made as to the potential condition and integrity of the soil matrix and potential site itself. Only once all these factors have been considered, can scientific value start to be assessed for an area with potential. Therefore, whilst scientific value and potential are linked, it must be noted that these values and potentials are not the same and can differ substantially for any single site or area with potential.

Areas with archaeological potential were assessed according to the definitions in *Table 4.4*. Proximity to a permanent water supply and landform is the primary factor appearing to determine the location of Aboriginal campsites within the region and scar trees can occur anywhere that trees of a suitable age remain.

Using Collins (1995) predictive model for Area 13:

1. At least 40 further artefact locations are predicted to occur within Area 13 and while on a gross scale these will be spread across the entire area, they will vary widely in size, content and complexity level. Site locations are likely to occur with a significantly higher frequency on lands based on the Touchwood Formation and the Fault Zone Complex rocks in the south east section of the area.

2. Open campsites (scatters of stone artefacts) and isolated stone artefacts will be found on slopes of 10° and less, with the majority of site locations and the greatest artefact frequencies occurring on flat or gently inclined land (up to 5°). The larger complex sites in particular will be associated with the lower gradients.

3. Open campsites and isolated stone artefacts will be found anywhere within 350 m of a water source with greatest site and artefact frequencies occurring within 350 m of swampland (existing or drained). Most of the larger and more complex sites will be found on the very edge of water sources.

4. The majority of open campsites and isolated stone artefacts will be found sealed within alluvium on natural levees along the bank of the Hastings River, and on the surface of footslopes and spur crests on bedrock lands. Sites will also be found on ridgeline saddles. Few sites will occur on slopes (particularly upper slopes), and few will be detectable on flats during any surface survey.

5. Open campsites and isolated stone artefacts will occur at all elevations but most will be found at elevations below 10 m AHD. Site locations will occur with the second greatest frequency at elevations above 20 m AHD.

6. Although open campsites and isolated stone artefacts will occur on land within the full circle of aspects, the vast majority of artefacts and site locations will face between north-north west and north east (316°-45°).

7. Scarred trees may occur in any area where ecologically mature trees have survived.

8. As a consequence of the acidity of soils within Area 13 bone and shell attrition rates will be high and it is unlikely that any such materials will have survived for more than a few hundred years. Small recent shell middens may, however, occur on low gradient land in similar contexts to the artefact sites. The presence of whelks at Site Wirrer 1 indicates that shellfish were transported from the estuary into the hinterland (in this case at least 2 km from Fernbank Creek).

Due to the scope for variation that comes with human choice, it cannot be assumed that all areas of predicted sensitivity will contain a high density of archaeological sites, or for that matter, any sites at all. Archaeological models predict 'typical' site locations and apply only to those sites that are representative in terms of their environmental setting. Therefore in this landscape known to have high usage then consultation is recommended.

Table 4.4 Definitions of Archaeological Potential

Rank	Definition	Example
Very Low potential	Artefacts are very unlikely to occur in situ.	Eroded landforms, reconstructed landscapes, hazardous landscape, developed areas.
Low potential	Artefacts are not normally found in comparable contexts but could occur in low densities making detection unlikely.	Landforms with no specific focus for use, i.e. areas not associated with or in proximity to water sources.
Moderate potential	Artefacts are known to occur in comparable landforms in detectable densities (~1artefact/m^2) and there is an unknown possibility for detection.	Landforms with an environmental focus which may have seen seasonal visitation.
High potential	Artefacts are consistently found in comparable landforms or similar environmental contexts and thus will certainly be found in any ground breaking works.	Landforms with known environmental focus encouraging repeat visitation to specific locale, i.e. margins of swamp or near high order creeks.

Table 4.5 below provides predictive statements from the previous studies, background research and the AHIMS data. All areas identified as having moderate or high levels of archaeological potential were targeted during the site visit (refer to *Section 6*). Specific management and mitigation measures have been recommended within *Section 9*.

Landform elements of highest potential archaeological sensitivity are level to gently inclined crests of ridges and spurs, particularly crests above 20 m AHD within 350 m of a water course. This does not occur within the Project area.

Elements with lowest potential archaeological sensitivity are hillslopes with gradients greater than 10° and poorly drained alluvial valley flats (including swamps). Irrespective of its topographic context, land which has been intensively disturbed (e.g. roads, services easements and quarries) will also have low archaeological sensitivity.

Table 4.5 Landforms in which Site Types Usually Occur

Site Types	Landform in which this Site Type is Usually Found	Assessment	Potential
Artefact Scatters	Stone artefact concentrations are collections of stone, frequently brought from other areas, which demonstrate evidence for Aboriginal working, use and/or discard of the stone at a single location. These sites may be found in any landforms particularly in association with hillslopes and water courses. This site type may be within several hundred metres of water, either on the low hill slopes / toe slopes, on terraces of the Richmond River or on low spurs leading down to water, with the highest concentrations occurring near the confluences. These sites are likely to have been impacted by European agricultural practices as landforms favoured for prehistoric occupation were also often favoured for the European occupation or agriculture.	Locations with highest potential for artefact scatters would be along the ridges and spurs in the central portion of the Project area and mostly associated with transient movement between the nearby resource rich areas. It is noted that the crest and ridges have all been subject to disturbance including intensive quarrying activities. The highest portion of the Project area (reported as a potential ceremonial site) has been completely removed by the current quarry activities and there is only moderate potential that evidence of Aboriginal occupation remains within the broader Project area. The low lying floodplains have low potential for artefact scatters as they are not favourable for habitation and the effects of flooding in the low lying areas would also have disturbed the integrity and condition of any sites that may have been here.	Moderate
Isolated finds	Sites consisting of only one identified stone artefact, isolated from any other artefacts or archaeological evidence. They are generally indicative of sporadic past Aboriginal use of a location. A distinction should be drawn between isolated finds which are a component of the background distribution and objects such as axes, hammer stones, grinding dishes, etc which would have been used repeatedly.	Isolated finds may occur anywhere, especially in disturbed locations near water sources or on travel routes. They are known to occur in comparable landforms and there is an unknown possibility for detection.	High

Site Types	Landform in which this Site Type is Usually Found	Assessment	Potential
Scarred trees	Scarred trees bear the marks of bark and wood removal for utilisation as canoes, shields, boomerangs or containers. It is commonly very difficult to confidently distinguish between Aboriginal scars and natural scars or those made by Europeans. Scars may also originate as 'foot-marks', small pockets cut into the bark of a tree enabling the tree to be climbed.	Small areas of remnant vegetation are present in the Project area making it possible that trees of sufficient age to bear scars of Aboriginal origin may be located within the Project area. Carved trees may also occur within the Project area, particularly given that a ceremonial site once existed at the site.	Moderate
Grinding grooves	Grooves resulting from the grinding of stone axes or other implements are found on flat areas of suitable sandstone. They are often located near waterholes or creek beds as water is necessary in the sharpening process. In areas where suitable outcrops of rock were not available, transportable pieces of sandstone were used.	Grinding grooves may be present, although picking up the small exposed bedrock that may be used for grinding grooves is difficult at the desktop level.	Low-moderate
Stone arrangements, and ceremonial grounds	These site types are often interrelated. Stone arrangements vary from simple cairns or piles of rocks to more elaborate arrangements; patterns of stone laid out to form circles and other designs, or standing slabs of rock held upright by stones around the base. Carved trees may have intricate geometric or linear patterns or representations of animals carved into their trunks. Ceremonial grounds and graves were often marked by such trees. Bora grounds are a common type of ceremonial site and they are generally associated with initiation ceremonies. They comprise two circles, generally edged with low banks of earth but sometimes of stone, a short distance apart and connected by a path. Bora grounds were generally situated near a camping ground large enough to accommodate all the tribes invited, and close to a river, creek or lagoon to provide sufficient water and food for all those attending the ceremonies (OEH 2013).	It has been reported that a ceremonial ground once existed within the Project area and is thought to have occupied the hill crest now being worked by the quarry. Aboriginal informants were told of the site many years ago by elderly European residents (Collins 1995 and Appleton 1996). No evidence to support the existence of a ceremonial site has been found although it is noted that any such evidence would have been removed during the removal of overburden at the site.	Low

Site Types	Landform in which this Site Type is Usually Found	Assessment	Potential
Middens	Middens predominantly consist of accumulations of shell that represent the exploitation and consumption of shellfish by Aboriginal people. Shell species may be marine, estuarine or freshwater depending on the environmental context. Middens frequently also include faunal remains, stone artefacts, hearths and charcoal.	Shell middens are known to occur within alluvial plains around Hastings River although they are generally found closer to the coast.	Low
Quarries	These are areas where stone was obtained for flaked artefacts or ground-edge artefacts, or where ochre was obtained for rock paintings, body decoration or decorating wooden artefacts.	Quarries are only located where appropriate stone or ochre resources are present. One ochre seam is located 800 m to the south east of the Project area although modelling for these resources is difficult at the desktop level.	Low
Burial sites	Burials may be of isolated individuals, or they may form complex burial grounds. Often associated with other site types such as middens, or mounds.	These sites are not expected to be found in the Project area although they cannot be discounted.	Low
Art sites	Aboriginal paintings, drawings and stencils are commonly to be found where suitable surfaces occur in sandstone shelters and overhangs. These sites are often referred to as rock shelters with painted art. Rock engravings, carvings or peckings are also to be found on sandstone surfaces both in the open and in shelters. These are referred to as rock engraving sites.	It is unlikely that the Project area contains suitable rock platforms or shelters.	Very Low
Shelter sites	Sandstone shelters and overhangs were used by Aboriginal people to provide habitation areas sheltered from the rain and sun. The deposits in such sites are commonly very important because they often contain clearly stratified material in a good state of preservation. The geomorphology of the New England Region to the west of the Project area lends itself to the occurrence of rock shelters along deeply incised gullies or near creek lines where sandstone is exposed.	The floodplain landform and low rises are very unlikely to contain any rock shelters, overhangs or gullies. The hill crest has already been heavily disturbed by quarrying activities.	Very Low

5 HISTORIC CONTEXT

5.1 BRIEF HISTORY OF PORT MACQUARIE AREA

European settlement of Port Macquarie began in 1821. The penal settlements in Sydney and Newcastle were close to capacity and a need was identified, by the authorities, for a more isolated settlement away from the farmland of the free settlers who had started to populate the Hunter region. As reported by Collins (2004), the settlement centred on land bounded by the Hastings River and Kooloonbung Creek. This area lies some 10 km east of the Project area and is now covered by the Port Macquarie CBD.

The first convoy of prisoners and soldiers arrived in 1821 and work started soon after with the clearing of trees and erection of temporary bark huts for the convicts and separate huts of similar construction for the soldiers. The convicts' huts were enclosed by a palisade and ditch to protect the soldiers. Construction of permanent quarters continued steadily from this point.

Convicts constructed Government House and other public buildings, as well as establishing farms to make the settlement self-sufficient. In 1821 it was recorded that 200 convicts were employed clearing land for wheat at St Rocks (Griffin & Howell, 1996:11). St Rocks was the location of one of two original government farms in the area, by 1826 the spelling of the name was recorded as Sancrox (Rogers, 1982: 45). The first crops of wheat both at Sancrox and Settlement Farm were affected by blight and rust, however 400 bushels were nonetheless gained from the Sancrox farm (Rogers, 1986: 79). Forty acres of corn was grown here in 1826 (Rogers, 1982: 59), however in 1830 the Surveyor General recommended that the government farm at St Rocks (Sancrox), among others, be opened for public selection (Rogers, 1982: 83).

The exact location of the original government farm is not known and there is no written account of structures on that farm. They would have been most likely simple timber dwellings of a temporary nature constructed close to the crops on the fertile flood plain. With no record of them, it is possible they disappeared during one of the numerous inundations (Appleton, 2013).

Port Macquarie operated exclusively as a penal settlement until 1830 when free settlers were encouraged to farm and settle the area. By 1831 Port Macquarie was well established and contained many buildings associated with a convict town of the period: prisoner barracks, a hospital and church, commissariats store, granary, civil officers' quarters, a clergyman's house, lumber yards, government house, police office, military barracks, and the rows of slab huts, located near to shore lines.

As reported by HSO (2008) a number of people bought land and established farms in the areas around the Hastings River. One such settler, Major Archibald Clunes Innes, established a farm near present day Lake Innes, growing crops for the convicts in the settlement (Hastings Writers 2003:28). The ruins of Innes House are now gazetted heritage items.

Over the following decades the primary industry of Port Macquarie was agriculture specialising in the pastoral wool trade, and production of crops such as maize and sugar cane. In 1887 the Town Council was formed and the Town Hall was opened in 1892. The redirection of the Pacific Highway in the mid-twentieth century resulted in Port Macquarie becoming more accessible and from business, tourism and residents.

In 1889 the timber mill that had been at nearby Wauchope was relocated to Sancrox with logs brought to the mill by bullock dray and paddle wheel boats. One of these paddle wheel boats was built at Sancrox as were a number of punts (Wauchope District Historical Society, 1990: 24). The Sancrox mill was the source of the wooden paving blocks found in early Sydney streets (Wauchope District Historical Society, 1990: 24). In 1906 the mill burnt down, the timber workers and their houses were relocated to another area and subsequently the village fell into decline (Wauchope District Historical Society, 1990: 32). The boat building yards would have been located on the banks of the Hastings, yet with no modern reference point, and subsequent and frequent inundation events, no record remains (Appleton, 2013).

Examination of early parish maps for the Sancrox area do not list any built items within the current Project area and there is no indication that either the original Government farm or the late nineteenth century mill or boat building yards were in the vicinity the current Project area, it is most likely they were further west towards Rawdon Island Road. However other items, such as tangible remnants of early farming, may still be present.

5.2 POTENTIAL FOR HISTORIC HERITAGE WITHIN THE PROJECT AREA

While much of the Port Macquarie hinterland was appropriated by European settlers during the first half of the 19th Century, based on the literature reviewed in the preparation of this assessment, the Project area itself experienced very little historical development.

The closest historic site reported by GHD (2010) (Oxley Highway to Kempsey Pacific Highway Upgrade Environmental Assessment) were eight hand cut sandstone kerb stones, although their original location and context were not known. This site was highlighted for its local significance only.

Two historic heritage items are located within a 5 km radius of the Project area on the Hastings Local Environmental Plan 2011 and Section 2 of the NSW State Inventory, both located on Rawdon Island:

- Former school building and teacher's dwelling-house, 479 Rawdon Island Road; and
- Former Post Office building, 489 Rawdon Island Road.

Based on a review of parish maps (*Annex C*) and the historical context of the area, it is considered unlikely that relics or additional sites of historical significance will be located within the Project area. Surviving sites and features of non-Indigenous cultural heritage value would be limited to portable domestic and rural artefacts, or features associated with grazing and timber extraction activities.

6 FIELDWORK METHODOLOGY AND RESULTS

This section provides an overview of the surveys of the Project area undertaken to determine the presence of Aboriginal and historic heritage sites.

6.1 FIELD SURVEY METHODOLOGY

The Project area was surveyed by the ERM Heritage Consultant, Katherine Deverson, and Jason Holten (BLALC and Birpai Traditional Owners Indigenous Corporation) on Wednesday 15 November and Thursday 16 November 2017.

The conditions encountered in the Project area during the fieldwork resulted in limited ground surface visibility due to leaf litter, which defined the opportunistic nature of the field survey. Observations were recorded using digital photography, GPS recording, as well as field notes. In accordance with OEH guidelines, photographic recording was undertaken of landforms, Aboriginal cultural material, areas of archaeological or cultural sensitivity, levels of disturbance, as well as other areas/items of interest.

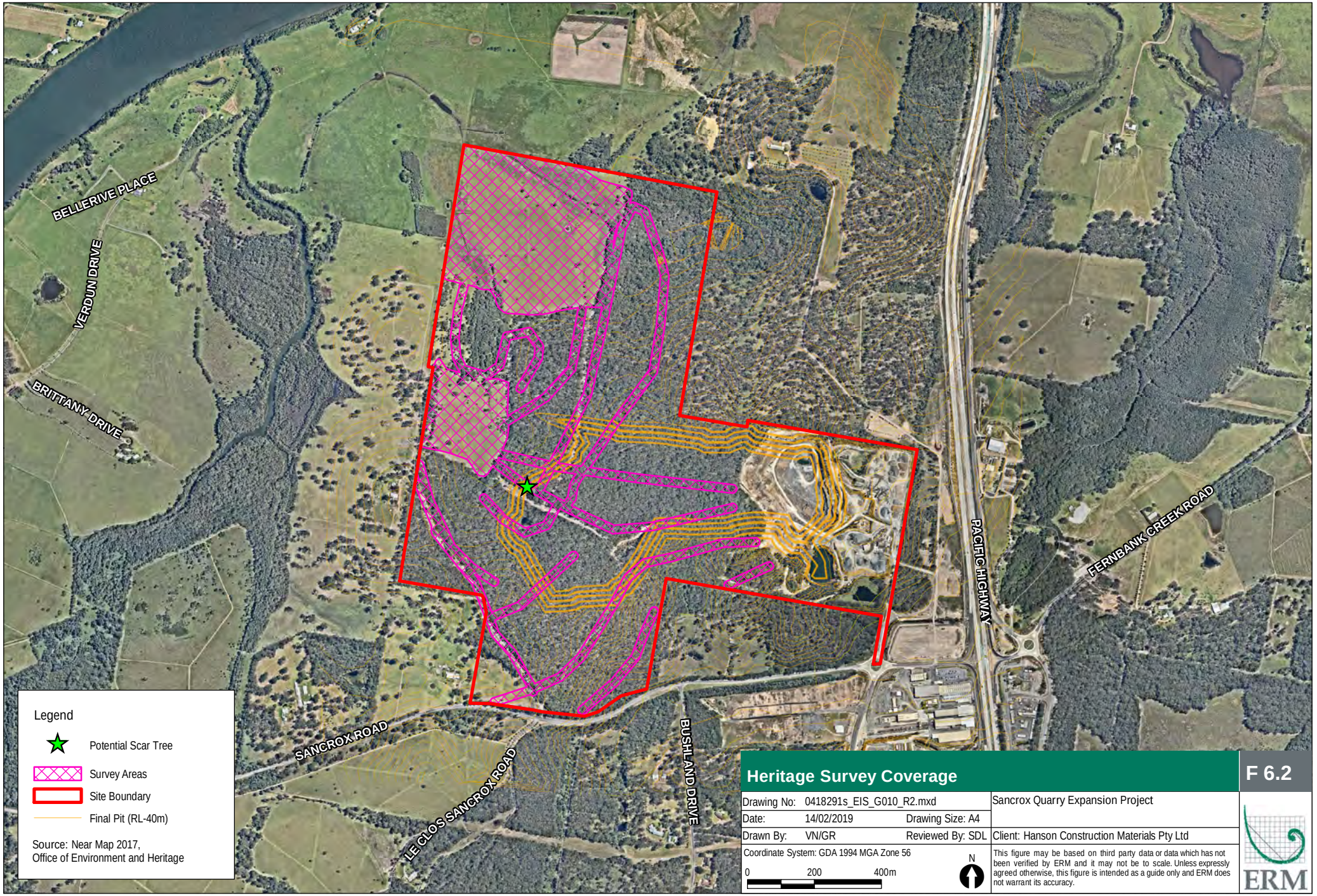
The survey focused on the identification of heritage values relating to archaeological sites, although discussion also included Aboriginal intangible values and the importance of Aboriginal sites to the local community, including the reported ceremonial site. Field survey methods were adopted to pursue the discovery of new archaeological sites, ensure their accurate recording and provide sufficient background information to provide an assessment of cultural (and social) significance to the extent that surface survey allowed.

6.2 SURVEY COVERAGE

In accordance with NSW NPWS (1997:18), the description of survey coverage includes the landform, survey unit area and a quantification of the level of exposure and visibility. The survey units were mapped using a combination of hand-held GPS and visible landmarks. The heritage survey coverage is shown in *Figure 6.1*.

Visibility refers to the amount of ground upon which artefacts could be sighted and is expressed as a percentage of the survey unit (NSW NPWS 1997:18). The presence of vegetation, leaf litter and other variables can obscure visibility. As a descriptive tool, *Table 6.1* has been devised which indicates the level of ground surface visibility. It is a subjective method of assessment, but provides a useful tool when attempting to describe the level of ground surface visible during field surveys or inspection.

The ground surface visibility was poor over most of the survey area. Where the ground surface was visible, it was in the form of vehicle tracks and fence lines or associated with the existing use of the site as an active quarry.


BELLERIVE PLACE
VERDUN DRIVE
BRITTANY DRIVE
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
Legend
Potential Scar Tree
Survey Areas
Site Boundary
Final Pit (RL-40m)
Source: Near Map 2017,
Office of Environment and Heritage
Heritage Survey Coverage
F 6.2
Drawing No: 0418291s_EIS_G010_R2.mxd
Sancrox Quarry Expansion Project
Date: 14/02/2019
Drawing Size: A4
Drawn By: VN/GR
Reviewed By: SDL
Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56
0
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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

Table 6.1 Ground Surface Visibility Rating

	Description	GSV Rating %
Very Poor	Heavy vegetation, scrub foliage or debris cover, dense tree of scrub cover. Soil surface of the ground very difficult to see.	0-9%
Poor	Moderate level of vegetation, scrub, and / or tree cover. Some small patches of soil surface visible in the form of animal tracks, erosion, scalds, blow outs etc., in isolated patches. Soil surface visible in random patches.	10-29%
Fair	Moderate levels of vegetation, scrub and / or tree cover. Moderate sized patches of soil surface visible, possibly associated with animal, stock tracks, unsealed walking tracks, erosion, blow outs, etc. Soil surface visible as moderate to small patches across a larger section of the Project area.	30-49%
Good	Moderate to low level of vegetation, tree or scrub cover. Greater amount of areas of soil surface visible in the form of erosion, scalds, blow outs, recent ploughing, grading or clearing.	50-59%
Very Good	Low levels of vegetation / scrub cover. Higher incidence of soil surface visible due to recent or past land-use practices such as ploughing, grading, mining, etc.	60-79%
Excellent	Very low to non-existent levels of vegetation/scrub cover. High incidence of soil surface visible due to past or recent land use practices, such as ploughing, grading, mining, etc.	80-100%

6.3 ABORIGINAL HERITAGE RESULTS

The archaeological survey did not result in the identification or recording of Aboriginal archaeological or cultural sites within the proposed extraction area, except for one potential scar tree which was noted to the north of a small farm dam at the western extent of the proposed extraction area (and ancillary infrastructure).

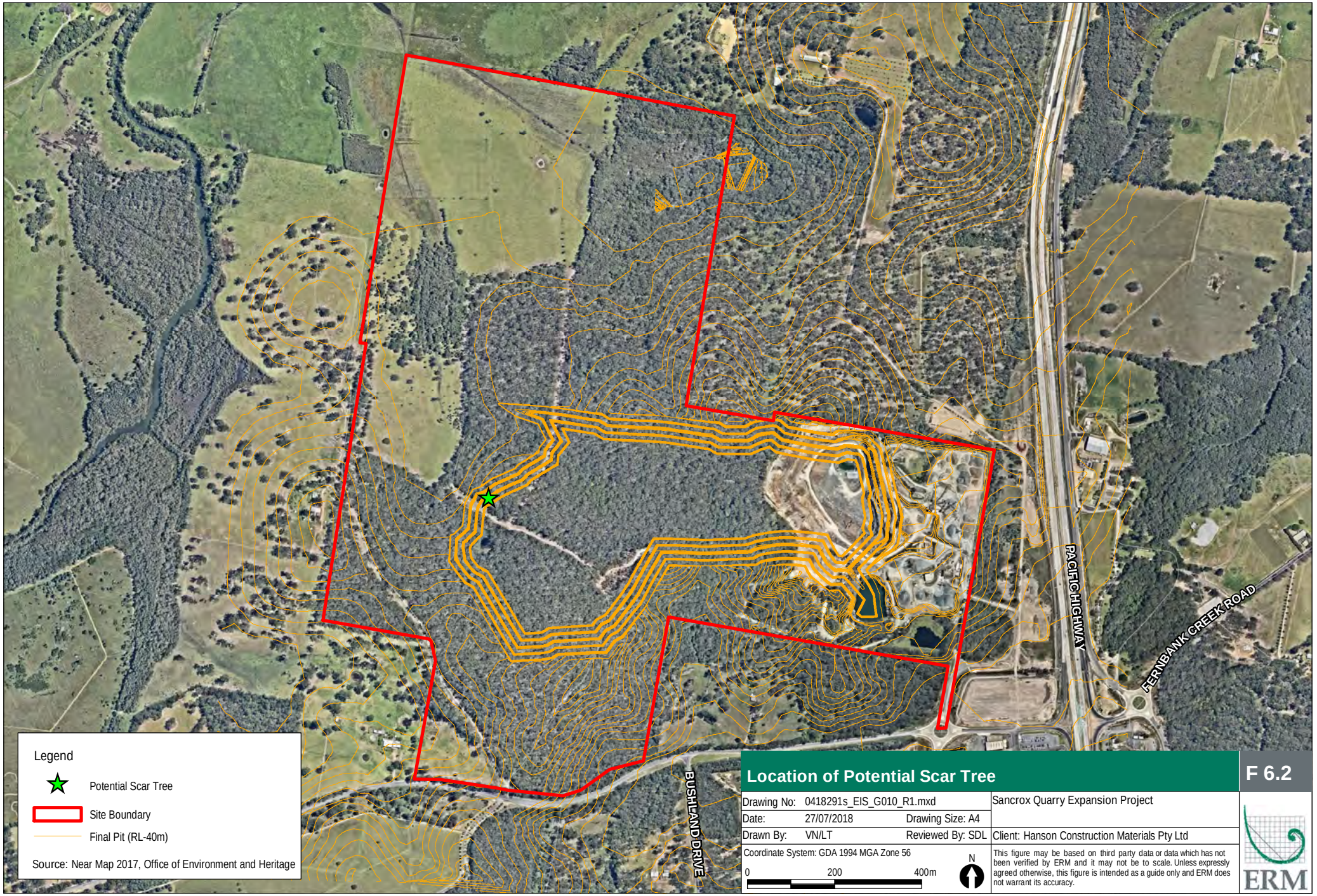
The tree is located approximately three metres from the edge of a cleared track. The scar is symmetrical, extending from the ground to 3.5 m in height. No Potential Archaeological Deposit (PAD) was recorded in association with the tree. No tool marks were noted, although the tree is of sufficient age to bear an Aboriginal scar (refer to *Figure 6.2* and *Photographs 9* and *10*).

Photograph 9

Potential Aboriginal scarred tree at the western extent of the proposed extraction area. The origin of the scar is difficult to determine based on the damage from recent fires (ERM 2017)

Photograph 10

Potential Aboriginal scarred tree noted at the western extent of the proposed extraction area. The tree is of sufficient age to bear an Aboriginal scar (ERM 2017)



Location of Potential Scar Tree

F 6.2

Drawing No:	0418291s_EIS_G010_R1.mxd		Sancrox Quarry Expansion Project
Date:	27/07/2018	Drawing Size: A4	
Drawn By:	VN/LT	Reviewed By: SDL	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 200 400m

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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

6.4 *HISTORIC HERITAGE RESULTS*

Desktop review and field survey has not identified any historical items within the Project area. As identified within *Section 5.2*, it is considered unlikely that relics or additional sites of historical significance will be located within the Project area. Surviving sites and features of non-Indigenous cultural heritage value would be limited to portable domestic and rural artefacts, or features associated with grazing and timber extraction activities.

This was confirmed during the field survey with abandoned farm machinery, stock yards and isolated clearings noted throughout. Brick piers and timber floor bracing was also recorded within the Project area and is likely to represent an abandoned farm house. These items are not of any local heritage significance and cannot be attributed to any notable local figures. They do not show any evidence of or provide additional information on the early settlement of the Sancrox area.

Photograph 11 - Evidence of previous land use - brick piers and timber floor bracing (ERM 2017)

(these items are not of any local heritage significance and cannot be attributed to any notable local figures. They do not show any evidence of or provide additional information on the early settlement of the Sancrox area).

7 SIGNIFICANCE ASSESSMENT

The heritage values significance assessment for the Project area has been assessed in accordance with the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011) and encompasses the four values outlined in the *Burra Charter* (social, historical, scientific and aesthetic) (Australian ICOMOS 2013).

7.1 ASSESSMENT OF ABORIGINAL ARCHAEOLOGICAL SIGNIFICANCE

7.1.1 Preamble

Aboriginal heritage sites, objects and places hold value for communities in many different ways. The nature of those heritage values is an important consideration when deciding how to manage a heritage site, object or place and balance competing land-use options.

Assessing the cultural significance of a place means identifying the reasons why a place is culturally important.

The NPWS Aboriginal Cultural Heritage Standards and Guidelines Kit (1997) states:

> While Aboriginal sites and places may have educational, tourism, and other values to groups in society, their two principal values are their cultural/social significance to Aboriginal people and their scientific significance to archaeologists. It is thus possible to identify two main streams in the overall significance assessment process: the assessment of cultural/social significance to Aboriginal people and the assessment of scientific significance to archaeologists… (1997: 92)

The OEH *Guideline for investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW* (2011) states that analysing cultural heritage significance involves two main steps:

- identifying the range of values present, including social, historic, scientific and aesthetic values; and
- assessing why they are important.

In addition to identifying the scientific and cultural (social) values of Aboriginal places, the OEH Guideline (2011:7) draws on the Burra Charter (2013) and adds that historic and aesthetic values should also be considered. The assessment process is shown diagrammatically in *Figure 7.1*.

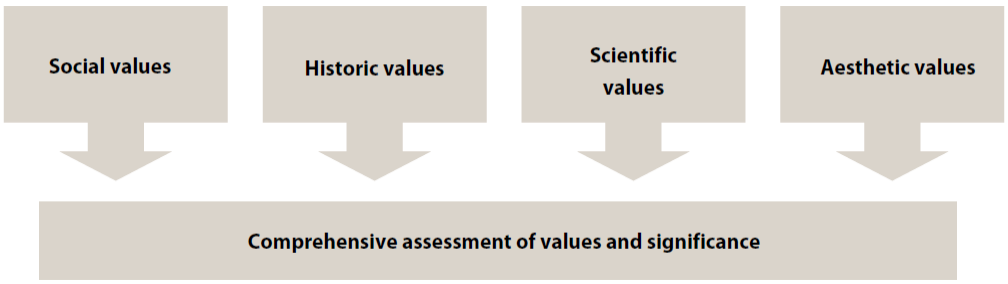

Figure 7.1 ***Diagrammatic presentation of the significance assessment process (OEH 2011)***

The assessment in *Section 7.1.3* focuses upon the scientific significance of the sites recorded during the survey. The cultural significance assessment is provided in *Section 7.1.4* of this report. Aboriginal groups who registered in the Project were afforded the opportunity to comment on the draft report for a cultural and social significance assessment of the sites recorded.

7.1.2 Background: Scientific Significance Assessment

This assessment has sought to identify Aboriginal heritage objects and sites within the Project area and obtain sufficient information to allow the scientific values of those objects and sites to be determined. NPWS (1997:93) have stated that *'while various criteria for archaeological significance assessment have been advanced over the years, most of them fall under the heading of archaeological research potential'*. As such, seven key criteria may be used to examine the scientific value/significance of a site. These are:

- Rarity: whether any or all aspects of a site (type, location, integrity, content and archaeological potential) can be considered common or rare within a local, regional or national context;
- Representativeness: the comparative rarity of the site when considered and contrasted against other similar sites conserved at the local and/or regional level;
- Archaeological landscapes: the study of the cultural sites relating to Aboriginal peoples within the context of their interactions in the wider social and natural environment they inhabited. Landscapes can be large or small depending upon specific contexts (i.e. local or regional conditions); they may also may be influenced by Aboriginal social and demographic factors (which may no longer be apparent);
- Connectedness: whether the site can be connected to other sites at the local or regional level through aspects such as type, chronology, content (i.e. materials present, manufacturing processes), spatial patterning or ethno-historical information;

- Integrity & condition: integrity refers to the level of modification a site has been subject to (the cultural and natural formation process) and whether the site could yield intact archaeological deposits, which could be spatially meaningful. Condition takes into account the state of the material, which is especially relevant for organic materials;
- Complexity: the demonstrated or potential ability of a site to yield a complex assemblage (stone, bone and/or shell) and/or features (hearths, fire pits, activity areas); and
- Archaeological potential: the potential to yield information (from sub-surface materials which retain integrity, stratigraphical or not) that will contribute to an understanding of contemporary archaeological interest, or which could be saved for future research potential.

7.1.3 Scientific Significance Assessment

The potential scar was not confirmed as a cultural scar and has only low scientific significance.

There is also no archaeological evidence to support the existence of a ceremonial site and it is noted that any such evidence would have been removed during the removal of overburden at the site. This site has only low scientific significance.

7.1.4 Aboriginal Cultural Significance Assessment

Cultural/social significance concerns the values of a place, feature or site to particular community groups, in this case the local Aboriginal communities. The primary guide to management of heritage places is the Australia ICOMOS Burra Charter 2013. The Burra Charter defines cultural significance as:

> *Cultural significance means aesthetic, historic, scientific, social or spiritual value for past, present or future generations.*
>
> *Cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects.*
>
> *Places may have a range of values for different individuals or groups.*

Aspects of cultural or social significance are relevant to sites, objects and landscapes that are important or have become important to local Aboriginal communities. This importance involves both traditional links with specific areas as well as an overall concern by Aboriginal people for sites generally and their continued protection. Aboriginal communities have provided input into the archaeological survey methodology and the archaeological and cultural significance assessment of the Project area. They will also be provided the opportunity to comment on the cultural and social significance assessment of the Project area.

Landscapes or locations within a landscape may hold special significance to Aboriginal communities as places where traditional lifestyles have occurred and where sacred or symbolic significance places exist. The evidence of Aboriginal heritage sites (including but not limited to artefact scatters, middens, scarred trees, burials) are direct evidence of past Aboriginal people, and reflect traditional ways of life including subsistence practices, ceremonial practices and aspects of cultural life. Therefore, it can be inferred that any identified site holds significance to Aboriginal people however; the level of significance may vary according to site type.

As such, the Aboriginal community can best determine Aboriginal cultural significance. Consultation with Aboriginal people (who can provide information about the local and regional significance of Aboriginal cultural heritage) is therefore required for any archaeological, social or cultural values assessment of Aboriginal heritage (especially where there is the potential for impact or harm to an Aboriginal heritage site or item). The consultation guidelines used for this assessment set out a process for identifying and registering Aboriginal parties who wish to be consulted on the proposed development. These processes have been followed and consultation with the registered Aboriginal stakeholder groups has been maintained throughout the assessment including during the field assessment.

The potential ceremonial site, although now completely destroyed, is considered to have high cultural significance and recognition of its location within the Sancrox area should be recognised.

7.2 HISTORICAL HERITAGE

No historical heritage items were found during the field survey, and there are no known non-Aboriginal heritage items located within the Project area.

8 *IMPACT ASSESSMENT*

The proposed works involve the following actions that have the potential to impact on Aboriginal heritage sites and values:

- increased size of the extraction area;
- grading of roads and upgrading of existing access roads;
- vehicle movement across eroded tracks;
- development of new access roads;
- clearance of regrowth vegetation; and
- construction of ancillary facilities.

There no historical heritage items known to occur within the Project area.

No archaeological evidence of the ceremonial site remains within the Project area.

The potential scar tree is located within the western extent of the proposed extraction area and is likely to be impacted as a direct result of the proposed extraction footprint.

9 RECOMMENDATIONS

9.1 HISTORICAL HERITAGE

No historical heritage items were found during the field survey, and there are no known non-Aboriginal heritage items located within the impact area. In the unlikely event that historic heritage items are found during works, the following Unexpected Finds Protocol is provided below.

9.1.1 *Unexpected Finds Protocol*

Historic heritage items could include relics, defined by the Heritage Act as, *"any deposit, artefact, object or material evidence that relates to the settlement of the area that comprises NSW, not being Aboriginal settlement; and is of State or local heritage significance"* or archaeological features (works). It is not considered unlikely that archaeological deposits will be found during trenching works; however the following steps are provided below in the event that deposits are found.

- where a potential historic heritage item is found during works, all works within the vicinity of the item, or with the potential to impact the item will cease and a temporary exclusion zone established;
- an appropriately qualified heritage consultant will examine the item to assess its significance and further archaeological potential; and
- where a relic is found, the NSW Heritage Council will be notified and approval will likely be required prior to the continuation of works. Other archaeological deposits will be recorded and assessed for significance and potential salvage by an appropriately qualified heritage consultant.

9.2 ABORIGINAL HERITAGE

The potential scar tree is located within the western extent of the proposed extraction area and is likely to be impacted as a direct result of the proposed extraction footprint. Avoidance is the preferred management measure, however if this cannot be achieved, it is recommended that BLALC is afforded the opportunity to retain the scar for educational and interpretive purposes if requested.

The ceremonial site, although now completely destroyed, is considered to have high cultural significance and recognition of its location within the Sancrox area could be considered for display in the quarry site office. The development of any cultural information will be undertaken in consultation with the BLALC.

9.2.1 Unexpected Finds Protocol

An unexpected (chance) finds procedure will be implemented for any locations subject to soil disturbance activities, including vegetation clearing. In the event that site workers identify any potential Aboriginal heritage sites, the unexpected finds procedure shall be implemented in compliance with s89 of NP&W Act. The procedure is as follows:

1. STOP WORK IMMEDIATELY. Any person that observes or uncovers potential Aboriginal heritage objects during the works must notify machinery operators immediately. All activities and/or works in the immediate area must cease (DO NOT collect samples to show someone);

2. NOTIFY. Notify the site supervisor immediately. The site supervisor will contact, notify and consult with Registered Aboriginal Parties (RAPs) and an appropriately qualified heritage professional (archaeologist);

3. AVOID DISTURBANCE of the area at and adjacent to the cultural finds;

4. PROTECT THE SITE. Any sand/soils removed must be identified and set aside for assessment. The disturbed area needs to be cordoned off as an exclusion zone so that no further disturbance occurs (include an adequate buffer area);

5. ASSESS THE FIND. The RAPs and archaeologist will investigate the nature; extent and location of the find;

6. RECORD/SALVAGE THE FIND. The RAPs and archaeologist will, in consultation with the site supervisor, arrange recording of the objects and if required salvage; and

7. RESUME WORK. Subject to the archaeologist's assessment, work may be able to recommence under the terms once the site is assessed and appropriately salvaged. Alternatively, where possible, work methods or location may be altered to minimise further harm to the find, or objects associated with the find.

In the event of the discovery of human skeletal material (or suspected human skeletal material) during Project activities, the following steps will be followed:

1. STOP WORK IMMEDIATELY. Any person that observes or uncovers human skeletal material (or suspected human skeletal material) during the works must notify machinery operators immediately. All activities and/or works in the immediate area must cease (DO NOT collect samples to show someone);

2. NOTIFY. Notify the site supervisor immediately;

3. PROTECT THE SITE. Monitor the area and keep all personal out of the area until further notice. Inform site personnel of the restricted access to that area. The disturbed area needs a to be cordoned off as an exclusion zone so that no further disturbance occurs (include an adequate buffer area);

4. ASSESS THE FIND. If human remains are suspected the site supervisor is to notify the NSW Police and provide available details of the remains and their location. The site supervisor will also notify the RAPs, an archaeologist/anthropologist and OEH;

5. POLICE INVESTIGATION. NSW Police and the Coroner will determine the nature of the suspected remains and advise on further actions.

6. RECORDING AND MANAGEMENT OF ABORIGINAL ANCESTRAL REMAINS. The RAPs must be present where it is reasonably suspected that Aboriginal burials or human remains have been encountered. Recording of Aboriginal ancestral remains must be undertaken by, or be conducted under the direct supervision of, a specialist physical anthropologist or other suitably qualified person; and

7. RESUME WORK. Subject to the archaeologist's assessment, work may be able to recommence under the terms once the site is assessed and appropriately managed. Alternatively, where possible, work methods or location may be altered to minimise further harm to the find, or objects associated with the find. Reburial of the remains to a specific location may be requested by the RAPs.

9.2.2 Cultural Awareness Training

In order to comply with best practice principles, all employees and subcontractors will undergo environmental awareness training as part of the site induction to ensure they understand their obligations and responsibilities. This training will include basic Aboriginal heritage awareness across the following topics:

- legal responsibilities and statutory obligations for heritage under the NPW Act and the Heritage Act;

- outline the location and type of archaeological sites within the Project Area and give instructions not to disturb these sites;

- provide the detailed locations of all known Aboriginal objects within the Project Area to all relevant personnel;

- outline the procedures for the discovery of previously unrecorded Aboriginal objects; and

- provide training on how to identify stone artefacts and other Aboriginal heritage sites.

It is important to note that only information endorsed for sharing by the BLALC would be included within the induction package, alternatively a representative of the BLALC could be employed to undertake an induction session for all major contractors prior to works commencing.

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Annex A

Aboriginal Stakeholder Consultation

RAP	Contact Name	Address	Phone	Email
Birpai Traditional Owners	Jason Holten		0498 238 692	jasonholten88@gmail.com.au
Birpai Local Aboriginal Land Council	David Carroll		0498 238 692	dcarroll.birpai@gmail.com
Yanggaay	Danial Carriage	369 Old Coast Road, Korora, NSW, 2450	0402883073	yanggaay@gmail.com
Norm Archibald	Norm Archibald	17 Flobern Ave, Wauchope NSW 2446		jtmanagement@live.com.au

Date	RAP/Contact Name	Contact Made By:	Form of Contact:	Evidence of Consultation	Details	**Response/Follow up?**	**Any Additional Actions Required?**
4 September 2017	-	-	Newspaper Advertisement	Yes	Port News		
30 August 2017	Birpai Local Aboriginal Land Council	ERM	Stage 1 Notification letter sent via email.	Yes	Letters have been sent to the relevant government agencies to determine the relevant stakeholder groups for contact. Response requested by Friday 15 September 2017.	05/9/2017 - response received via email to register an interest and confirming the proposed work is wholly located within the boundary of the Birpai Local Aboriginal Land Council. Also suggested that Birpai Traditional Owners group would be interested.	
30 August 2017	the Registrar	ERM	Stage 1 Notification letter sent via email and post.	Yes	Letters have been sent to the relevant government agencies to determine the relevant stakeholder groups for contact. Response requested by Friday 15 September 2017.	6/09/2017 – email response confirming that the project area described does not have Registered Aboriginal Owners pursuant to Division 3 of the Aboriginal Land Rights Act 1983 (ALRA).	
30 August 2017	OEH Port Macquarie	ERM	Stage 1 Notification letter sent via email and post.	Yes	Letters have been sent to the relevant government agencies to determine the relevant stakeholder groups for contact. Response requested by Friday 15 September 2017.	17/09/2017 – letter providing a list of potential interested parties.	

Date	RAP/Contact Name	Contact Made By:	Form of Contact:	Evidence of Consultation	Details	**Response/Follow up?**	**Any Additional Actions Required?**
30 August 2017	NTSCorp	ERM	Stage 1 Notification letter sent via email and post.	Yes	Letters have been sent to the relevant government agencies to determine the relevant stakeholder groups for contact. Response requested by Friday 15 September 2017.		
30 August 2017	NNTT	ERM	Stage 1 Notification letter sent via email and post.	Yes	Letters have been sent to the relevant government agencies to determine the relevant stakeholder groups for contact. Response requested by Friday 15 September 2017.	20/06/17 – response email from NNTT, no Native Title Determination Applications, Determinations of Native Title, or Indigenous Land Use Agreements over the identified area.	
30 August 2017	Port Mac Hastings Council	ERM	Stage 1 Notification letter sent via email and post.	Yes	Letters have been sent to the relevant government agencies to determine the relevant stakeholder groups for contact. Response requested by Friday 15 September 2017.		
30 August 2017	North Coast LLS	ERM	Stage 1 Notification letter sent via email and post.	Yes	Letters have been sent to the relevant government agencies to determine the relevant stakeholder groups for contact. Response requested by Friday 15 September 2017.		
5 September 2017	Birpai Local Aboriginal Land Council	David Carroll	Email	Yes	David sent an email registering BLALC in the project and confirming that the proposed work is wholly located within the boundary of the Birpai Local Aboriginal Land Council. David also	5/09/2017 - ERM replied thanking David for his response and confirming that we will be in contact soon.	

Date	RAP/Contact Name	Contact Made By:	Form of Contact:	Evidence of Consultation	Details	**Response/Follow up?**	**Any Additional Actions Required?**
					suggested contact with Birpai Traditional owners group.		
11/09/2017	Jason Holten Birpai Traditional Owners	Jason Holten Birpai Traditional Owners	Phone	Consultation log	JH called KD ERM to register Birpai Traditional Owners as RAP for project. Received letter from NTS		
4/10/2017	Saltwater Tribal Council	ERM KD	Mail	Yes	Letter sent to groups identified from Stage 1.1 letter to government agencies to determine the relevant stakeholder groups for contact, letter requested registration of interest to be consulted. Response requested by 13 October 2017.		
4/10/2017	Ghinni Ghinni Youth and Culture Aboriginal Corporation	ERM KD	Email & Mail	Yes	Letter sent to groups identified from Stage 1.1 letter to government agencies to determine the relevant stakeholder groups for contact, letter requested registration of interest to be consulted. Response requested by 13 October 2017.		
4/10/2017	Bindi Aboriginal Heritage & Cultural Centre Inc.	ERM KD	Mail	Yes	Letter sent to groups identified from Stage 1.1 letter to government agencies to determine the relevant stakeholder groups for contact, letter requested registration of interest to be consulted. Response requested by 13 October 2017.		
4/10/2017	Jason Holten Birpai Traditional Owners	ERM KD	Email	Yes	Letter sent to groups identified from Stage 1.1 letter to government agencies to determine the relevant stakeholder groups for contact, letter requested registration of interest to be consulted.		

Date	RAP/Contact Name	Contact Made By:	Form of Contact:	Evidence of Consultation	Details	**Response/Follow up?**	**Any Additional Actions Required?**
					BTO have already registered interest however letter sent to ensure that all groups have the same information.		
4/10/2017	Lakkari NTCG Mick Leon	ERM KD	Email & mail	Yes	Letter sent to groups identified from Stage 1.1 letter to government agencies to determine the relevant stakeholder groups for contact, letter requested registration of interest to be consulted. Response requested by 13 October 2017.		
4/10/2017	Birpi Local Aboriginal Land Council Steve Miles	ERM KD	Email & Mail	Yes	Letter sent to groups identified from Stage 1.1 letter to government agencies to determine the relevant stakeholder groups for contact, letter requested registration of interest to be consulted. Response requested by 13 October 2017.		
4/10/2017	Norm Archibald	ERM KD	Email & Mail	Yes	Letter sent to groups identified from Stage 1.1 letter to government agencies to determine the relevant stakeholder groups for contact, letter requested registration of interest to be consulted. Response requested by 13 October 2017.		
4/10/2017	Yangaay Danial Carriage	ERM KD	Mail	Yes	Letter sent to groups identified from Stage 1.1 letter to government agencies to determine the relevant stakeholder groups for contact, letter requested registration of interest to be consulted. Response requested by 13 October 2017.		
13/10/2017	Yangaay	Yangaay	email	Yes	Danial sent an email registering an interest in the project.	13/10/2017 ERM replied to confirm the registration and that we will be in	

Date	RAP/Contact Name	Contact Made By:	Form of Contact:	Evidence of Consultation	Details	**Response/Follow up?**	**Any Additional Actions Required?**
	Danial Carriage					contact with additional information soon.	
17/10/17	Jason Holten Birpai Traditional Owners	ERM KD	Email	Yes	Letter sent to RAPs providing project information and invitation to fieldwork on 15 & 16 November. Requesting response by 13 November.		
17/10/17	Birpi Local Aboriginal Land Council David Carroll	ERM KD	Email	Yes	Letter sent to RAPs providing project information and invitation to fieldwork on 15 & 16 November. Requesting response by 13 November.		
17/10/17	Yangaay Danial Carriage	ERM KD	Email	Yes	Letter sent to RAPs providing project information and invitation to fieldwork on 15 & 16 November. Requesting response by 13 November.		
21/10/17	Norm Archibald	Norm Archibald	Email	Yes	Norm sent an email registering an interest in the project. Norm apologised for delayed registration as there were issues with the mail.	27/10/2017 ERM replied to confirm the registration	
27/10/17	Norm Archibald	ERM KD	Email	Yes	Email to advise that ERM had included Norm as RAP and extended invitation to fieldwork in form of below letter. Letter sent to RAPs providing project information and invitation to fieldwork on 15 & 16 November. Requesting response by 13 November.		

Date	RAP/Contact Name	Contact Made By:	Form of Contact:	Evidence of Consultation	Details	**Response/Follow up?**	**Any Additional Actions Required?**
8/11/2017	Birpi Local Aboriginal Land Council cc. OEH	ERM	Email	Yes	Letter sent to the LALC in accordance with the consultation guidelines advising them that the Registered Aboriginal Parties (RAPs) for the Sancrox Quarry Project are: • Birpai Local Aboriginal Land Council; • Birpai Traditional Owners; • Yanggaay; and • Norm Archibald.		
9/11/17	Jason Holten Birpai Traditional Owners	ERM KD	Phone	Consult log	Called to advise that fieldwork still going ahead on 15 & 16 November. Jason advised that he would be conducting the fieldwork on behalf of Birpai Traditional Owners and Birpi Local Aboriginal Land Council		
9/11/2017	Birpi Local Aboriginal Land Council	ERM KD	Phone	Consult log	Called to advise that ERM had spoken to Jason Holten who had advised he would be conducting the fieldwork on behalf of Birpai Traditional Owners and Birpi Local Aboriginal Land Council. Requested insurance information be sent on Jason's behalf.		
9/11/17	Yangaay Danial Carriage	ERM KD	Phone	Consult log	Called to advise that fieldwork still going ahead on 15 & 16 November. Message that phone number was disconnected.		

Date	RAP/Contact Name	Contact Made By:	Form of Contact:	Evidence of Consultation	Details	**Response/Follow up?**	**Any Additional Actions Required?**
19/01/2018	Jason Holten Birpai Traditional Owners	ERM KD	Email	Yes	Draft heritage assessment provided to all RAPs for their review and comment. Comments requested by COB Friday 16 February 2018.		
19/01/2018	Birpi Local Aboriginal Land Council David Carroll	ERM KD	Email	Yes	Draft heritage assessment provided to all RAPs for their review and comment. Comments requested by COB Friday 16 February 2018.		
19/01/2018	Yangaay Danial Carriage	ERM KD	Email	Yes	Draft heritage assessment provided to all RAPs for their review and comment. Comments requested by COB Friday 16 February 2018.		
19/01/2018	Norm Archibald	ERM KD	Email	Yes	Draft heritage assessment provided to all RAPs for their review and comment. Comments requested by COB Friday 16 February 2018.		
14/3/2018	Birpi Local Aboriginal Land Council	LALC	Email	Yes	Response received on the draft report. The Birpai Local Aboriginal Land Council has viewed the draft heritage assessment dated January 2018 and we are satisfied with the assessment, methodology and the protocols and do not wish to make any further comments.	No further action required	

Annex B

Heritage Database Searches

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 0481291

Client Service ID : 298680

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
30-3-0202	Wirrer 3	AGD	56	485780	6521920	Open site	Valid	Artefact : -	Isolated Find	4024,98713
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0203	Wirrer 4	AGD	56	485780	6521850	Open site	Valid	Artefact : -	Open Camp Site	4024
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0204	Wattoo 1	AGD	56	484980	6520790	Open site	Valid	Artefact : -	Isolated Find	4024,98713
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0205	Wattoo 2	AGD	56	485150	6521220	Open site	Valid	Artefact : -	Isolated Find	4024,98713
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0206	Wattoo 3	AGD	56	485220	6521450	Open site	Valid	Artefact : -	Open Camp Site	4024,98713
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**	2945	
30-3-0207	Brettar 1	AGD	56	484010	6520580	Open site	Valid	Artefact : -	Open Camp Site	4024,98713
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0208	Brettar 2	AGD	56	483920	6520860	Open site	Valid	Artefact : -	Isolated Find	4024,98713
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0211	Brettar 5	AGD	56	483550	6521050	Open site	Valid	Artefact : -	Open Camp Site	4024,98713,102213
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0212	Brettar 6	AGD	56	483370	6520840	Open site	Valid	Artefact : -	Open Camp Site	4024,98713,102213
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0217	Rawdon 1;Rawdon Island;	AGD	56	478680	6523500	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0221	Rawdon 1;	AGD	56	478680	6523500	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0156	RTA 1	AGD	56	483520	6519035	Open site	Destroyed	Artefact : -	Isolated Find	2711,98713
	Contact	**Recorders**	ADISE Pty Ltd,Ms.Jacqueline Collins,Ms.Jacqueline Collins					**Permits**	3214,3216	
30-3-0157	RTA 2	AGD	56	483650	6519060	Open site	Destroyed	Artefact : -	Isolated Find	2711,98713
	Contact	**Recorders**	ADISE Pty Ltd,Ms.Jacqueline Collins,Ms.Jacqueline Collins					**Permits**	3214,3216	
30-3-0158	RTA 3	AGD	56	484380	6518440	Open site	Valid	Artefact : -	Open Camp Site	2711,98713
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0162	Brettar 7	AGD	56	483400	6520870	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	4024,98713,102213
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0163	Tarrokoe 1	AGD	56	484370	6518450	Open site	Valid	Artefact : -	Isolated Find	4024,98713
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		

Report generated by AHIMS Web Service on 30/08/2017 for Joanne Woodhouse for the following area at Lat, Long From : -31.4664, 152.7767 - Lat, Long To : -31.4117, 152.8634 with a Buffer of 1000 meters. Additional Info : Heritage Assessment. Number of Aboriginal sites and Aboriginal objects found is 83

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
30-3-0164	Tarrokoe 2	AGD	56	484350	6518130	Open site	Valid	Artefact : -	Open Camp Site	4024,98713
	Contact	Recorders	Ms.Jacqueline Collins					Permits		
30-3-0165	Tarrokoe 3	AGD	56	484310	6518420	Open site	Valid	Artefact : -	Open Camp Site	4024,98713
	Contact	Recorders	Ms.Jacqueline Collins					Permits		
30-3-0168	Tarrakoe 6	AGD	56	484240	6517850	Open site	Valid	Artefact : -	Isolated Find	98713
	Contact	Recorders	Ms.Jacqueline Collins					Permits		
30-3-0169	Tarrokoe 7	AGD	56	484150	6518270	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	4024,98713
	Contact	Recorders	Ms.Jacqueline Collins					Permits		
30-3-0170	Biller 1	AGD	56	485560	6525160	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	4024
	Contact	Recorders	Ms.Jacqueline Collins					Permits		
30-3-0171	Biller 2	AGD	56	485650	6525260	Open site	Valid	Artefact : -	Open Camp Site	4024
	Contact	Recorders	Ms.Jacqueline Collins					Permits		
30-3-0172	Biller 3	AGD	56	485700	6525400	Open site	Valid	Artefact : -	Isolated Find	4024
	Contact	Recorders	Ms.Jacqueline Collins					Permits		
30-3-0173	Biller 4	AGD	56	484950	6525450	Open site	Valid	Artefact : -	Open Camp Site	4024
	Contact	Recorders	Ms.Jacqueline Collins					Permits		
30-3-0175	Biller 6	AGD	56	484250	6525250	Open site	Valid	Artefact : -	Isolated Find	4024
	Contact	Recorders	Ms.Jacqueline Collins					Permits		
30-3-0176	Biller 7	AGD	56	485550	6525090	Open site	Valid	Artefact : -	Isolated Find	4024
	Contact	Recorders	Ms.Jacqueline Collins					Permits		
30-3-0177	Bittrow 1	AGD	56	481370	6522330	Open site	Valid	Artefact : -	Isolated Find	4024
	Contact	Recorders	Ms.Jacqueline Collins					Permits		
30-3-0178	Bittrow 2	AGD	56	481420	6522070	Open site	Valid	Artefact : -	Isolated Find	4024
	Contact	Recorders	Ms.Jacqueline Collins					Permits		
30-3-0179	Bittrow 3	AGD	56	481320	6522050	Open site	Valid	Artefact : -	Open Camp Site	4024
	Contact	Recorders	Ms.Jacqueline Collins					Permits		
30-3-0180	Bittrow 4	AGD	56	481380	6521850	Open site	Valid	Artefact : -	Isolated Find	4024
	Contact	Recorders	Ms.Jacqueline Collins					Permits		
30-3-0181	Bittrow 5	AGD	56	481400	6521480	Open site	Valid	Artefact : -	Open Camp Site	4024
	Contact	Recorders	Ms.Jacqueline Collins					Permits		
30-3-0182	Bittrow 6	AGD	56	481500	6521600	Open site	Valid	Artefact : -	Open Camp Site	4024
	Contact	Recorders	Ms.Jacqueline Collins					Permits		

Report generated by AHIMS Web Service on 30/08/2017 for Joanne Woodhouse for the following area at Lat, Long From : -31.4664, 152.7767 - Lat, Long To : -31.4117, 152.8634 with a Buffer of 1000 meters. Additional Info : Heritage Assessment. Number of Aboriginal sites and Aboriginal objects found is 83

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SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
30-3-0183	Bullii 1	AGD	56	481560	6520250	Open site	Valid	Artefact : -	Isolated Find	4024,98713
Contact		Recorders	Ms.Jacqueline Collins					Permits		
30-3-0184	Piyerbang 1	AGD	56	486220	6518050	Open site	Valid	Artefact : -	Open Camp Site	4024,98713
Contact		Recorders	Ms.Jacqueline Collins					Permits		
30-3-0185	Piyerbang 2	AGD	56	486320	6518020	Open site	Valid	Artefact : -	Open Camp Site	4024,98713
Contact		Recorders	Ms.Jacqueline Collins					Permits		
30-3-0186	Piyerbang 3	AGD	56	486250	6517990	Open site	Valid	Artefact : -	Open Camp Site	4024,98713
Contact		Recorders	Ms.Jacqueline Collins					Permits		
30-3-0187	Piyerbang 4	AGD	56	485850	6518270	Open site	Valid	Artefact : -	Open Camp Site	4024,98713
Contact		Recorders	Ms.Jacqueline Collins					Permits		
30-3-0188	Piyerbang 5	AGD	56	485900	6518000	Open site	Valid	Artefact : -	Open Camp Site	4024,98713
Contact		Recorders	Ms.Jacqueline Collins					Permits		
30-3-0189	Cooricki 1	AGD	56	485370	6517570	Open site	Valid	Artefact : -	Open Camp Site	4024,98713
Contact		Recorders	Ms.Jacqueline Collins					Permits		
30-3-0191	Cooricki 3 (Port Macquarie)	AGD	56	485060	6517450	Open site	Valid	Artefact : -	Open Camp Site	98713
Contact		Recorders	Ms.Jacqueline Collins					Permits		
30-3-0192	Cooricki 4	AGD	56	485000	6517720	Open site	Valid	Artefact : -	Open Camp Site	4024,98713
Contact		Recorders	Ms.Jacqueline Collins					Permits		
30-3-0193	Cooricki 5	AGD	56	484920	6517750	Open site	Valid	Artefact : -	Open Camp Site	4024,98713
Contact		Recorders	Ms.Jacqueline Collins					Permits		
30-3-0196	Carkon 1	AGD	56	484800	6522300	Open site	Valid	Artefact : -	Open Camp Site	4024
Contact		Recorders	Ms.Jacqueline Collins					Permits		
30-3-0197	Carkon 2	AGD	56	484700	6522150	Open site	Valid	Artefact : -	Isolated Find	4024
Contact		Recorders	Ms.Jacqueline Collins					Permits		
30-3-0199	Carkon 4	AGD	56	484830	6522240	Open site	Valid	Artefact : -	Open Camp Site	4024
Contact		Recorders	Ms.Jacqueline Collins					Permits		
30-3-0200	Wirrer 1	AGD	56	485620	6521670	Open site	Valid	Shell : -, Artefact : -	Midden	4024,98713
Contact		Recorders	Ms.Jacqueline Collins					Permits		
30-3-0201	Wirrer 2	AGD	56	485820	6521970	Open site	Valid	Artefact : -	Isolated Find	4024
Contact		Recorders	Ms.Jacqueline Collins					Permits		
30-3-0121	Partridge Creek Swamp	AGD	56	486400	6522200	Open site	Valid	Stone Quarry : -, Artefact : -	Quarry	98713
Contact		Recorders	Mr.Gordon Atkinson					Permits	2945	
30-3-0322	Ah-E2	AGD	56	486775	6519450	Open site	Valid	Artefact : 1		
Contact		Recorders	ADISE Pty Ltd,Ms.Jacqueline Collins					Permits	3214,3216	

Report generated by AHIMS Web Service on 30/08/2017 for Joanne Woodhouse for the following area at Lat, Long From : -31.4664, 152.7767 - Lat, Long To : -31.4117, 152.8634 with a Buffer of 1000 meters. Additional Info : Heritage Assessment. Number of Aboriginal sites and Aboriginal objects found is 83

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SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
30-3-0323	Ah-D1	AGD	56	485634	6519193	Open site	Partially Destroyed	Artefact : 6, Potential Archaeological Deposit (PAD) : 0		
	Contact	**Recorders**	ADISE Pty Ltd,Ms.Jacqueline Collins					**Permits**	3214,3216	
30-3-0324	Ah-D2	AGD	56	484550	6518829	Open site	Partially Destroyed	Artefact : 2		
	Contact	**Recorders**	ADISE Pty Ltd,Ms.Jacqueline Collins					**Permits**	3214,3216	
30-3-0325	Ah-D3	AGD	56	484338	6518950	Open site	Partially Destroyed	Artefact : 6		
	Contact	**Recorders**	ADISE Pty Ltd,Ms.Jacqueline Collins					**Permits**	3214,3216	
30-3-0326	Ah-D6	AGD	56	486310	6519300	Open site	Valid	Artefact : 5		
	Contact	**Recorders**	ADISE Pty Ltd,Ms.Jacqueline Collins					**Permits**	3214,3216	
30-3-0327	Karikeree 1	AGD	56	483975	6517775	Open site	Valid	Artefact : 20		
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**	2627,2841	
30-3-0328	Karikeree 2	AGD	56	483525	6517727	Open site	Valid	Artefact : 1		
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0329	Restriction applied. Please contact ahims@environment.nsw.gov.au.					Open site	Valid			
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0330	Restriction applied. Please contact ahims@environment.nsw.gov.au.					Open site	Valid			
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0331	Restriction applied. Please contact ahims@environment.nsw.gov.au.					Open site	Valid			
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0332	Watoo 7	AGD	56	485625	6520875	Open site	Valid	Artefact : 20		
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0333	Watoo 8	AGD	56	485510	6519856	Open site	Valid	Artefact : 1		
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0334	Watoo 9	AGD	56	483875	6520036	Open site	Valid	Artefact : 1		
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0335	Restriction applied. Please contact ahims@environment.nsw.gov.au.					Open site	Valid			
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0338	TKA-OS1 with PAD	AGD	56	486330	6520823	Open site	Valid	Artefact : -, Potential Archaeological Deposit (PAD) : -		
	Contact T Russell	**Recorders**	Birpai Local Aboriginal Land Council					**Permits**		

Report generated by AHIMS Web Service on 30/08/2017 for Joanne Woodhouse for the following area at Lat, Long From : -31.4664, 152.7767 - Lat, Long To : -31.4117, 152.8634 with a Buffer of 1000 meters. Additional Info : Heritage Assessment. Number of Aboriginal sites and Aboriginal objects found is 83

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SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
30-3-0353	CA62#2 & #3	AGD	56	479670	6518519	Open site	Valid	Artefact : 2		
	Contact	**Recorders**	Kevin Smith					**Permits**		
30-3-0354	C62#4	AGD	56	479804	6518573	Open site	Valid	Artefact : 2		
	Contact T Russell	**Recorders**	Kevin Smith					**Permits**		
30-3-0198	Carkon 3	AGD	56	485130	6521940	Open site	Valid	Artefact : -	Open Camp Site	4024
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**	2945	
30-3-0174	Biller 5	AGD	56	484400	6525300	Open site	Valid	Artefact : -	Open Camp Site	4024
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0392	OHK 46/A	GDA	56	482543	6525461	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Mr.Peter Kuskie					**Permits**		
30-3-0390	Thrumster PAD 1	GDA	56	485200	6522800	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		
	Contact	**Recorders**	ERM - Maitland					**Permits**		
30-3-0391	OHK 47/A	GDA	56	482513	6525387	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Mr.Peter Kuskie					**Permits**		
30-3-0409	RD - 1	AGD	56	487200	6524975	Open site	Valid	Artefact : 11		101178
	Contact	**Recorders**	Lindsay Moran					**Permits**		
30-3-0166	Tarrokoe 4	AGD	56	484140	6518300	Open site	Valid	Artefact : -	Open Camp Site	4024,98713
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0167	Tarrakoe 5	AGD	56	484500	6518080	Open site	Valid	Artefact : -	Isolated Find	98713
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0209	Brettar 3	AGD	56	483820	6520850	Open site	Valid	Artefact : -	Isolated Find	4024,98713
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0210	Brettar 4	AGD	56	483520	6520830	Open site	Valid	Artefact : -	Open Camp Site	4024,98713,102213
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0405	Thrumster Sewerage 1	AGD	56	485200	6522800	Open site	Valid	Artefact : 36		101206
	Contact	**Recorders**	Doctor.Diana Neuweger					**Permits**	3065	
30-3-0403	Tarrokoe 5	GDA	56	484500	6518080	Open site	Valid	Artefact : -		4024
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0404	Tarrokoe 6	GDA	56	484240	6517850	Open site	Valid	Artefact : 6		4024
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**		
30-3-0194	Bocal 1	AGD	56	482750	6522800	Open site	Valid	Artefact : -	Open Camp Site	4024,100934,101426
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**	2940,2941	

Report generated by AHIMS Web Service on 30/08/2017 for Joanne Woodhouse for the following area at Lat, Long From : -31.4664, 152.7767 - Lat, Long To : -31.4117, 152.8634 with a Buffer of 1000 meters. Additional Info : Heritage Assessment. Number of Aboriginal sites and Aboriginal objects found is 83

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 0481291

Client Service ID : 298680

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
30-3-0195	Bocal 2	AGD	56	482730	6522350	Open site	Valid	Artefact : -	Open Camp Site	4024,100934,101426
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**	2940,2941	
30-3-0410	PAD Ah-1 (Not an Aboriginal Site)	GDA	56	485449	6519140	Open site	Valid	Potential Archaeological Deposit (PAD) : 0		
	Contact	**Recorders**	Ms.Jacqueline Collins					**Permits**	3214,3216	
30-3-0412	Ah-D7	GDA	56	483865	6518963	Open site	Destroyed	Artefact : 8		
	Contact	**Recorders**	ADISE Pty Ltd,Ms.Jacqueline Collins,Ms.Jacqueline Collins					**Permits**	3214	
30-3-0413	Ah-D8	GDA	56	483391	6519079	Open site	Destroyed	Artefact : 8		
	Contact	**Recorders**	ADISE Pty Ltd,Ms.Jacqueline Collins,Ms.Jacqueline Collins					**Permits**	3214	

Report generated by AHIMS Web Service on 30/08/2017 for Joanne Woodhouse for the following area at Lat, Long From : -31.4664, 152.7767 - Lat, Long To : -31.4117, 152.8634 with a Buffer of 1000 meters. Additional Info : Heritage Assessment. Number of Aboriginal sites and Aboriginal objects found is 83

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Annex C

Parish Maps

Staff: Unknown /Doc: Town of Sancrox (Town Maps-Historical Parish Maps) /Rev: 30 Sep 2011 /Prt: 11 Dec 2017 23:1 /Seq: 1 of 1 /Src: Pixel
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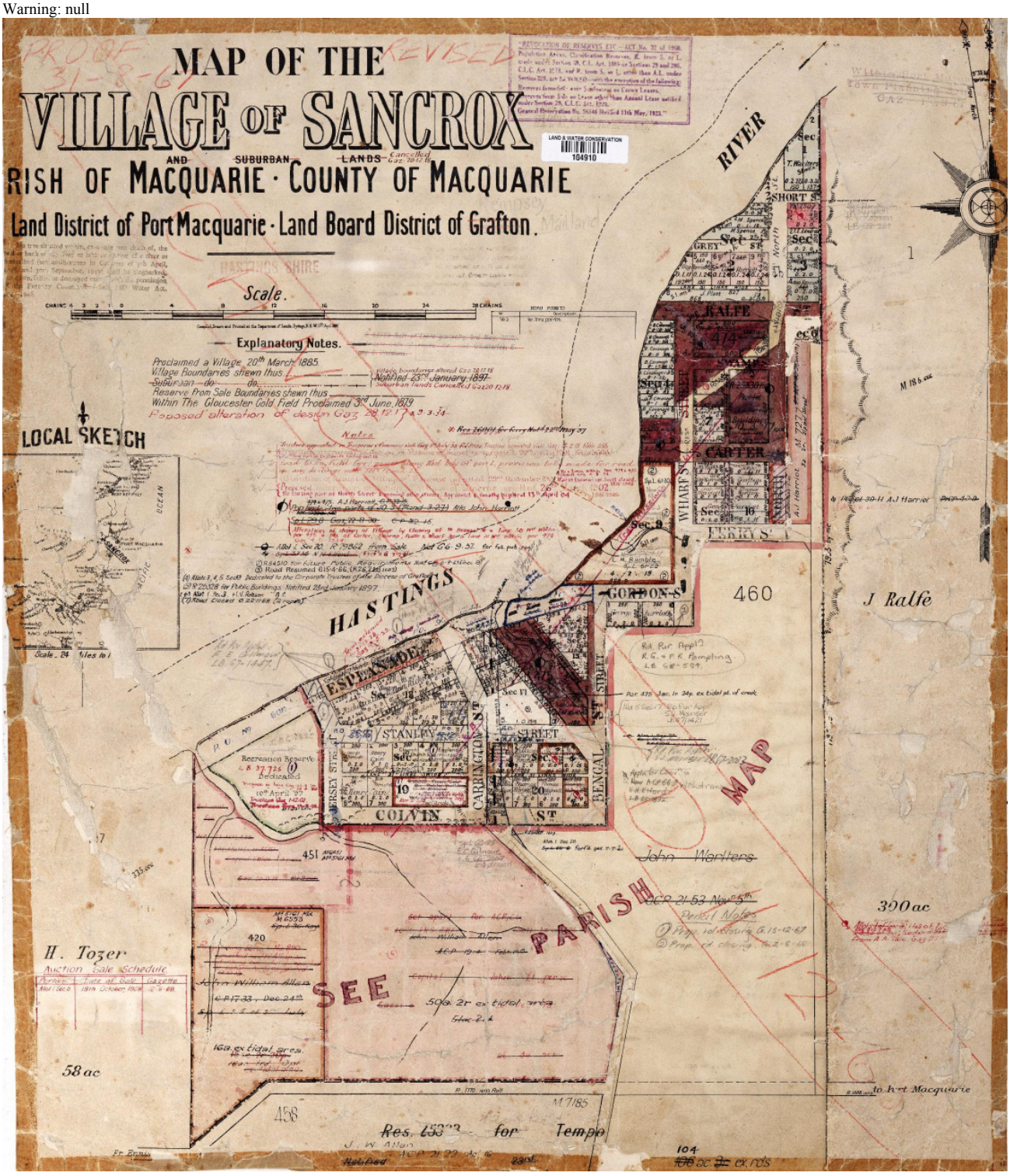

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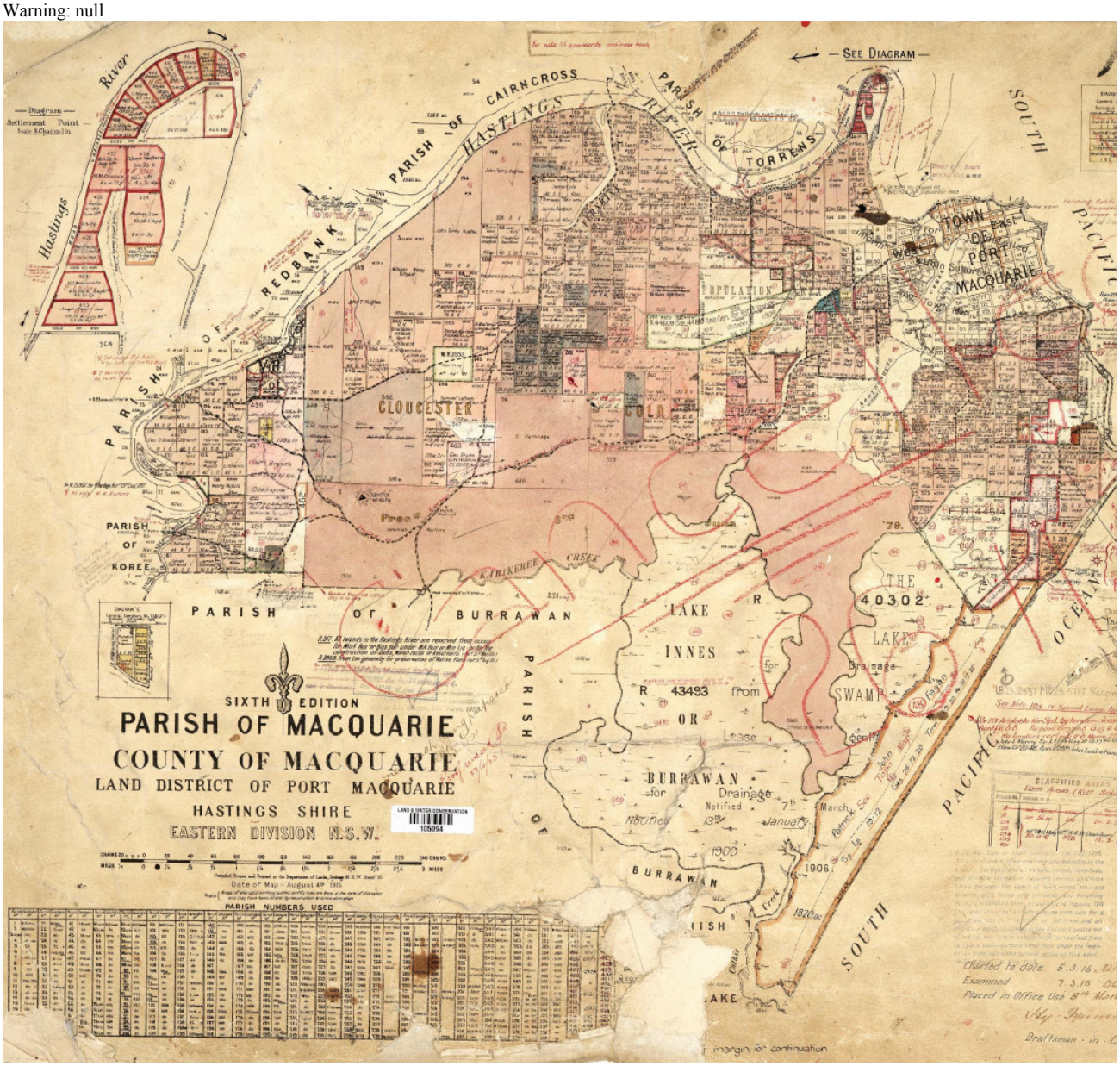

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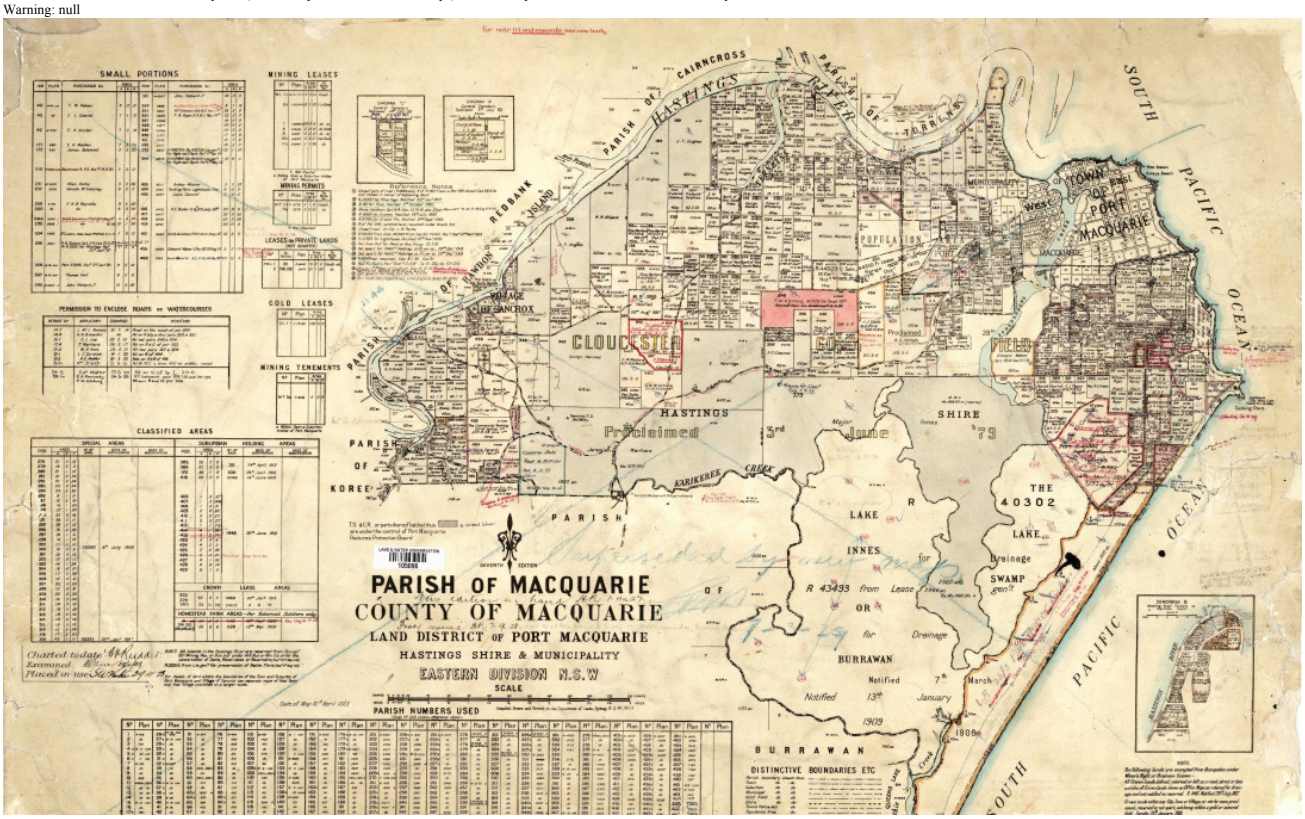

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Warning: null

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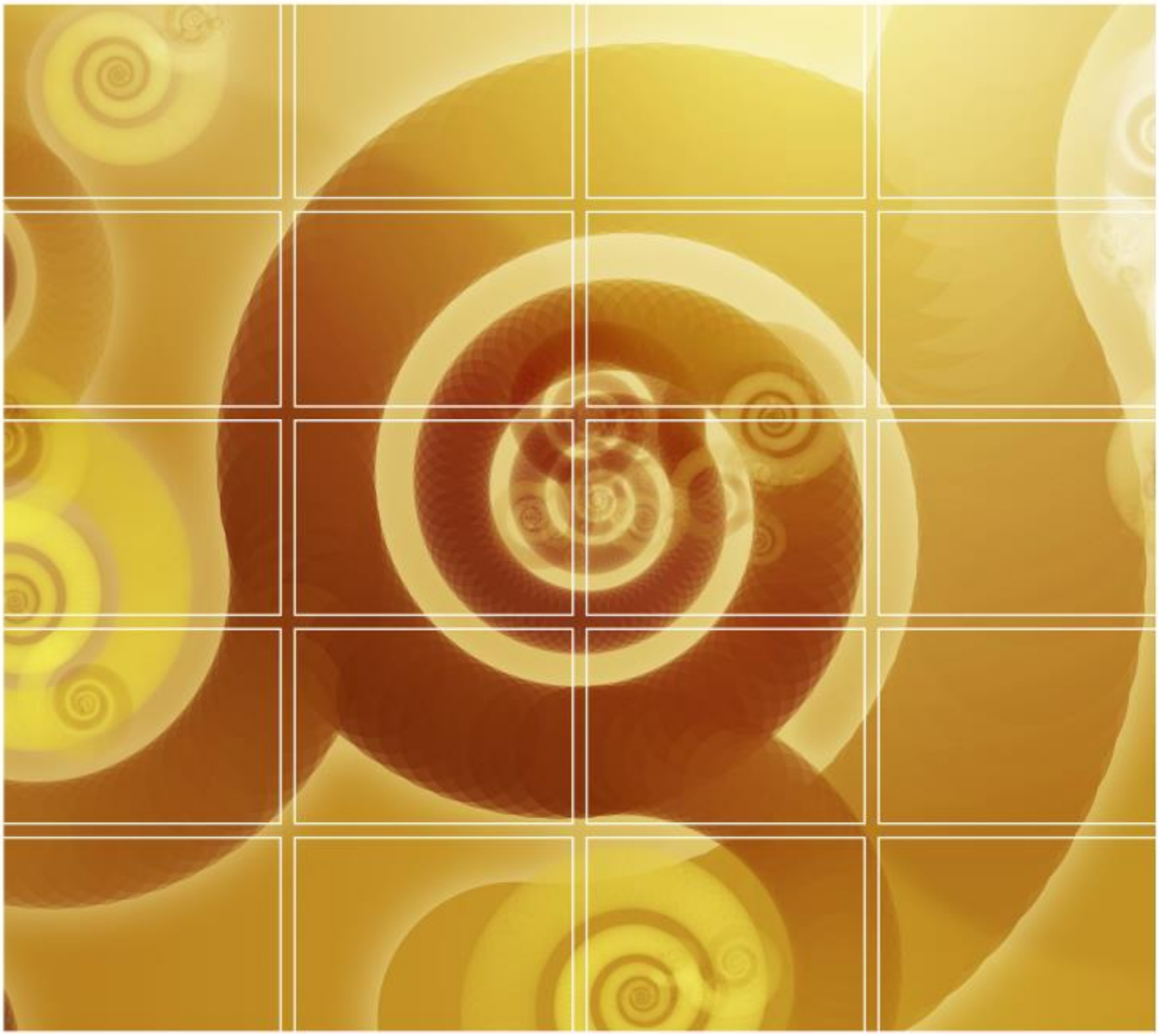
ERM

Annex E

Hydrology Assessment



Sancrox Quarry Expansion
Hydrology Assessment

Hanson Construction Materials Pty Ltd

August 2019

0418291_Final

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ERM

Approved by:	*Thomas Buchan*
Position:	Project Manager
Signed:	
Date:	*28 August, 2019*
Approved by:	*Murray Curtis*
Position:	Partner Director
Signed:	
Date:	*28 August 2019*

Environmental Resources Management Australia Pty Ltd

Sancrox Quarry Expansion

Hydrology Assessment

Hanson Construction Materials Pty Ltd (Hanson)

August 2019

0418291_Final

www.erm.com

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1 INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Hanson Construction Materials Pty Ltd (Hanson) to conduct a Hydrology Assessment to inform the Environmental Impact Assessment (EIA) for the proposed Sancrox Quarry Expansion Project (the Project). The Project is a State Significant Development (SSD #7293) and therefore the planning approvals process is regulated under the *Environmental Planning and Assessment Act 1979* (the EP&A Act), which requires Department of Planning and Environment (DP&E) approval for development consent, supported by an Environmental Impact Statement (EIS).

1.1 BACKGROUND

Hanson currently operates a hard rock quarry, known as Sancrox Quarry, on Sancrox Road, Sancrox, located approximately 8 kilometres west of Port Macquarie, within the Port Macquarie Hastings Council (PMHC) local government area. The quarry has been owned and operated by Hanson since 1998, and is considered a major economic resource for regional and state development.

The Project will extend the life of Sancrox Quarry (the quarry site) by expanding the approved extraction boundary and increasing approved extraction limits. The Project proposes to increase the current annual maximum extraction limit from 455,000 tonnes per annum (tpa) to 750,000 tpa. The Project will involve an upgrade and relocation of the existing infrastructure area including processing plant, offices, weighbridge, and workshop. The Project also includes the construction of a new concrete batching plant, concrete recycling facility, asphalt production plant and pug mill on site.

1.2 OBJECTIVES AND SCOPE

The objective of this Hydrology Assessment is to meet the requirements of the Secretary's Environmental Assessment Requirements (SEARs). ERM has conducted the assessment to meet the requirements of the SEARs, as provided in *Table 1.1*. The Table details where within the report the SEARs are addressed. Landcom (2004) *Managing Urban Stormwater: Soils and Construction* was used as the guidance document for developing this assessment and the mitigation measures.

Table 1.1 Secretary's Environmental Assessment Requirements

Secretary's Environmental Assessment Requirement	Section of Report where Addressed
A detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures	*Section 7* and *Section 6.4.1*
Identification of any licensing requirements or other approvals under the Water Act 1912 and/or Water Management Act 2000;	*Section 2*
Demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP)	*Section 2* and *Section 7*
A description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo	*Section 2*
An assessment of any likely flooding impacts of the development	*Section 5.2*
An assessment of the likely impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives	*Section 3.3, Section 5*, *Section 8, Annex B* and *C* and separate *Groundwater Assessment* (ERM, 2018)
An assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users	*Section 5*, *Section 8, Annex B* and *C* and separate *Groundwater Assessment* (ERM, 2018)
A detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts	*Section 6*

1.3 PROJECT OVERVIEW

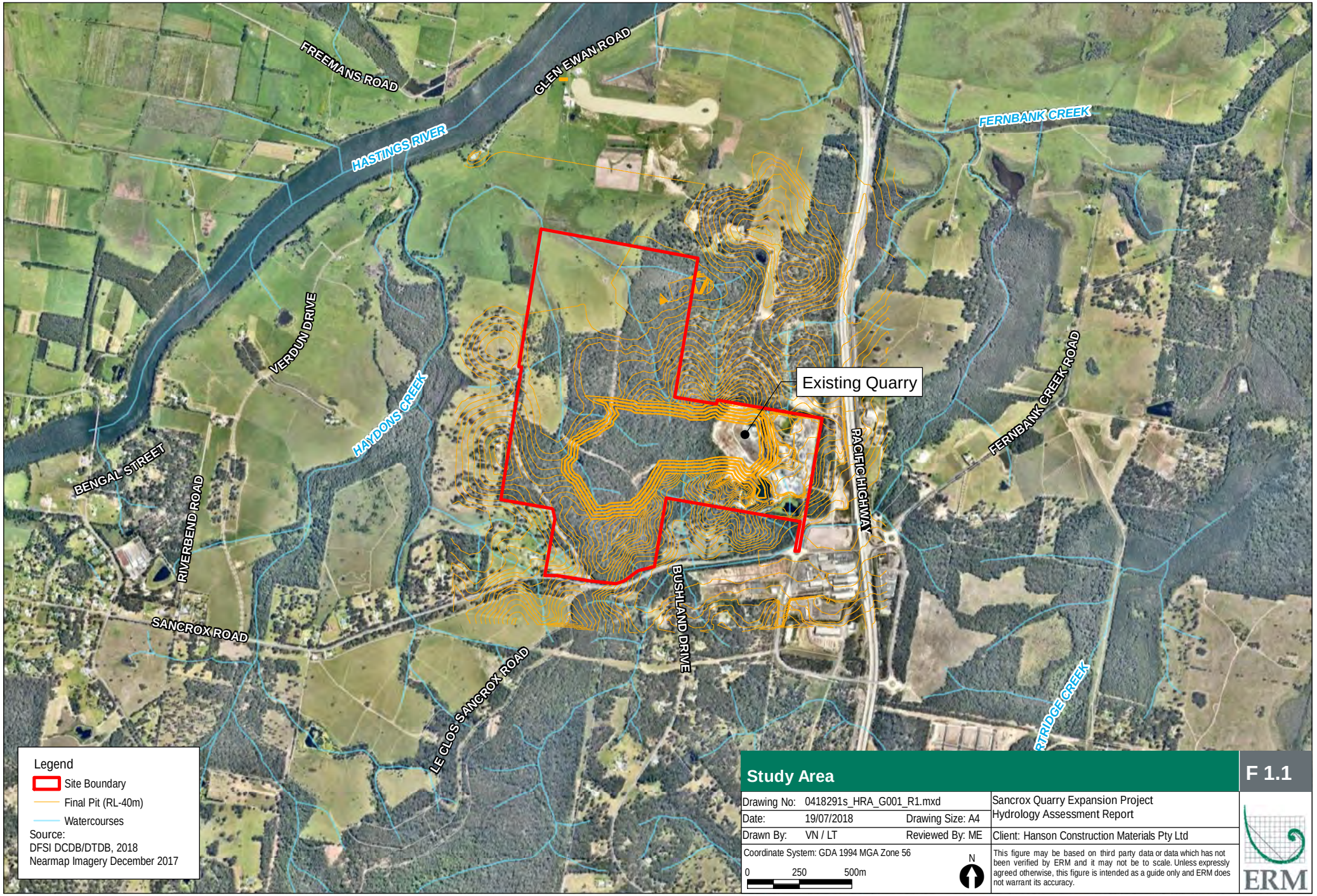
The proposed expansion of the Sancrox Quarry will increase operations to 24 hours, 7 days a week, increasing extraction from 455,000 tpa to 750,000 tpa. The expansion of the quarry will progress westward and southward to excavate new resource. The quarrying will be undertaken in five stages, with the first two extending the footprint of the quarry, the third stage deepening within the footprint, and the final two stages extending the footprint and extracting to the approved depth of - 40 m Australian Height Datum (AHD).

In addition to the expansion of the quarry, the site will establish new ancillary facilities, including:

- a concrete batching plant (50,000tpa);
- a concrete recycling facility (20,000tpa); and
- an asphalt production plant (50,000tpa).

Further detail on the Project is provided in Chapter 2 of the EIS.

The final extent of the quarry is herein referred to as the Project site. The Study Area encompasses the catchments of the Project site that drain to the Hastings River. The Study Area and proposed location of the ancillary facilities is provided in *Figure 1.1* and *Figure 1.2* respectively.


FREEMANS ROAD
GLEN EWAN ROAD
HASTINGS RIVER
FERNBANK CREEK
VERDUN DRIVE
HAYDONS CREEK
Existing Quarry
BENGAL STREET
RIVERBEND ROAD
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
SANCROX ROAD
BUSHLAND DRIVE
LE CLOS SANCROX ROAD
RTRIDGE CREEK
Legend
Site Boundary
Final Pit (RL-40m)
Watercourses
Source:
DFSI DCDB/DTDB, 2018
Nearmap Imagery December 2017
Study Area
F 1.1
Drawing No: 0418291s_HRA_G001_R1.mxd
Date: 19/07/2018
Drawing Size: A4
Drawn By: VN / LT
Reviewed By: ME
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Hydrology Assessment Report
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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Quarry sump

Silt Retention Dam

Concrete Batching Plant & Recycling Facility

Pit Floor

Three tier sediment treatment train

Old Processing Plant (to be relocated)

New Processing Plant

New Asphalt Production Plant

New Stockpile Area

Water Holding Dam 1 (WHD1)

Existing Site Office, Weightbridge & Workshop

Water Holding Dam (WHD2)

Noise Bund

Legend

- Existing Property Ownership
- Lot Boundary
- Infrastructure
- Haul Road
- Road Network

Source:
Spatial Data: DFSI DCDB/DTDB 2017
Imagery Data: nearmap August 2017

Ancillary Infrastructure

F 1.2

Drawing No:	0418291s_HRA_G002_R3.mxd		Sancrox Quarry Expansion Project **Hydrology** Assessment Report
Date:	30/09/2019	Drawing Size: A4	
Drawn By:	GC	Reviewed By: ME	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 25 50m

N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

2 REGULATORY CONSIDERATIONS

2.1 ENVIRONMENTAL PROTECTION LICENCE

The quarry site is subject to Environment Protection Licence (EPL) No. 5289 (anniversary date 15 February). The EPL specifies a single point of discharge and concentration limits for discharge waters along with requirements for water quality monitoring in relation to oil and grease, pH, total nitrogen and total suspended solids, at a frequency of every two months and following each overflow event.

Should approval be granted to the Project, the EPL will need to be updated with the following:

- increased extraction volume;
- proposed licenced discharge points at the existing and proposed sediment basins; and
- the proposed surface water monitoring program.

It is noted that the scheduled activity relating to resource recovery and waste processing requirements do not apply, as the waste concrete to be received will meet the conditions of the Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014 – The recovered aggregate order 2014 at the time that it is received.

A Pollution Incident Response Management Plan (PIRMP) has previously been prepared for the site. The PIRMP will need to be updated to include the new activities should the Project be approved.

2.2 WATER ACT 1912

Section 10 of the *Water Act 1912* requires that:

(1) Any occupier of land whereon any work to which this Part extends (not being a joint water supply scheme) is constructed or used, or is proposed to be constructed or used, for the purpose of:

(a) water conservation, irrigation, water supply or drainage, or

(b) (Repealed)

(c) changing the course of a river

May apply to the Ministerial Corporation in the form prescribed for a licence to construct and use the said work, and to take and use for the purposes specified in the application the water, if any, conserved or obtained thereby, and to dispose of such water for the use of occupiers of land for any purpose.

2.2.1 *Implications for the Project*

In addition to Section 10 of the *Water Act 1912* outline above, the NSW Aquifer Interference Policy specifies that a water licence is required irrespective of whether water is taken for consumptive use (i.e. for water supply purposes) or whether water is taken incidentally in the course of undertaking the activity. Aquifer interference activities taking water outside of Water Sharing Plan (WSP) areas require a license under the *Water Act 1912* and the water take estimation provided by the groundwater modelling should be taken into consideration during the water licence application process. Hanson currently hold a Water Access Licence (WAL42524) for water supply works undertaken on site. The predicted water take of the quarry extension should be compared to the current licence allowance prior to submitting a request for a revised or new licence.

Refer to the Groundwater Assessment (ERM, 2018) for further information on the Project's potential groundwater impacts, including estimated water take and licencing considerations and estimated water level drawdown and potential impact on groundwater users.

2.3 *WATER MANAGEMENT ACT 2000*

The *Water Management Act 2000* (WMA) was introduced to provide for a comprehensive singular piece of legislation to effectively manage and regulate access, and use of, the State's water resources. The objectives of the WMA include:

- to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and the water quality; and
- to recognise and foster the significant social and economic benefits to the state that result from the sustainable and efficient use of water.

Sections of the Act that pertain to hydrology related aspects of the Project are outlined below.

2.3.1 *Activity Approvals*

Section 89 of the WMA states the following in relation to water use approvals:

(1) A water use approval confers a right on its holder to use water for a particular purpose at a particular location.

(2) A water use approval may authorise the use within New South Wales of water taken from a water source outside New South Wales.

Section 90 of the WMA states the following in relation to water management work approvals:

(1) There are three kinds of water management work approvals, namely, water supply work approvals, drainage work approvals and flood work approvals.

(2) A water supply work approval authorises its holder to construct and use a specified water supply work at a specified location.

(3) A drainage work approval confers a right on its holder to construct and use a specified drainage work at a specified location.

(4) A flood work approval confers a right on its holder to construct and use a specified flood work at a specified location.

Section 91 of the WMA states the following in relation to activity approvals:

(1) There are two kinds of activity approvals, namely, controlled activity approvals and aquifer interference approvals.

(2) A controlled activity approval confers a right on its holder to carry out a specified controlled activity at a specified location in, on or under waterfront land.

(3) An aquifer interference approval confers a right on its holder to carry out one or more specified aquifer interference activities at a specified location, or in a specified area, in the course of carrying out specified activities.

Chapter 3 part 3 of the WMA requires that approval be granted for works that are classified as "controlled activities" within waterfront land (generally being land within 40m of a waterway). A controlled activity is defined as:

(a) the erection of a building or the carrying out of a work (within the meaning of the Environmental Planning and Assessment Act 1979), or

(b) the removal of material (whether or not extractive material) or vegetation from land, whether by way of excavation or otherwise, or

(c) the deposition of material (whether or not extractive material) on land, whether by way of landfill operations or otherwise, or

(d) the carrying out of any other activity that affects the quantity or flow of water in a water source.

An aquifer interference activity means an activity involving any of the following:

(a) the penetration of an aquifer,

(b) the interference with water in an aquifer,

(c) the obstruction of the flow of water in an aquifer,

(d) the taking of water from an aquifer in the course of carrying out mining, or any other activity prescribed by the regulations,

(e) the disposal of water taken from an aquifer as referred to in paragraph (d).

Implications for the Project

Part 4 Division 4.7 Section 4.41 (1)(g) of the EP&A Act states that authorisations are not required should the Project be granted SSD approval, including:

a water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the Water Management Act 2000.

Therefore the Project is exempt under Section 89(J) of the EP&A Act for the need to obtain:

- a controlled activity permit;
- a water supply work approval;
- a drainage work approval;
- a flood work; or
- a water use approval.

An aquifer interference approval will however be required.

2.3.2 *Water Sharing Plans*

The draft WSP for the Hastings Unregulated and Alluvial Water Sources 2016 under the *Water Management Act 2000* includes proposed rules for protecting the environment, water extractions, managing licence holders' water accounts, and water trading in the plan area. The draft plan area comprises all streams and alluvial aquifers within the Hastings River Valley.

Since 1 July 2004 licensing and approvals under the WMA has been in effect in specific areas of NSW covered by operational WSPs – these areas cover most of the State's major regulated river systems. Currently, outside these areas, licensing provisions of the *Water Act 1912* are still in force.

Implications for the Project

The Project does not currently fall within a gazetted WSP area[1] therefore any access to groundwater would be applied for under the *Water Act 1912*.

[1]http://www.water.nsw.gov.au/water-management/water-sharing/plans_commenced

2.3.3 Basic Landholder Rights

Part 1 of the WMA outlines basic landholder rights, which include domestic and stock rights (Section 52 of the Act), harvestable rights (Section 53 of the Act) and native title rights (Section 55 of the Act).

In relation to harvestable rights, Section 53 of the WMA states:

(1) An owner or occupier of a landholding within a harvestable rights area is entitled, without the need for any access licence, water supply work approval or water use approval:

(a) to construct and use a dam for the purpose of capturing and storing rainwater run-off, and

(b) to use water that has been captured and stored by a dam so constructed, in accordance with the harvestable rights order by which the area is constituted.

Implications for the Project

Landholders in NSW can build dams on minor watercourses (first or second order watercourses which do not permanently flow) that capture 10 per cent of the average regional rainfall run-off on land in the Central and Eastern Divisions, and up to 100 per cent on land in the Western Division[2]. The quarry site makes up approximately 1.5 km^2 which falls within the Eastern Division.

Based on the location and size of the quarry site, the Maximum Harvestable Right Dam Capacity is 19.5 megaLitres (ML). Dams that qualify as "excluded works" under Schedule 1, Section 3, of the WMA, include those "*solely for the capture, containment and recirculation of drainage and/or effluent*". Sediment basins meet this definition and are exempt from harvestable rights calculations.

[2] http://www.water.nsw.gov.au/water-licensing/basic-water-rights/harvesting-run-off

The volume of existing the two Water Holding Dams (WHD1 and WHD2, as shown in *Figure 1.2*) in the south eastern corner of the quarry site is 14.05 ML. There is also a small farm dam within the lot owned by Hanson, but the volume of this dam is conservatively estimated at 0.5ML, which when added to the quarry WHDs is below the allowable harvestable rights. All future water holding bodies will be for the purpose of erosion and sediment control and therefore will be excluded from harvestable rights.

2.4 CONSULTATION

The SEARs require consultation with relevant local, State and Commonwealth Government authorities. These agencies as relevant to the hydrology assessment are outlined in *Table 2.1,* along with the response received.

Table 2.1 Stakeholder Consultation

Relevant Stakeholder	Consultation Method	Response
Environment Protection Agency	Letter advising that the EIS process is underway and the assessment will address the SEARs. Request for additional comments made.	No further comments at this stage.
Department of Primary Industries (Office of Water)	Same as above.	No further comments at this stage.

3 SITE SETTING

3.1 ENVIRONMENTAL SETTING

3.1.1 Climate

Long-term climate data is available from a Bureau of Meteorology (BoM) weather station located in Telegraph Point (Farrawells Road, 060031), approximately 10.5 km north of the site. The weather station has been operational since 1910.

3.1.2 Temperature

Temperature data and mean rain days (daily rainfall ≥ 1mm) was sourced from the Port Macquarie Airport (060139) Automatic Weather Station (AWS), located approximately 4km east of the site. The weather station has been operational since 1995. On average, January is the warmest month in Port Macquarie with a mean daily maximum of 27.7^{o}C. The coolest month is July with a mean daily minimum temperature of 6.4^{o}C.

3.1.3 Rainfall

The mean annual rainfall recorded at Telegraph Point (060031) and mean annual rain days recorded at Port Macquarie is 1314.6 mm, and 100 days, respectively. The mean monthly precipitation and mean monthly rain days summarised in *Table 3.1* below. As demonstrated in the table, the BoM weather station at Telegraph Point has been in operation for over 100 years. Thus it was considered a more robust data source for annual average rainfall compared to the station at Port Macquarie Airport, which has been in operation for 22 years. The annual averages at both locations are similar, with approximately 1315 mm recorded at the Telegraph Point station and approximately 1428 mm recorded at Port Macquarie Airport station. The airport station is approximately 5 km east of the Project site, while the Telegraph Point Station is approximately 11 km north west.

The nearest BoM weather station with mean monthly evaporation data available was Yarras (Mount Seaview, 060085), approximately 44 km to the south west of the site. The mean annual evaporation is 960.9mm.

Table 3.1 Monthly Precipitation and Evaporation Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean monthly rainfall (mm)[1]	138.1	175.1	167.2	127.2	104.4	109.2	66.7	58.5	59.7	83.6	109.0	114.1	1314.6
Mean monthly rain days[2]	8.9	10.4	11	9.3	8.0	7.5	6.3	5.6	5.5	7.4	10.6	9.2	99.7
Mean monthly evaporation (mm)[3]	105.4	81.2	77.5	63.0	49.6	42.0	46.5	71.3	93.0	111.6	102.0	117.8	960.9

1. Mean monthly rainfall from Telegraph Point (Farrawells Road, 060031) (1910 - present), Latitude 31.34°S, Longitude 152.79°E, Elevation 10m.

2. Mean monthly rain days from Port Macquarie Airport (060139) (1995-present), Latitude 31.43°S, Longitude 152.87°E, Elevation 4m.

3. Mean monthly evaporation from Yarras (Mount Seaview, 060085) (1970 – present), Latitude 31.39°S, Longitude 152.25°E, Elevation 155m.

3.1.4 Landform and Elevation

The topography surrounding the proposed Study Area is characterised by floodplains and low lying hills up to approximately 60mmAHD, which is the highest point of the Study Area.

Run-off from the majority of the existing quarry site flows into the pit which is pumped to existing WHDs in the southeast corner of the site. These WHDs also collect the majority of the run-off from the workshop and southern stockpile area. There is sediment basin in the northeast of the quarry site that captures surface run-off from part of the crushing and northern aggregate stockpile area (herein referred to as the 'Silt Retention Dam' and the upslope 'three tier sediment treatment train'). These features are demonstrated in *Figure* 1.2. The majority of the northern aggregate stockpile area drains to the southeast and has minimal current sediment controls, with improvements to be implemented outlined in *Section 6.4.1*. The quarry site is surrounded by a bund at its extents.

The future stages of the Project will progress into the peak to the west of the existing quarry and along the ridgeline further to the west. This will limit/avoid the requirement for upslope diversions to prevent clean run-on entering the excavation areas.

3.1.5 Soils and Geology

The 1:250,000 Hastings Geological Map Series SH 56-14 indicates that the Project site is situated over the Byabbara Beds Formation of the Carboniferous Period and Palaeozoic Era. The Byabbara Beds are characterised by lithic sandstone, siltstone, tuff, shale and limestone.

The soils at the existing quarry site have predominately been removed prior to the excavation of the quarry in search of 'hard rock'. The highly disturbed extraction area is characterised by exposed rock and crushed particles of rock and clays. Several stockpiles of crushed material were present across the Project site during the site inspection. The stockpiles are not covered to protect from erosive forces, though run-off generated from the stockpiles predominately drains towards sediment treatment devices.

According to the soil landscapes described by Atkinson (1999), the majority of undisturbed portions of the Project site are part of the Cooperabung Soil Landscape. The western and southern extent of the Project site extends into the Euroka Soil Landscape. A small portion of the western extent of the Project site comprises the Kundabung Landscape.

Soil Texture Group and Dispersibility

Cooperabung Soil Landscape

Landcom (2004) states that the Cooperabung soil landscape is characterised as the Type F or Type D sediment type; being fine and dispersible. The Revised Universal Soil Loss Equation (RUSLE) includes a factor for soil erodibility, the K-Factor. K-factors range from 0.075 (very high) to 0.005 very low. The range of K-factors observed for the Cooperabung landscape range between 0.024 to 0.05. The soil Hydrologic Group is Group B (low-moderate run-off potential) /Group C (moderate to high run-off potential).

Euroka Soil Landscape

Landcom (2004) states that the Euroka soil landscape is characterised as the Type F or Type D sediment type; being fine and/or dispersible. The K-factor for this landscape ranges between 0.011 to 0.037. The soil Hydrologic Group is Group C (moderate to high run-off potential).

Kundabung Soil Landscape

Landcom (2004) states that the Kundabung soil landscape is characterised as the Type F or Type D sediment type; being a fine/and or dispersible. The K-factor for this landscape ranges between 0.017 and greater than 0.094. The soil Hydrological Group is Group C/Group D (high to very high run-off potential).

3.2 SURFACE WATER RESOURCES

3.2.1 Receiving Waters

Fernbank Creek

The quarry site is located within the Fernbank Creek catchment. The quarry has the potential to discharge from two locations, the WHD 2 in the southeast and the Silt Retention Dam in the northern portion of the site. WHD 2 is the licenced discharge point and the Silt Retention Dam does not overflow as it is managed by pumps and has over designed capacity (see *Section 6.4.2*). Both locations would flow into separate first order watercourses which meet with Fernbank Creek (a third order watercourse), approximately 820 m and 690 m north east from each potential discharge point respectively. Fernbank Creek is located on the opposite (eastern) side of the Pacific Highway relative to the quarry site.

Haydon's Creek

Outside of the existing quarry site, the west and northwest portions of the Project site are located within the Haydon's Creek catchment. Haydon's Creek is situated approximately 360 m west from the western extent of the Project site and flows in to the Hastings River approximately 700 m to the northwest. The southern portion of the Project site is located within the Fernbank Creek catchment area, with surface flows likely to join a third order watercourse prior to meeting with those from the southern quarry site discharge location.

Hastings River

The Hastings River is the final receiving watercourse for all run-off from the quarry catchment (including potential discharges/overflows) prior to entering the Pacific Ocean. The Hastings River rises in the Great Dividing Range and flows south east through a coastal floodplain to Port Macquarie, where it meets the Pacific Ocean. Fernbank Creek and Haydon's Creek both flow to the Hastings River.

"Due to the high density of rural settlement, the region's rivers and estuaries tend to be affected by changed run-off conditions caused by land clearing, agricultural use, human settlement and recreation. Most of the rivers and creeks in the Hastings River Basin are unregulated, without major storages to capture and control flows. Most water users rely on natural flows or small structures, such as weirs for their water supplies. As in most unregulated rivers, flows are most affected during relatively dry times, when water levels are low and demand high. In the lower reaches, important local users include livestock grazing, fishing, oyster farming grapes, tourism, and urban and rural residential. Local councils, water utilities, conservation and forestry are also major water users in the catchment" (WaterNSW, 2017).

Other Watercourses

With the exception of a third order watercourse in the far northern portion of the lot, that will not be affected by the Project, all other watercourses directly impacted by the Project are first or second order watercourses.

3.3 NSW WATER QUALITY AND RIVER FLOW OBJECTIVES

The NSW government has set up the NSW Water Quality and River Flow Objectives (WQRFO), which are agreed environmental values and long-term goals for NSW surface waters. The objectives are consistent with the agreed national framework for assessing water quality set out in the ANZECC 2000 Guidelines.

Surface waters from the existing site discharge point are released into Fernbank Creek before flowing into the Hastings River. The new basins required for the quarry expansion would discharge to the Haydon's Creek catchment and flow to the Hastings River. Ultimately, all site overflow/discharge will flow to the Hastings River. The Hastings River forms part of the Camden Haven and Hastings River Catchment under the WQRFO.

Under the WQRFO scheme, the Camden Haven and Hastings River Catchment defines four categories of surface waters each within its own set of environmental objectives. These are:

- uncontrolled streams;
- waterways affected by urban development;
- estuaries; and
- mainly forested areas.

The watercourses adjacent the Project site and the immediate receiving waters would meet the categorisation "uncontrolled streams". These waters include all waterways that are not in estuaries or the other categories. Their flow patterns are largely natural but may have been altered to a limited degree. The WQRFO for uncontrolled streams are provided in *Table 3.2*.

Table 3.2 Uncontrolled Stream – Water Quality and River Flow Objectives

Sub-catchment	Water Quality Objectives	River Flow Objectives
Uncontrolled Stream	• Aquatic ecosystems • Visual amenity • Secondary contact recreation • Primary contact recreation • Livestock water supply • Irrigation water supply • Homestead water supply • Drinking water at point of supply - disinfection only • Drinking water at point of supply clarification and disinfection • Drinking water at point of supply-Groundwater • Aquatic foods (cooked)	• Protect pools in dry times • Protect natural low flows • Protect important rises in water levels • Maintain wetland and floodplain inundation • Mimic natural drying in temporary waterways • Maintain natural flow variability • Manage groundwater for ecosystems • Minimise effects of weirs and other structures

3.3.1 Riparian Lands and Previous Water Quality Monitoring

The Hastings Catchment Ecohealth project (Ryder et. al., 2013) details that the Hastings River Catchment covers an area of 3,720 km² and has a total length of over 180 km. Ryder et. al. (2013) details that the concentrations of various measures for phosphourus and nitrogen consistently exceed trigger values in all monitoring locations on the river. Dissolved oxygen is below trigger levels during low flow conditions (Ryder et. al., 2013). The Ecohealth project determined that in the Hastings River water quality issues are most pronounced in estuarine reaches, with trigger values consistently exceeded for all variables during both high and low flow conditions (Ryder et. al. 2013).

Ryder et.al (2013) details that riparian conditions and habitat scores along the Hastings River were low due to evidence of tree and log removal.

3.4 HYDROLOGICAL DATA

3.4.1 Intensity Frequency Duration Analysis

Site hydrological data was obtained from an Intensity-Frequency-Duration (IFD) table developed for the site using the process outlined in Australian Rainfall and Run-off (Pilgrim, 1987) The BoM's web-based IFD application (BoM, 2017) was used to develop the table. A copy of the IFD table is provided in *Annex A*.

4 EXISTING WATER MANAGEMENT

4.1 INVESTIGATION METHODOLOGY

To gain an understanding of the site characteristics and current water management at the site, ERM's Senior Environmental Scientist and Certified Professional in Erosion and Sediment Control, Tim Haydon carried out a site investigation on 30 November 2017. This investigation was undertaken to understand the site sub-catchments and discuss site water management with the Proponent's representative. Surface water quality sampling was also undertaken to gain an understanding of the current water quality on the site and inform the groundwater assessment (as to whether groundwater is infiltrating site surface water bodies). Surface water samples were taken from:

- the two WHDs in the south east of the site;
- the quarry sump; and
- one location outside the quarry void where a suspected spring is located.

The surface water quality monitoring results are provided in *Annex D*.

To further inform the understanding gained from the site inspection, ERM undertook the following desktop activities:

- review of previous reports prepared for the quarry site;
- review and interpretation of:
  - aerial photography;
  - site survey; and
  - Proponent and PMHC supplied Geographical Information System (GIS) data.

4.2 SITE STORMWATER SUB-CATCHMENTS AND CURRENT CONTROLS

The existing quarry site and Project Site have been broken into sub-catchments based on the methodology outlined in *Section 4.1* and are described in *Table 4.1* and *Figure 4.1*. The existing sediment controls are also outlined in *Figure 1.2*

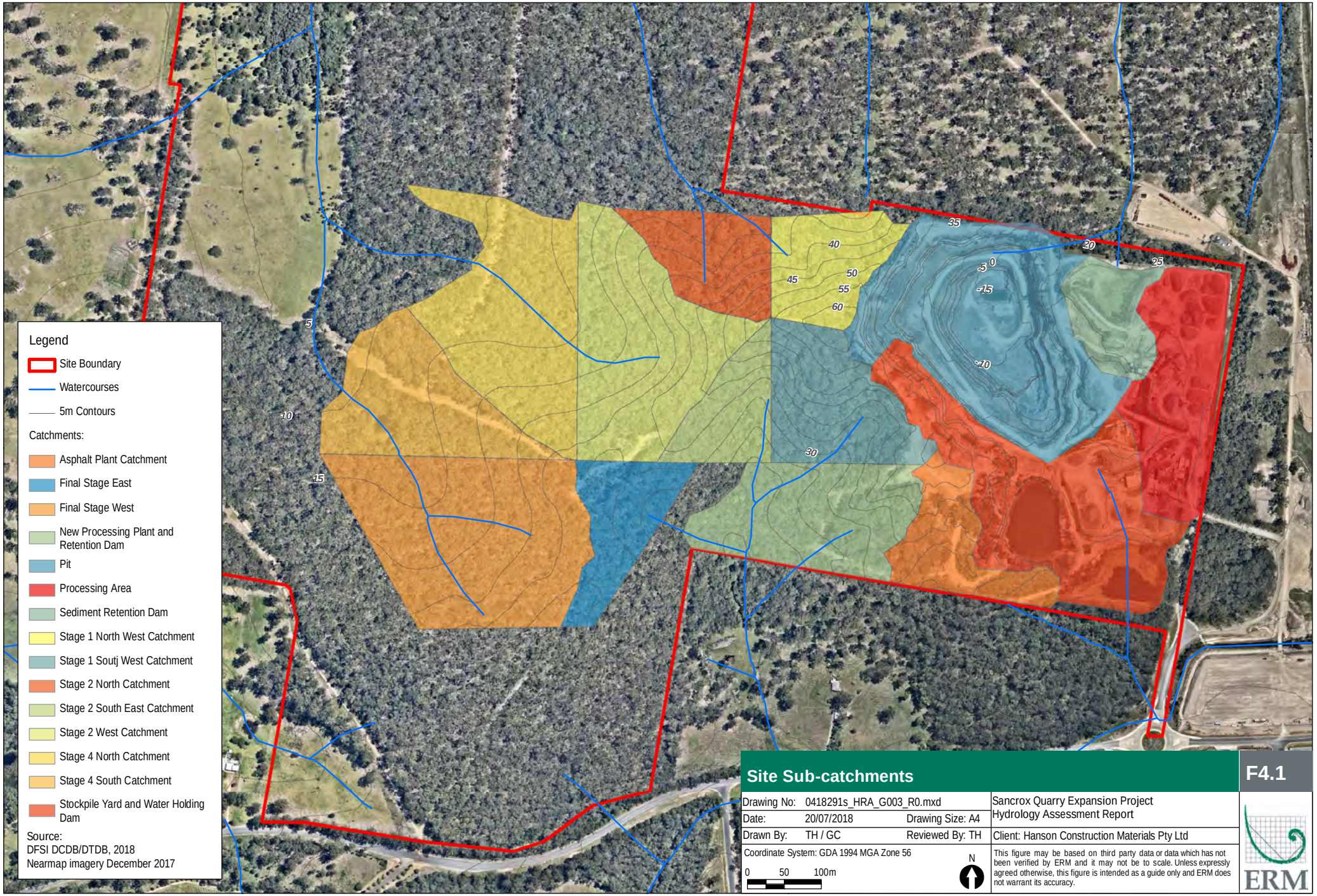
Table 4.1 Site Stormwater Sub-catchments

Sub-catchment	Area (ha)	Approximate percentage disturbed at time of assessment	Landform/Description	Existing Sediment controls
Existing catchments under previous approvals				
Pit	7.35	100	The current void created by previous quarrying activities. Quarry faces are predominately benched and access track is present to gain access to quarry floor.	Excavation at base of pit accumulates run-off within the void. Location of void is such that limited run-off from clean upslope catchments enter the pit.
Processing Area	3.49	100	This catchment is predominately flat to a low grade to the east. The eastern extent of processing area is a bund to prevent run-off exiting the site over the slope to the east.	Bund wall prevents run-off from exiting over eastern slope. Minor depressions accumulate rainfall but are not designed sediment controls. Improvement to controls are required in the form of a sediment basin as described in *Section 6* and *Table 5.1*.
Silt Retention Dam	1.49	100	Series of sediment traps and larger retention dam. Captures a portion of the existing processing area. wash water from processing enters into the series of traps and ultimately the sediment retention basin.	This catchment is predominately for the capture of washwater from the processing activities and capture of sediment entrained run-off from small portion of catchment. The treatment within the area is larger than the proposed run-off generated in the design storm event. This basin is controlled from overflowing by pumping to the WHDs.
Stockpile Yard and Water Holding Dams	6.22	90	The stockpile yard is predominately flat with very shallow grade to the WHDs. The steeper areas in the western portion of the site drain to the western most dam (WHD2). Some vegetation is present on the fringes for the dams in this catchment	The large dams in this catchment are utilised for sediment control from the stockpile area and other disturbed areas. The dams also hold water for use in dust suppression and other activities on site.
Asphalt Plant Catchment (currently an access track and storage area)	2.08	30	Access track and vegetation	Vegetation is providing informal sediment control in this location. As disturbance occurs controls will be required, in the form of a sediment basin as described in *Section 6* and *Table 5.1,* with drainage to direct run-off to WHD1.

Sub-catchment	Area (ha)	Approximate percentage disturbed at time of assessment	Landform/Description	Existing Sediment controls
Project Site Catchments				
New Processing Plant and Stockpile Area	3.76	15	Current disturbance limited to access tracks. The catchment comprises the confluence of three first order watercourses with second order watercourses. An additional first order course is present in the south east of the catchment. Upon disturbance, a pad will be established to provide level foundation for processing plant and stockpiles.	Vegetation is providing informal sediment control in this location. Controls required with disturbance as described in *Section 6*.
Stage 1 North West	2.14	0 – Fully vegetated at time of assessment	Comprises the northern side of the peak of the hill that the quarry is exploiting. A first order watercourse is present in the north western portion of the site.	No requirement for erosion and sediment controls at present. Controls required with disturbance as described in *Section 6*.
Stage 1 South West	3.02	0 – Fully vegetated at time of assessment	This catchment comprises the southern side of the peak of hill being quarried. A ridgeline travels south of the peak and a first order watercourse is present in the eastern portion of the site and adjacent to the western extent of the stage boundary. The first order watercourses converge to become a second order watercourse in the new processing and stockpiling area.	No requirement for erosion and sediment controls at present. Controls required with disturbance as described in *Section 6*.
Stage 2 North	2.13	0 – Fully vegetated at time of assessment	Two first order watercourses present in this catchment drain to the north.	No requirement for erosion and sediment controls at present. Controls required with disturbance as described in *Section 6*.
Stage 2 South East	1.66	0 – Fully vegetated at time of assessment	The catchment drains to the east to the first order watercourse located on the confluence of the Stage 1 and 2 boundary.	No requirement for erosion and sediment controls at present. Controls required with disturbance as described in *Section 6*.
Stage 2 West	5.11	5	Catchment predominately drains to the west via a first order watercourse.	No requirement for erosion and sediment controls at present. Controls required with disturbance as described in *Section 6*.

Sub-catchment	Area (ha)	Approximate percentage disturbed at time of assessment	Landform/Description	Existing Sediment controls
Stage 4 North	5.21	0 – Fully vegetated at time of assessment	First order watercourse conveys run-off approximately through the centre of the catchment.	No requirement for erosion and sediment controls at present. Controls required with disturbance as described in *Section 6*.
Stage 4 South	3.55	10	The catchment predominately drains to a second order watercourse in the south western portion of the catchment.	No requirement for erosion and sediment controls at present. Controls required with disturbance as described in *Section 6*.
Final Stage East	2.03	10	The southernmost portion of this catchment captures the peak of a hill. The site predominately drains to the first order watercourse in the east.	No requirement for erosion and sediment controls at present. Controls required with disturbance as described in *Section 6*.
Final Stage West	6.59	5	Two first order watercourses form into a second order that drains to the north west. The south eastern most portion of the catchment incorporates the peak of the hill	No requirement for erosion and sediment controls at present. Controls required with disturbance as described in *Section 6*.

1. Sub-catchments were determined based on observations made during the site inspection, interpretation of aerial photography and the site survey data.



Site Sub-catchments

F4.1

Drawing No:	0418291s_HRA_G003_R0.mxd		Sancrox Quarry Expansion Project Hydrology Assessment Report
Date:	20/07/2018	Drawing Size: A4	
Drawn By:	TH / GC	Reviewed By: TH	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 50 100m

N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

To gain an understanding of current water holding volumes of dams and basins, the areas of each water body were estimated. Depths were assumed based on information extrapolated from the site survey data. A conversion factor of 0.4 was applied to account for the slope of the dam sides (NOW, 2010). This information is shown in *Table 4.2*.

Table 4.2 Existing Water Holding Dam/Basin Size Estimates

Existing Location	Area (m^2)	Depth (m)	Estimated Volume (m^3)
Sediment Retention Dam	3,721	1	1,488
Three tier sediment treatment train	399 – western sump 161 – eastern most sump 155 – southern most sump	1	286
WHD 2	8,218	2.5	8,218
WHD 1 (old quarry void)	5,833	2.5	5,833
Quarry Sump	662	6	1,589

1. The locations of these water holding bodies are shown in *Figure 1.2*

4.3 EFFLUENT MANAGEMENT

Sewerage is treated in the council approved septic system south of the site office and workshop. Hanson has recently commissioned a new male toilet block and two concrete septic tanks. The toilet block comprises of two toilets, two hand basins, a urinal and a shower. The existing women's toilet has been plumbed into the new pump-out septic tank system, which comprises of one toilet and a hand basin. The septic tank specifications are as follows:

- 1 x 7100L Concrete Septic/Pump-out Tank
- 1 x 7100L Concrete Collection Holding Tank

The two tanks have a minimum holding capacity of 11,200L and installation was undertaken as per the relevant council approvals. Based on the site occupancy information and the AS/NZS 1547:2012 guidelines, the site wastewater management system is designed to manage a wastewater load of 1,250L/day (50L per person per day, with 25 site occupants equates to 1,250L/day).

5 POTENTIAL IMPACTS TO SURFACE WATER

Table 5.1 provides a summary of the potential impacts to soil and surface water within and adjacent to the Project site resulting from the proposed construction and operation activities.

The potential impacts would be managed through implementation of appropriate mitigation and management measures. These would be outlined in a Soil and Water Management Plan (SWMP) prepared post approval. *Section 6* outlines a range of management practices that would contribute to sound management of the sites soil and water resources.

5.1 EROSION HAZARD ASSESSMENT

A quantitative assessment of the potential surface water impacts based on the erosion hazard of the Project site was undertaken using the Revised Universal Soil Loss Equation (RUSLE). The RUSLE provides a prediction of the long-term average annual soil loss from erosion at a specific site according to specific management practices.

The RUSLE and the inputs utilised in this assessment are provided in *Annex B*. *Figure 4.1* demonstrates the site sub-catchments utilised in the RUSLE calculations. The conceptual basin designs generated by the RUSLE and location will be refined by a SWMP, with Progressive Erosion and Sediment Control Plans (PESCPs) upon approval of the Project.

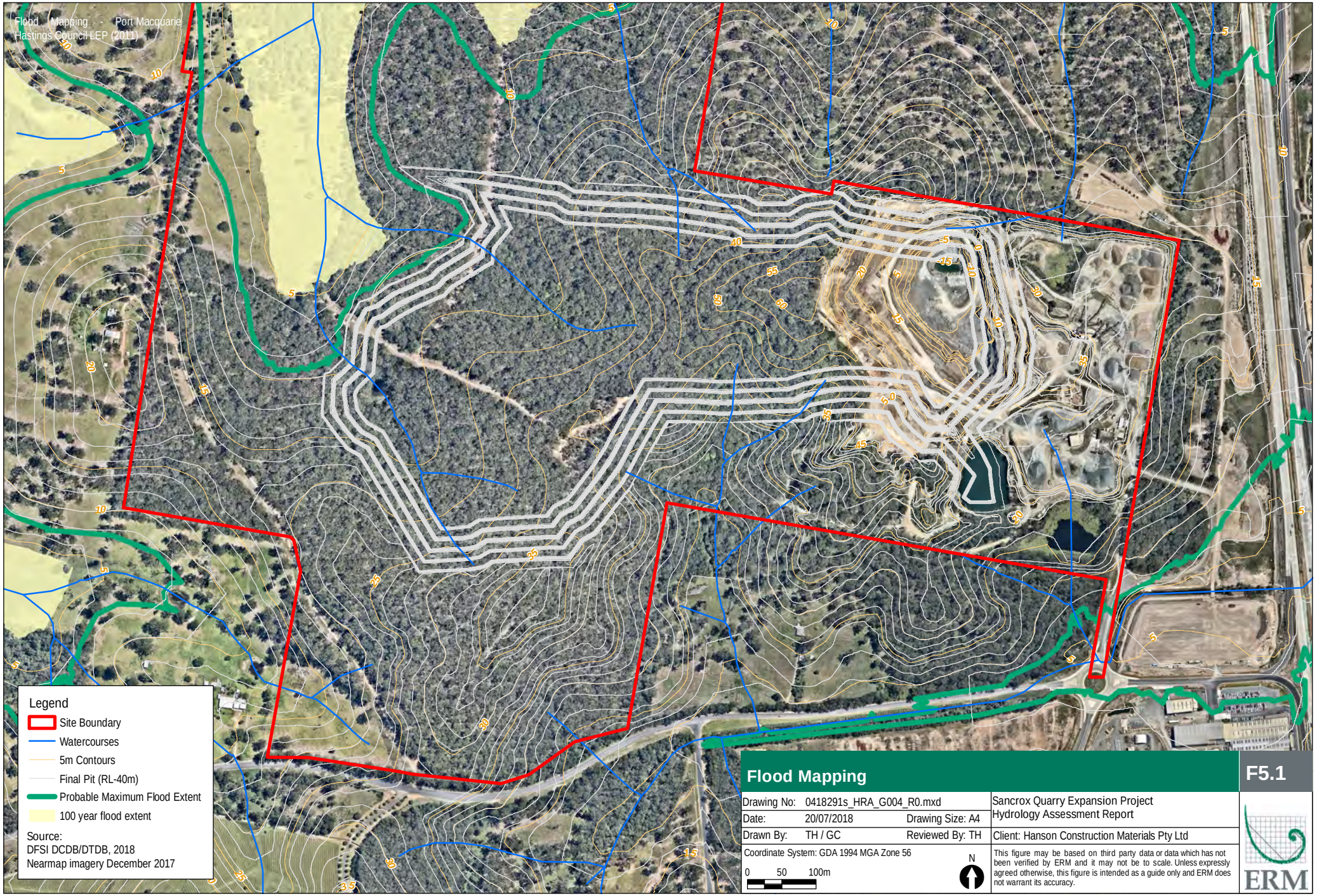
5.2 FLOODING POTENTIAL

PMHC provided 1 in 100 year and Probable Maximum Flood (PMF) mapping data as shown in *Figure 5.1*. The quarry footprint is outside of the PMF boundary.

Table 5.1 Potential Soil and Surface Water Impacts

Construction Activities	Potential Impacts	Duration of Impact	Significance
Unsealed Road Network	• Creation of fugitive dust emissions due to vehicle movements. • Mud tracking at confluence of internal access roads with public road network.	Persistent during establishment of new stages and lifetime of quarrying operations. Internal road network will progressively increase as new stages are developed.	Low - access tracks created during stage establishment will be managed by sediment basins. Internal quarry roads during operation will run-off towards basins. Dust suppression measures proposed.
Establishment of future quarry stages	• Erosion of large disturbed areas during staged/progressive establishment and subsequent sedimentation of run-off. • Creation of fugitive dust emissions due to land and vegetation clearing activities. • Mulch stockpiles generating leachate run-off that may enter the surrounding surface water network.	Progressively increasing with life of quarry. Each basin for each stage will be functional until the quarrying excavates such that the run-off falls into the quarry void. This has been assumed to be no longer than three years per basin.	High – Significant area (greater than 38 ha is to be disturbed to allow for future quarry stages). It will be effectively managed by sediment basins until quarry void engulfs the catchment. Improvements to current site water management will be achieved by the establishment of the basin in the processing area and improved management in the proposed asphalt plant catchment via the conveyance of run-off to existing WHD 1.
Dewatering of site sediment basins and water accumulation points	• Introduction of contaminated water to natural surface waters, including release of water with high suspended solids.	Persistent during establishment of new stages and quarry operations.	Medium – Industry Standard procedure to dewater will manage risk. Surface water monitoring program and EPL variation will outline criteria for discharges/overflows from site water holding bodies.
Stockpile management	• Erosion of stockpiles and loss of soil resource. • Introduction of contaminated water to natural surface waters.	Persistent during quarry operational activities.	Low – dust suppression and management of moisture content, along with progressive stabilisation of topsoil to be used for rehabilitation limits risk.
Concrete Batching Plant	• Contamination of waterways from water impacted by cement (washouts, cement storage areas, immediate vicinity of batch plant).	Lifetime of concrete batching plant	Medium – control measures as per *Section 6* to be implemented to manage risk and prevent negative impacts.

Construction Activities	Potential Impacts	Duration of Impact	Significance
	• Release of water to soil and/or water bodies with increased pH, total suspended solids (TSS) and potentially other contaminants.		
Asphalt Production Plant	• Introduction of hydrocarbon contamination to plant pad site, and subsequent potential contamination of run-off.	Lifetime of asphalt production	Low – industry standard practice limits potential for impacts
General site activities	• Hydrocarbon spills from machinery (burst hoses, mechanical failures, leaking machinery, etc.). • Contamination of waterways from hazardous substances due to incorrect storage (including drums and containers and spent oil filters). • Increased refuse in watercourses due to littering. • Contamination of soils and waterways from poor refuelling practices. • Discovery of previously contaminated sites.	Persistent throughout establishment of each stage and quarry operation	Low – risk is comparable to other construction activities. Within quarry void have very low potential for off-site contamination or surface water due to the topographical separation provided by the excavated void.
Water supply from within site	• Over-extraction of surface water or groundwater resulting in reduced environmental flows, reduced water availability for existing licensed users and impacts on water–dependent ecosystems.	Water required throughout entire lifetime of quarrying and concrete batching operations. Minimal volumes required during construction for dust suppression.	Low- Water balance undertaken to determine available water from existing and proposed water holding bodies. See *Section 6.*



Flood Mapping

F5.1

Drawing No:	0418291s_HRA_G004_R0.mxd		Sancrox Quarry Expansion Project Hydrology Assessment Report
Date:	20/07/2018	Drawing Size: A4	
Drawn By:	TH / GC	Reviewed By: TH	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 50 100m

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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

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6 SOIL AND WATER MANAGEMENT

6.1 APPROACH

Landcom (2004) details seven key principles for effective soil and water management, as outlined below:

1. Assess the soil and water implications of a project at the planning stage;
2. Plan for erosion and sediment control and assess site constraints during the design phase and before any earthworks begin;
3. Minimise the area of soil disturbed and exposed to erosion;
4. Conserve topsoil for later site rehabilitation/regeneration;
5. Control water flows from the top of and through the project area – divert up-slope 'clean' water away from disturbed areas and ensure concentrated flows are below erosive levels;
6. Rehabilitate disturbed lands quickly; and
7. Maintain erosion and sediment control measures for the duration of the project and until the site is successfully rehabilitated.

In addition, the SWMP will prioritise erosion control, which is the most effective means of limiting adverse environmental impacts. Specific erosion controls will be targeted at 'high risk' areas, such as drainage lines that receive concentrated flows, steep or long slopes containing erodible materials, or areas that are not well protected by downstream pollution controls. It is noted however that quarry sites represent a challenge for erosion control due to the large areas of exposed soil surface (which is often unavoidable), and erosion control will only ever be partially effective. Therefore, to protect receiving waters against pollution, sediment controls such as large sediment basins near final discharge locations and smaller sediment traps targeting problem areas, will be an important element of the SWMP.

6.2 IMPROVED STORMWATER DRAINAGE AND WATER MANAGEMENT

6.2.1 Stormwater Diversion

Stormwater diversion will be required within both clean and dirty catchments throughout the development of the Project.

Diversions in the form of bunds or drains, as fitted to the topography of the specific catchment, will be implemented to allow for the diversion of sediment-laden run-off to sediment basins and in a few circumstances to divert clean run-off from entering the site. Diversions within clean catchments are to be stabilised quickly (through covering of the diversion channel with geofabric or revegetation). Diversion measures within dirty catchments will incorporate rock check dams to reduce sediment loads within the run-off prior to reaching the basin (to maximise efficiency of the basin and reduce desilting requirements) and where possible have low grade to lower flow velocities.

6.3 IMPROVED EROSION CONTROL

6.3.1 Mulch

The progressive clearing of the Project site will generate large volumes of vegetative matter that can be mulched for re-use onsite. The mulch will be mixed with topsoil and applied to batters and other locations requiring rehabilitation, acting as both an addition of organic matter to boost the soil quality (along with other ameliorants) and act as an erosion control measure.

Mulch will be used as a replacement to sediment fences, by creating a bund of between 300 and 500 mm high. Mulch can also be applied as a blanket, of approximately 150 mm thick, to cover disturbed areas and prevent erosion.

6.3.2 Site Stabilisation and Rehabilitation

A progressive site rehabilitation approach will be adopted, whereby stabilisation works (either by revegetation, hard armouring or allowing hard rock finishes to remain where no sediment-laden run-off will be generated) is undertaken immediately following the completion of the activity. Key principles of progressive rehabilitation include:

- availability of acceptable soil materials;
- correct site preparation and replacement of topsoil;
- selection of the most suitable establishment technique;
- selection of appropriate plant species, fertilisers and ameliorants;
- application of sufficient water for germination and to sustain plant growth if rainfall is insufficient;
- an adequate maintenance program; and
- areas not satisfactorily revegetated will be investigated to determine the reason for failure. Appropriate remedial action will be undertaken, including replacing any lost topsoil and re-sowing the site.

Further information quarry closure and rehabilitation post-quarry operations is provided in EIS Chapter 17.

6.4 SEDIMENT CONTROL

6.4.1 Proposed Sediment Basins

Sediment basins have been proposed as a treatment method at the Project site where there is sufficient space for basin construction and the average annual soil loss as predicted by the RUSLE is greater than 150 cubic metres/hectare/year (Landcom, 2004).

The design storm event used in the conceptual sediment basin design was the 80th percentile, 5 day storm event of 40.1mm (as recommended for a basin with an operational lifetime of 1-3 years, discharging to a standard sensitivity environment, Table 6.1 of DECC (2008)).

The sediment basins will require stringent management of water quality parameters and capacities to ensure they operate at optimum efficiency and the potential for environmental impacts to downstream watercourses is minimised.

Water from the sediment basins can be used for quarrying activities such as dust suppression, input into batching processes and watering revegetated/landscaping areas. If of suitable quality, the water can also be utilised in the concrete production activities.

The proposed sediment basins volumes represent the minimum recommended volume for the calculated catchment areas. Basins with greater volumes can be established to provide higher levels of protection or provide additional water sources for project activities. In any case, the required volume for the sediment settling zone is to be provided in between storm events.

Basin Capacity Management, Discharges and Overflows

Basins will be managed to ensure that capacity is available to accept the 80th percentile design, 5-day storm event of 40.1mm (design storm event), as recommended by NSW government basin design guidelines (Landcom, 2004 and DECC 2008). Basin capacity management will involve on-site beneficial reuse and controlled discharges.

Collected runoff within basins can be beneficially reused on-site for the purposes of dust suppression (of product stockpiles and site access tracks), providing product moisture content and in later quarrying stages, watering of internally draining revegetation areas.

The standard practice of controlled discharges will also be undertaken from sediment basins. Collected runoff is to be sampled prior to being discharged, to confirm it meets the water quality criteria stated in *Table 8.3*. This water quality criteria will be included in the sites EPL. If the water quality criteria is not met, the basin cannot legally be discharged offsite. To discharge offsite when water parameters are not met is an offence under Section 120 of the POEO Act. Hence controlled discharges will only occur when collected runoff is confirmed to meet water quality criteria.

Upon confirming compliance with the water quality criteria, the Proponent must restore the design storage capacity to each basin by controlled discharge within five days of the cessation of a rainfall event that causes run-off to occur on the site. Controlled discharges would be released into the surrounding environment from the spillways of the sediment basins. The sediment basins and the co-ordinates of the spillways that will be the controlled discharge points will be listed in the EPL, as outlined further in *Section 8.* Volumes to be discharged following a runoff generating storm event will be limited to a maximum of the sediment settling zone volume of the basin (as stated in *Table 8.1*).

DECC (2008) states for sites at the bulk earthworks stage, where there has not been significant preceding rainfall, rainfall depth of at least 5–10mm may be needed before runoff commences. It can be reasonably assumed that 10mm rainfall is required to generate sufficient runoff to collect in the basins and require capacity management. The BoM Port Macquarie Airport (060139) weather station details that the annual average number of days that rain is equal to or greater than 10mm (over the course of the 23 years of monitoring recorded) is 38 days. Based on this annual average rain days of rainfall ≥10mm data, it can be assumed that the frequency that the basins may require management, including controlled discharge upon meeting water quality criteria, would be a maximum of 38 times per year.

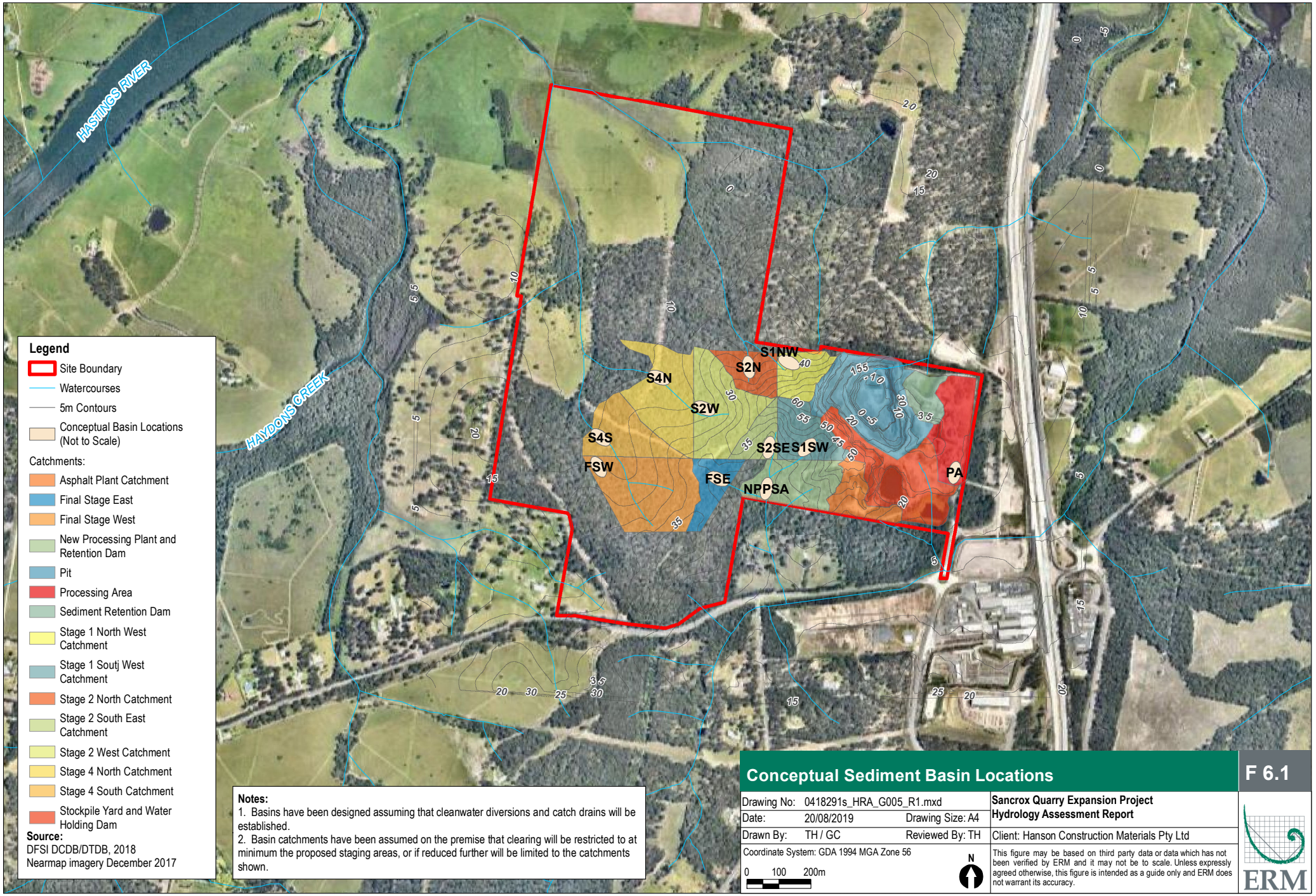
Where rainfall events exceed the design storm, basins will overflow via the designed spillways. DECC (2008) outlines that a basin designed to the 80th percentile storm event typically will overflow at a frequency of six to eight times per year.

6.4.2 General Principles

In identifying the proposed basin locations, it is assumed that each quarry expansion stage will be entirely cleared to its full extent. Where required, stormwater diversions and catch drains will be established to prevent upslope cleanwater run-off entering the site and sediment-laden water from exiting the site (prior to undergoing treatment).

Conceptual sediment basin design has identified the basin locations shown in *Figure 6.1.* Sediment basins will be established prior to the removal of all vegetation across each stage, where practicable. Essentially, this will require clearing a path to the basin location, removing the vegetation, constructing the basin and then clearing the remainder of the catchment.

The conceptual sizes of the basins area outlined in *Table 6.1.*


HASTINGS RIVER
HAYDONS CREEK
S1NW
S2N
S4N
S2W
S4S
S2SE
S1SW
FSW
FSE
NPPSA
PA
Legend
Site Boundary
Watercourses
5m Contours
Conceptual Basin Locations (Not to Scale)
Catchments:
Asphalt Plant Catchment
Final Stage East
Final Stage West
New Processing Plant and Retention Dam
Pit
Processing Area
Sediment Retention Dam
Stage 1 North West Catchment
Stage 1 Soutj West Catchment
Stage 2 North Catchment
Stage 2 South East Catchment
Stage 2 West Catchment
Stage 4 North Catchment
Stage 4 South Catchment
Stockpile Yard and Water Holding Dam
Source:
DFSI DCDB/DTDB, 2018
Nearmap imagery December 2017
Notes:
1. Basins have been designed assuming that cleanwater diversions and catch drains will be established.
2. Basin catchments have been assumed on the premise that clearing will be restricted to at minimum the proposed staging areas, or if reduced further will be limited to the catchments shown.
Conceptual Sediment Basin Locations
F 6.1
Drawing No: 0418291s_HRA_G005_R1.mxd
Date: 20/08/2019
Drawing Size: A4
Drawn By: TH / GC
Reviewed By: TH
Coordinate System: GDA 1994 MGA Zone 56
0 100 200m
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Sancrox Quarry Expansion Project
Hydrology Assessment Report
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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Table 6.1 Conceptual Basin Sizing

Basin Catchment	Basin Name	Total Catchment Area (ha)	Sediment Storage zone (m^3)	Settling Zone Volume (m^3)	Total Basin Volume (m^3)	Comment
Processing Area	PA	3.49	123	714	837	Basin is required to treat sediment entrained run-off that currently has insufficient controls.
Sediment Retention Dam	SRD	1.49	45	305	350	Existing basin and three-tier treatment train volume is approximately 1,774 m^3. No new basin required.
Stockpile Yard and WHD	SYWH	6.22	674	1247	1921	Current volume of two dams is approximately 14,051 m^3
Asphalt Plant Catchment (currently an access track and storage area)	APC (this is the label within the basin design spreadsheet – but run-off will be directed to existing WHD1	2.08	333	425	758	Drain could be installed to direct water from this catchment into existing WHD 1 (old quarry void) to prevent the requirement for an additional basin. The existing capacity of the WHD is 5,833 m^3, well in excess of the 1,921 m^3 basin volume required to treat run-off from the catchment to the design event.
New Processing Plant and Stockpile Area	NPPSA	3.76	407	769	1176	It is noted that alterations to location and size may occur in development of SWMP and PESCPs as it may be more suitable to increase size of basin and incorporate up-slope catchments of Stage 1 southwest, Stage 2 southeast and potentially even establishing the basin with enough capacity for Final Stage east.
Stage 1 North West	S1NW	2.14	821	438	1259	Catch drains will need to be established to convey run-off from the extent of this catchment to the basin and effectively treat all sediment-laden run-off.
Stage 1 South West	S1SW	3.02	1109	618	1727	As outlined above – increasing basin size in New Processing Plant and Stockpile Area may replace this basin.

Basin Catchment	Basin Name	Total Catchment Area (ha)	Sediment Storage zone (m^3)	Settling Zone Volume (m^3)	Total Basin Volume (m^3)	Comment
Stage 2 North	S2N	2.13	304	436	740	Catch drains will need to be established to convey run-off from the extent of this catchment to the basin and effectively treat all sediment-laden run-off.
Stage 2 South East	S2SE	1.66	440	339	779	As outlined above – increasing basin size in New Processing Plant and Stockpile Area may replace this basin.
Stage 2 West	S2W	5.11	553	1045	1598	Catch drains will need to be established to convey run-off from the extent of this catchment to the basin and effectively treat all sediment-laden run-off.
Stage 4 North	S4N	5.21	147	1086	1233	Catch drains will need to be established to convey run-off from the extent of this catchment to the basin and effectively treat all sediment-laden run-off.
Stage 4 South	S4S	3.55	242	826	1068	Diversion will need to be created to prevent upslope clean run-off from existing watercourse in Final stage footprint entering this stage of works.
Final Stage East	FSE	2.03	137	415	552	As outlined above – increasing basin size in New Processing Plant and Stockpile Area may replace this basin.
Final Stage West	FSW	6.59	331	1348	1679	As outlined above – increasing basin size in New Processing Plant and Stockpile Area may replace this basin.

1. Basins have been designed assuming that clean water diversions and catch drains will be established.
2. Basin catchments have been assumed on the premise that clearing will be restricted to at minimum the proposed staging areas, or if reduced further will be limited to the catchments shown

6.4.3 Basin Desilting

The sizing of the basins includes an allowance for sediment storage based on the ability to store 2-months soil loss as calculated by the RUSLE. Therefore, basins will be desilted every two months. If a greater interval is desired, the basin size will be increased accordingly.

All sediment basins will be inspected regularly for accumulated sediment. Graduated markers placed within the basin will assist in measuring sediment depths. The recommended sizes of the sediment storage and settling zones are provided in *Table 6.1* and *Annex C*.

Dams and basins requiring desilting will need to be pumped free of residual water first. Access to the sediment basin will be maintained, to allow for machinery employed in removing sediment (e.g. excavators).

Sediment removed from the basin will be stockpiled on site, and desilted material will be stored within the quarry footprint to allow for any potential stockpile run-off to be directed to sediment basin.

Sediment fences should be installed around the base of silt stockpiles excavated from basins (if the excavated silt is stockpiled in a location outside of areas serviced by a sediment basin.

Once excavated sediment has drained, it will be reincorporated into fill material where possible. It could also be used for landscaping (topsoiling) purposes, though testing would be desirable to confirm the suitability of the sediment.

6.4.4 Water Treatment and Flocculation

The Proponent indicated that at present the basin with the licenced discharge point does not need to be flocculated prior to discharging. It is highly likely that the conceptual basins proposed to be established as the various future quarrying stages commence will require flocculation. This can be achieved using gypsum. Gypsum is widely used and the industry standard for flocculating sediment basins. The use of gypsum does not require the addition of addition surface water monitoring requirements as it is innocuous.

Surface water samples taken on the day of the site inspection (results provided in *Annex D*) identified that the collected water on the site was within EPL pH parameters. Should parameters appear outside of the allowable limits, hydrochloric acid may be applied to treat alkalinity and lime applied to treat acidity.

6.5 *POLLUTION CONTROL*

Waste receptacles will be provided for the safe and efficient storage of all construction and miscellaneous wastes, as necessary. Recyclable materials will be separated and recycled where possible. Otherwise, disposable wastes will be removed from site regularly and disposed of by approved means.

Spent chemical and hydrocarbon drums will be removed from site immediately to limit the potential for spills of the remnant product.

Refuelling within active quarry areas will be carried out using a mobile fuel cart fitted with an electronic fuel pump.

Routine maintenance of all plant and machinery will be carried out in the designated maintenance area adjacent to the site office to minimise the potential of accidental contamination of water.

6.5.1 *Spill Management*

Spill kits will be provided at active work locations, the workshop area, refuelling areas and adjacent to pump locations. Training of site personnel in their use will ensure that in the event of any spills appropriate action can be taken rapidly to prevent and minimise impacts to surface waters.

Material Safety Data Sheets (MSDS) for all chemicals stored on-site are to be collected and maintained by the quarry manager and made available to site personnel. Site personnel will be informed of their location as a part of the site induction.

An impervious bund will be constructed to contain any spills of more than 110% of the volume of the largest container in the bunded area, should none be present in the workshop area. Any spillage will be immediately contained and absorbed with a suitable absorbent material.

Storage and transport of Dangerous Goods, Flammable and Combustible Liquids will comply with AS 1940 1993 The Storage and Handling of Flammable and Combustible Liquids and National Code of Practice for the Storage and Handing of Workplace Dangerous Goods [NOHSC: 2017 (2001)].

6.6 *ASPHALT PRODUCTION PLANT CONTROLS*

The following management measures will be implemented for the asphalt production plant:

- clean water diversions around the asphalt production plant site to limit catchment to smallest footprint possible and prevent clean water run-on;
- the proposed sediment basin will be contrasted to capture sediment-laden run-off from the plant catchment area;

- a triple interceptor or similar pollution control device will be utilised as a "first flush" for the potential hydrocarbon contaminated areas in the plant site;

- all oils, fuels, lubricants, liquids and chemicals will be stored in appropriately bunded areas as outlined in *Section 6.5.1*;

- bitumen, diesel and other chemicals handling will be undertaken within a contained (bunded) area. Any spillages should be immediately ameliorated; and

- The sediment basin servicing the plant catchment will be fitted with a floating hydrocarbon boom as a precautionary measure to contain any potential loss of hydrocarbons from the plant catchment.

6.7 CONCRETE BATCHING PLANT CONTROLS

The following management measures will be implemented for the concrete batching plant:

- the footprint of the plant will be limited to the smallest extent practicable to reduce the area from which contaminated stormwater can be generated (EPA Victoria, 1998);

- all contaminated stormwater and process wastewater will be collected and recycled at the earliest possible opportunity (EPA Victoria, 1998);

- a dedicated, paved and bunded washout area will be established for the following locations:

  - truck washing and agitator drum washout area;

  - the concrete batching area; and

  - any other location that will generate stormwater contaminated with cement dust or residues.

- the stormwater from these locations will be directed to a first flush system. The OEH (2015) recommended design criteria for first flush containment systems utilised for concrete batching plants must be able to contain 10 mm of rainfall;

- a bypass to the first flush system is to be created to allow for run-off from larger storm events (greater than 20mm) to bypass the collection system for when the first flush collection is full;

- dry cement will be stored where it cannot generate fugitive dust or be exposed to water and generate run-off;

- the sediment collected in the first flush must be regularly cleaned out; and
- whenever wet weather discharges occur from the catchment system within the plant, pH and total suspended solid monitoring will be undertaken (EPA Victoria, 1998). EPA Victoria (1998) also states run-off after heavy rainfall (more than 20 mm over 24 hours) contains very small quantities of wastes and is unlikely to pose a significant threat to the environment.

6.8 SITE MONITORING AND MAINTENANCE

Essential to an effective system of sediment control devices, is an adequate inspection, maintenance and cleaning program. Inspections, particularly during storms, will show whether devices are operating effectively. Where a device proves inadequate, it will be quickly redesigned to make it effective.

It is recommended that a delegated site representative undertake regular inspections of the erosion and sediment controls and advise on necessary changes, to help ensure the success of the erosion and sediment control program. Inspections will be undertaken at least monthly, and always after rainfall events (greater than 20 mm).

7 SITE WATER BALANCE

7.1 WATER DEMANDS

Water is required in different parts of the quarry site for a range of purposes, including:

- toilets and hand washing basins;
- vehicle and equipment washing;
- dust suppression on haul roads;
- dust suppression and moisture addition to stockpiled aggregates and blended products; and
- dust suppression and general cleaning and maintenance in the crushing plant.

The addition of the concrete batching and asphalt production plant will also require water for the production of respective products.

7.1.1 Potable Water

Potable water is required at the site for the following purposes:

- drinking water provision;
- showering;
- hand washing;
- toilet flushing; and
- dishwashing.

An estimated average of 40 Litres (L) per person per working day is assumed for the aforementioned uses. Given the current employee quota of 15 full time employees and three labour hires at the site, the current daily potable water demand is 680 L. The proposed increase in extraction may generate a maximum of 10 additional staff members. Based on the above assumptions this will increase the proposed water usage to 1,000L/day. Assuming 365 working days per year this is an annual demand of 365 kL.

Water for employee use is supplied from the PMHC potable water supply mains along Sancrox Road. Water for employee use is supplied by the 1,000 gallon roof collection water tank located adjacent to the office and workshop complex.

The workshop area has a large roof space that may be suitable as a catchment area for a water storage tank. This water could be used for flushing toilets on the site and would reduce the volume required from council supplied mains. A formalised stormwater discharge point will also be established for the roofed areas on-site to allow for this clean water to be effectively released from site. Upon inspection on the 30 November 2017, it was evident that the down pipes from the works shop and crib shed discharge to ground surface, allowing for this 'non-project impacted' water to interact with sediment before discharging off-site.

7.1.2 Dust Suppression

Water used for dust suppression within the stockpile area and haul roads is obtained from either WHD 1 or WHD 2. The methods of dust suppression include water cart runs and fixed sprinklers along bunds adjacent to haul roads. The current water cart used on-site has a capacity of 10,000 L.

The frequency of use of the water cart is dictated by environmental conditions, with more regular pass-bys on days with dry, hot and windy conditions as well as frequency of daily truck movements. Hanson indicated that the water cart can undertake 5-6 refills and releases in a day during hot windy days. Extrapolation of this estimation predicts that currently, in one day running at maximum operation, the water cart can use up to 60 kL per day. To determine the immediate water requirement of the current quarry footprint, should the proposal, with its revised hours of operation be approved, the following assumptions have been used:

- the total days of water cart use have been assumed as 255 days:
- that the water cart would not be used on rain days (average number of wet days is 99.7 days/year);
- no works occur on public holidays (assumed to be ten a year);
- that on occasion would not be required until haul roads have dried after large events; and
- requirement for spraying is reduced during days of favourable conditions.

Hence, the estimated current annual water usage associated with the water cart for the current quarry footprint operating at the proposed new 24 hours/day, 7 days/week schedule is 15.3 ML. The equation used for this determination is outlined below:

255 days of use/year x 60 kL/day = 15.3 ML - water used by the water cart/year

The site will increase by approximately three times its existing size upon the implementation of the final stage. Hence, the aforementioned annual water usage for dust suppression has been multiplied by three to provide an approximation of total water usage required for dust suppression, when the entire site is disturbed. This is a total estimated volume of 45.9 MegaLitres/year (ML/year) for dust suppression.

It has been estimated that approximately 1 ML/year being applied to the site for dust suppression from the sprinkler system. This is assumed to remain the same throughout the quarry lifetime as the additional disturbed areas will be managed by the water cart operations outlined above.

7.1.3 Concrete Production

Water input estimate is based on a typical cement:sand:aggregate ratio of 1:2:3 and a water:cement ratio of 0.4. Total production within a year would be 50,000 tpa. Application of the ratios generates a water usage rate of approximately 3,333 kL to produce the annual allowance of concrete.

7.1.4 Concrete Agitator Washout

Chini et. al. (2000) outlines that the washing of a concrete trucks drum on a daily basis uses approximately 565 to 1,135 L. For the purpose of this assessment, an estimate of 1,000 L/truck/day has been assumed.

Assuming the density of wet concrete is 2400 kg/m^3, the annual volume of concrete permitted to be produced at the site is 20,833 m^3. Assuming that the capacity of the agitators delivering the materials is 6.5 m^3 (Maxi Agitator capacity as taken from Hanson (2017)) and that the Project will make approximately 11 deliveries per day over approximately 300 work days. This has been assumed to be approximately 3 trucks that will deliver the daily requirement of concrete, hence 3 washouts will be required per day. This equates to approximately 900 kL/annum of water required for washout. The equation used to determine this volume is provided below:

3 washouts/day x 1,000 L/washout x 300 washout days per year = 900,000 kL of washout water/year

It is noted that the washout water also needs to be captured and managed due to its high pH and sediment (cement and other components) load.

7.1.5 Product Moisture Content

The Proponent has indicated that the moisture content of material on-site is typically 6%. The maximum potential tonnage of product that would leave the site in a year would be 750,000 tpa. Hence, the percentage of water required for optimum moisture content in the stockpiled material that would leave site would be approximately 45,000 tonnes of water per annum, applying density conversion factors, a 45,000 kL/annum of water for product moisture per annum.

7.1.6 Process Water/Crushing Plant

Water required for the crushing and processing plant is pumped from the SRD.

The Proponent did not have data available on the volume of water utilised in screening and crushing of product. Therefore, ERM used estimates that were available from other quarrying sites provided in previous assessments.

At a hard rock quarry in Northern NSW crushing approximately 200,000 tpa of basalt, in an average year, the annual water requirements for processing and dust suppression are approximately 10 ML. This is a water requirement of approximately 50 L/tonne of product.

At a much larger hard rock quarry near Newcastle, crushing approximately 800,000 tpa of basalt, the annual water requirements for processing, dust suppression and production of washed products, is approximately 90 ML. This is a water requirement of approximately 113L/tonne of product.

A conservative water use estimate of 100L/tonne has been assumed for this assessment. Therefore applying a dust suppression water application rate of 100L/tonne for the production of 750,000 T equates to a water requirement of approximately 75 ML.

7.1.7 Asphalt Batch Plant

The proponent outlined that the asphalt production process requires 5kL water/day. An assumption of 300 operational days per year has been applied to the asphalt batching process. This assumption is based on the premise that on Sundays and Public Holidays it is likely that projects would be operating that could receive the asphalt as they would likely be subject to standard construction hours). Hence using the equation below it is assumed that 1.5 ML of water per year is required for the batching process.

5 kL/day required for asphalt production x 300 asphalt batching days/year = 1.5 ML/year for asphalt production

7.1.8 Total Water Demand

The approximate total water demand, as outlined for the purposes in *Table 7.1* is conservatively estimated at 131.1 ML/year.

Table 7.1 Approximate Total Water Demand from On-site Sources

Activity	Approximate Volume of Water Required (ML) from on-site sources
Road dust suppression	45.9
Concrete manufacture	3.3
Concrete agitator washout	0.9
Crushing and screening dust suppression	75
Product moisture	4.5
Asphalt production	1.5
Total	**131.1**

7.2 WATER SUPPLY

7.2.1 Existing Site Storage Capacity

Table 4.2 provides the estimated capacity of the existing WHDs and sediment basins on site. The dry capacity of all the site water holding bodies is 17,414 m^3, or 17.4 ML.

7.2.2 Stormwater Run-off – Catchment Yields

Annual catchment yields were estimated for the sediment basin and WHD catchments for dry, normal and wet years, using long-term annual rainfall statistics from Telegraph Point (Farrawells Road, 060031). The 10- percentile annual rainfall at Telegraph Point (a dry year) is 903.7 mm; the median annual rainfall (a normal year) is 1210.8 mm and the 90-percentile annual rainfall (a wet year) is 1825.7 mm.

Catchment yields were estimated by multiplying catchment areas by rainfall depth by an annualised volumetric run-off coefficient (Cv) and then applying a factor to convert to ML. See *Annex C* for further details on the run-off co-efficients used.

The yields are provided in *Table 7.2* and *Table 7.3*.

7.2.3 Groundwater Input

The groundwater modelling indicates a steady state groundwater inflow rate (to the final pit void) of approximately 40 to 60 m^3/day (modest inflows for a pit void of this size and likely minimal when compared to direct precipitation). While the modelling represents a modest inflow rate, annually groundwater input will amount to approximately 15 to 22 ML/year.

Table 7.2 Catchment Surface Water Yields for Site Water Storages

	Catchments								
	Existing Pit	**Sediment Retention Dam**	**Stockpile Yard and WHD**	**Asphalt Plant Catchment**	**New Processing Plant and Stockpile Area**	**Stage 1 Total**	**Stage 2 Total**	**Stage 4 Total**	**Final Stage**
Catchment Area (ha)	7.35	1.49	6.22	2.08	3.76	5.16	8.9	8.75	8.62
Annual Run-off Co-efficient (Cv)	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.54	0.51
Catchment Yields (ML/year)									
10%ile rain year (903.7 mm)	33.88	6.87	28.67	9.59	17.33	23.78	41.02	42.72	39.73
50%ile year (1210.8mm)	45.39	9.2	38.41	12.84	23.22	31.86	54.96	57.24	53.23
90%ile year (1825.7 mm)	68.44	13.87	57.91	19.37	35.01	48.05	82.87	86.3	80.26

1. This data demonstrates the hypothetical water available for capture. Sediment Retention basins are designed to capture a design storm event of 40.1mm. Creation of dams greater than the sizing for the design storm event will allow for more water to be captured for reuse on-site. To ensure that a basins primary function of sediment retention is maintained it must be ensured that capacity to receive a design storm event (0f 40.1mm) is available within five days of the cessation of a rain event.
2. The proposed new sediment basins will provide a source of water for use around the site, but it must be ensured that capacity is restored to the basin within five days of the cessation of the rainfall event

Table 7.3 Progressive Catchment Yields with On-going Quarrying

	Current Operations	Asphalt Plant and Stage 1	Stage 2	Stage 4	Final Stage
Included catchments	The current operations include: • existing pit; • Sediment Retention Dam; • Stockpile Yard and WHD; and • Asphalt Plant Catchment (currently an access track and storage area).	The asphalt plant and Stage 1 include: • Current operations; • new Processing Plant; and • all of Stage 1 catchments.	Stage 2 includes: • Asphalt plant and Stage 1; and • All of the Stage 2 catchments	Stage 4 includes: • Stage 2; and • All of the Stage 4 catchments	Final Stage includes: • Stage 4; and • All of the final stage catchments.
10%ile year (903.7 mm)	79	120.11	161.13	203.85	243.57
50%ile year (1210.8mm)	105.84	160.92	215.88	273.12	326.35
90%ile year (1825.7 mm)	159.6	242.65	325.52	411.82	492.08

7.3 WATER BALANCE

This water balance has assumed that the inputs to the production processes will be provided from on-site, non-potable water sources.

Current operations could provide 79 ML of water based solely on possible catchment yield with no restriction from available storage sizes during a low rainfall (10%ile year). The requirement for the Project at full operation and at final extent of disturbance is approximately 131.1 ML. With the implementation of the first stage of the Project, the additional catchment of disturbed area has the potential to generate 120.11 ML during a low rainfall (10%ile year). Hence, it is reasonable to assume that if site WHDs were managed such that all rainfall within the year could be captured, then sufficient water would be available for site activities and dust suppression as the quarrying stages progressively increase the disturbance footprint, even in a low rainfall (10%ile year). The implementation of the quarry void as an additional water holding body will provide additional buffer to the water management system, providing an additional storage for circulation of captured water throughout the site to prevent unnecessary loss and ensure available supply.

The water balance has solely been based on precipitation inputs. The groundwater assessment outlined that inputs to the quarry void will be in the order of 15 to 22 ML/year. This input in addition to the surface water capture on-site could also be utilised for site water requirements and would further lessen the likelihood of the site being water deficient.

8 SURFACE WATER MONITORING PROGRAM

Water quality monitoring is proposed as a method of determining the efficacy of sediment and water control systems, and is likely to be a requirement of the revised EPL for the quarry. A recommended monitoring plan is provided below, but should be refined where necessary based on the results of monitoring and ongoing quarry operations.

8.1.1 Objectives

The objectives of surface water quality monitoring are to:

- ensure the quarry is operating as anticipated with respect to water quality protection;
- assess the effectiveness of site water management strategies in protecting downstream water quality;
- identify unforeseen impacts from the quarry operations; and
- verify that the quarry is achieving its environmental protection objectives.

8.1.2 Locations and Frequency

Monitoring of the existing discharge point on EPL 5289 should remain unchanged. For the proposed new sediment basins, the basin register (refer to *Table 8.1*) should be attached to the EPL, and the Proponent notify the EPA in writing of when each basin is commissioned/decommissioned, to allow for ease of management due to the staged and progressive quarrying approach. The EPA should be notified at least 7 days prior to the commissioning of a basin and at least 21 days prior to the decommissioning of a basin. The conceptual basins are listed in *Table 8.1* and the locations are shown in *Figure* 6.1. Once the final basins are determined, they should be submitted to the NSW EPA with the EPL variation application.

Table 8.1 Proposed Concept Basin Register

Basin Catchment	Basin Name on EPL
Processing Area	PA
Sediment Retention Dam	SRD
Stockpile Yard and WHD	To remain as Discharge Point 1
Asphalt Plant Catchment (currently an access track and storage area)	AP
New Processing Plant and Stockpile Area	NPPSA
Stage 1 North West	S1NW
Stage 1 South West	S1SW
Stage 2 North	S2N
Stage 2 South East	S2SE
Stage 2 West	S2W
Stage 4 North	S4N
Stage 4 South	S4S
Final Stage East	FSE
Final Stage West	FSW

The outlet of the sediment basins will be the monitoring location and the spillway will form the controlled discharge location.

The Proponent must restore the design storage capacity to each basin within five days of the cessation of a rainfall event that causes run-off to occur on the site.

8.1.3 Surface Water Monitoring Parameters

The existing parameters within the EPL 5289 remain applicable to the Project. These are provided in *Table 8.2* and apply to the existing Discharge Point 1.

The monitoring parameters, method and frequency for the conceptual sediment basins are provided in *Table 8.3.*

Table 8.2 Existing EPL 5289 Surface Water Monitoring Requirements for Discharge Point 1 (discharge from Water Holding Dam)

Pollutant	Units of Measurement	100%ile Concentration Limit	Frequency	Method
Oil and Grease	milligrams/Litre	10 and/or not visible	Each overflow event	Visual (grab sample to be taken if sheen observed)
pH	-	6.5 – 8.5	Once during overflow event and every two months	Grab sample/calibrated field probe
Total Suspended Solids	milligrams/Litre	30	Once during each overflow and every two months.	Grab sample
Total Nitrogen	milligrams/Litre	-	Every two months	Grab sample

Table 8.3 Proposed Additional Surface Water Monitoring Requirements for Basins to be listed on the Basin Register

Pollutant	Units of Measurement	100%ile Concentration Limit	Frequency	Method
Oil and Grease	milligrams/ Litre	10 and/or not visible	<24 hours prior to a controlled/scheduled discharge and daily for any continued controlled/scheduled discharge	Visual (grab sample to be taken if sheen observed)
pH	-	6.5 – 8.5	<24 hours prior to a controlled/scheduled discharge and daily for any continued controlled/scheduled discharge	Grab sample/calibrated field probe

Pollutant	Units of Measurement	100%ile Concentration Limit	Frequency	Method
Total Suspended Solids	milligrams/ Litre	50	<24 hours prior to a controlled/scheduled discharge and daily for any continued controlled/scheduled discharge	Grab sample

The licence should include a statement that exceedance of the pH and Total Suspended Solid limits is only permitted when the locations are discharging as a result of 5-day accumulated rainfall exceeding the design storm event of 40.1mm.

9 CONCLUSION

This hydrology assessment identifies the potential soil and water impacts and constraints related to the Project. An erosion hazard assessment was undertaken using the RUSLE to determine the potential impacts of the Project, and this in turn was utilised to design the predominant mitigation measure for managing sediment-laden run-off generated by the site - the conceptual sediment basins.

The water balance for site operations demonstrates that surface water is available to meet the demands of the Project. The additional input provided by groundwater entering in to the quarry void will further supplement the water supply available for use. An aquifer interference approval will be required for the consumption of this groundwater (refer to *Groundwater Assessment* for further details).

A surface water monitoring program has been prepared and the site EPL will need to be varied to incorporate the proposed revision to current water monitoring. The program outlines the proposed surface water monitoring regime for the sediment basins that will be installed as the staged expansion progresses. With the implementation of sediment basins, the utilisation of the mitigation measures and the development of a SWMP and PESCPs, the potential soil and water impacts of the Project can be effectively managed so that there is no significant, negative impact to the environment.

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Annex A

Intensity Frequency Duration Table

Intensity-Frequency-Duration Table

Location: 31.425S 152.825E NEAR.. Sancrox Quarry Issued: 7/11/2017

Rainfall intensity in mm/h for various durations and Average Recurrence Interval

Average Recurrence Interval

Duration	1 YEAR	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
5Mins	102	131	170	192	221	260	290
6Mins	95.6	123	159	180	208	244	272
10Mins	78.2	101	132	150	173	204	228
20Mins	56.7	73.9	97.7	112	131	155	175
30Mins	46.0	60.1	80.2	92.4	108	129	146
1Hr	31.4	41.2	55.5	64.3	75.6	90.7	103
2Hrs	21.1	27.6	37.4	43.3	51.0	61.3	69.4
3Hrs	16.6	21.8	29.5	34.2	40.2	48.3	54.6
6Hrs	11.1	14.5	19.6	22.6	26.6	31.9	36.0
12Hrs	7.38	9.66	12.9	14.9	17.5	21.0	23.7
24Hrs	4.85	6.35	8.47	9.77	11.4	13.7	15.4
48Hrs	3.10	4.05	5.38	6.19	7.23	8.64	9.72
72Hrs	2.33	3.03	4.02	4.61	5.38	6.41	7.21

(Raw data: 41.23, 9.7, 3.04, 90.95, 20.95, 6.37, skew=0.03, F2=4.35, F50=16.28)

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Annex B

Revised Universal Soil Loss Equation (RUSLE)

The RUSLE equation is:

A = R K LS P C

where,

A = calculated soil loss (tonnes/ha/yr)

All site characteristics have been assumed at the worst case (following clearing and grubbing with little modification to topography, to ensure that dams are sufficient when the site is at its most vulnerable to erosion).

R = rainfall erosivity factor

R is calculated from the following formula:

$R = 164.74\ (1.1177)^{S}\ S^{0.6444}$

where,

S = 2-year ARI, 6 hour ARI rainfall event.

This formula yields an R-factor of 4630 for the Sancrox Quarry Site.

K =soil erodibility factor

The K-factor for the site was determined from the range of K-factors for the soil landscapes observed on the site in Table C9 of Landcom (2004). The K-factors chosen are considered conservative as they are at the higher end of the range for K-factors for the soil landscapes on the site. Where two landscapes were encompassed within a catchment a value between each worst case K-factor was utilised, with consideration to the percentage of the landscape within the catchment.

LS = slope length/gradient factor

The slope length/gradient correlation was obtained from Table A1 of Landcom (2004) following interpretation of the site topographic map. Generally the slope length/gradient factor was limited to 80m, a procedural control where foreman will institute controls such that slope lengths will not exceed immediately before forecast rain or during shutdown periods to limit average annual soil loss (Landcom 2004).

P = erosion control practice factor

P-factor taken as 1.3, as recommended for construction sites by Landcom (2004).

C = ground cover and management factor.

The C-factor applied to the site was 1.0, typical of bare, compacted soil, and reflective of soil conditions on construction sites. The C-factor of 1.0 is also recommended by Landcom (2004) for construction sites.

Basin Design Criteria

The sediment basin design procedure as outlined in Landcom (2004) was used to design the Type D/F sediment basins required on the site. Assumptions used in the design of the basins included:

- the design storm event was the 80 percentile, 5 day storm event of 40.1mm (as recommended for a basin with an operational lifetime of 1-3 years, discharging to a standard sensitivity environment, Table 6.1 of DECC (2008)). It is likely that all areas cleared for quarrying will be excavated within 1-3 years such that run-off will drain to within the pit;

- the basins have been designed to the most stringent criteria of the site (Type D), as both type F and Type D soils were recorded on the site;

- the upslope diversion drains/bunds will be constructed prior to topsoil stripping commencing, thus reducing the disturbed catchment area available to generate run-off to be directed to a basin and treated;

- volumetric run-off coefficients were taken from worst case scenario of Soil hydrological Group from each soil landscape as directed by Table C9 (Landcom 2004), for a design event of 40.1mm, from Table F2 of Landcom 2004):

    - Cooperabung Hydrological Group B/C (as provided in Table C9) and volumetric run-off co-efficient of 0.51 (Table F2);

    - Euroka Hydrological Group C (as provided in Table C9) and volumetric run-off co-efficient of 0.51(Table F2);

    - Kundabung Hydrological Group C/D (as provided in Table C9). The Kundabung soil landscape was present with Euroka in the western most catchments on-site. To account for the two different hydrological groups encompassed in the catchment a value was chosen that incorporated both landscapes values. That is the fourth stage north catchment was allocated a run-off co-efficient of 0.52 (approximately 6% of the catchment is the Kundabung landscape and the fourth stage south catchment was allocated a run-off coefficient of 0.58 (the catchment is approximately spilt in half by each landscape;

- A limit to slope length of 80m has also been provided to guide foreman on how to manage the sub-catchments with steeper slopes, such that the basin operates efficiently. Not providing contour bunds/drains to restrict slope length and slow velocities would greatly increase the size of basin required in these steeper catchments. Hence it is critical that these slope lengths are adhered to. As the filling of the site commences and the construction area gains a more even grade, such as locations where pads are required for batch plants and processing equipment, the reduction in other factors of the RUSLE allow for greater slope lengths with no greater influence in soil loss;

- the length to width ration of the basin will be at least 3:1 where design permits (the use of baffles will be considered during the detailed design); and

- the treated discharge waters should not exceed 50 milligrams/litre (mg/L) of suspended sediment in the design storm event.

Annex C

Sediment Basin Design Calculations

1. Erosion Hazard and Sediment Basins

Site Name: Sancrox Quarry

Site Location: Sancrox, Port Macquarie

Precinct/Stage: Existing Basins and Quarry Site

Other Details:

Site area	Sub-catchment or Name of Structure						Notes
	SRD	PA	STWH D	APC			
Total catchment area (ha)	1.49	3.49	6.22	2.08			
Disturbed catchment area (ha)	1.49	3.49	6.22	2.08			

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	D	D	D	D			From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)							Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)							
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							See Section 6.3.3(e). Auto-calculated
Soil Texture Group	D	D	D	D			Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5	5	5	5			See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	80	80	80	80			
x-day, y-percentile rainfall event (mm)	40.1	40.1	40.1	40.1			
Rainfall R-factor (if known)							Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)	14.5	14.5	14.5	14.5			

RUSLE Factors

Rainfall erosivity (*R*-factor)	4630	4630	4630	4630			Auto-filled from above
Soil erodibility (*K*-factor)	0.05	0.05	0.05	0.05			RUSLE LS factor calculated for a high rill/interrill ratio.
Slope length (m)	80	80	80	80			
Slope gradient (%)	3.5	4	10	12			
Length/gradient (*LS*-factor)	0.78	0.91	2.81	3.70			
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C*-factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2	2	2	2	2	2	Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.51	0.51	0.5	0.51			See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	235	275	845	1114			
Soil Loss Class	3	3	6	6			See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	181	211	650	857			Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	45	123	674	297			See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	305	714	1247	425			See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	350	837	1921	722			

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

1. Erosion Hazard and Sediment Basins

Site Name: Sancrox Quarry

Site Location: Sancrox, Port Macquarie

Precinct/Stage: Future Quarry Later Stages and New Plants

Other Details:

Site area	Sub-catchment or Name of Structure						Notes
	S4S	FSW	FSE		ABP	NPPSA	
Total catchment area (ha)	3.55	6.59	2.03		2.08	3.76	
Disturbed catchment area (ha)	3.55	6.59	2.03		2.08	3.76	

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	D	D	D		D	D	From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)							Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)							
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							See Section 6.3.3(e). Auto-calculated
Soil Texture Group	D	D	D		D	D	Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5	5	5		5	5	See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	80	80	80		80	80	
x-day, y-percentile rainfall event (mm)	40.1	40.1	40.1		40.1	40.1	
Rainfall R-factor (if known)							Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)	14.5	14.5	14.5		14.5	14.5	

RUSLE Factors

Rainfall erosivity (*R* -factor)	4630	4630	4630		4630	4630	Auto-filled from above
Soil erodibility (*K* -factor)	0.06	0.037	0.037		0.05	0.05	
Slope length (m)	80	80	80		80	80	
Slope gradient (%)	6	7	9		13	10	RUSLE LS factor calculated for a high rill/interrill ratio.
Length/gradient (*LS* -factor)	1.47	1.76	2.37		4.15	2.81	
Erosion control practice (*P* -factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C* -factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2	2	2		2	2	Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.58	0.51	0.51		0.51	0.51	See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	531	392	527		1250	845	
Soil Loss Class	5	4	5		6	6	See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	408	301	405		962	650	Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	242	331	137		333	407	See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	826	1348	415		425	769	See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	1068	1679	552		758	1176	

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

1. Erosion Hazard and Sediment Basins

Site Name: Sancrox Quarry

Site Location: Sancrox, Port Macquarie

Precinct/Stage: Existing Basins and Quarry Site

Other Details:

Site area	Sub-catchment or Name of Structure						Notes
	S1SW	S1NW	S2SE	S2W	S2N	S4N	
Total catchment area (ha)	3.02	2.14	1.66	5.11	2.13	5.21	
Disturbed catchment area (ha)	3.02	2.14	1.66	5.11	2.13	5.21	

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	D	D	D	D	D	D	From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)							Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)							
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							See Section 6.3.3(e). Auto-calculated
Soil Texture Group	D	D	D	D	D	D	Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5	5	5	5	5	5	See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)							
x-day, y-percentile rainfall event (mm)	40.1	40.1	40.1	40.1	40.1	40.1	
Rainfall R-factor (if known)							Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)	14.5	14.5	14.5	14.5	14.5	14.5	

RUSLE Factors

Rainfall erosivity (*R* -factor)	4630	4630	4630	4630	4630	4630	Auto-filled from above
Soil erodibility (*K* -factor)	0.05	0.05	0.05	0.05	0.05	0.04	RUSLE LS factor calculated for a high rill/interrill ratio.
Slope length (m)	80	80	80	80	80	80	
Slope gradient (%)	25	26	19	10	12	4	
Length/gradient (*LS* -factor)	9.51	9.94	6.87	2.81	3.70	0.91	
Erosion control practice (*P* -factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C* -factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2	2	2	2	2	2	Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.51	0.51	0.51	0.51	0.51	0.52	See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	2863	2992	2068	845	1114	220	
Soil Loss Class	7	7	7	6	6	2	See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	2202	2301	1591	650	857	169	Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	1109	821	440	553	304	147	See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	618	438	339	1045	436	1086	See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	1727	1259	779	1598	740	1233	

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

Annex D

Surface Water Monitoring Results

Table D.1 Surface Water Monitoring Results

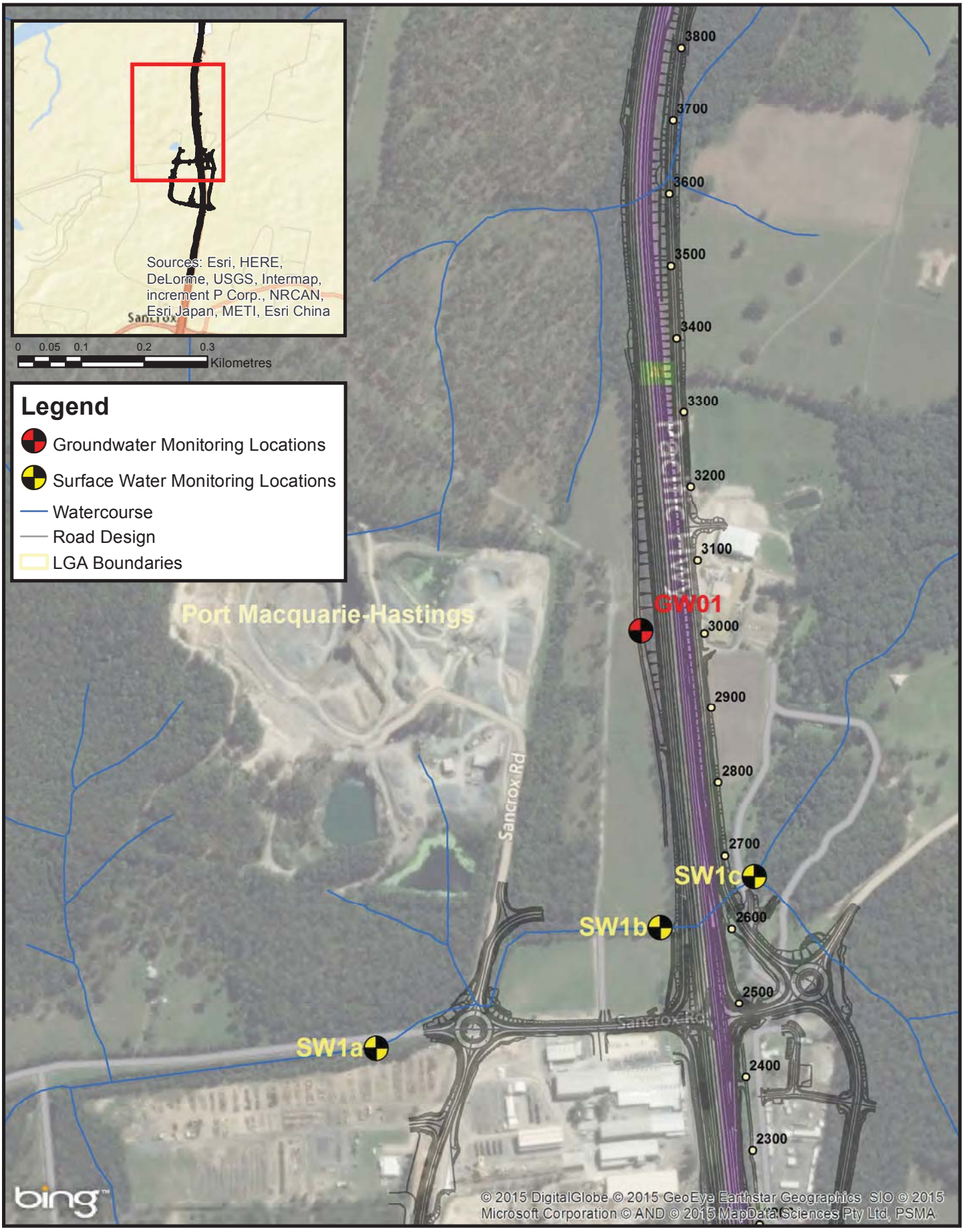
Monitoring Bore	Date	pH	EC (µS/cm)	TDS[1] (mg/L)	ORP (mV)	DO (mg/L)	Temperature (°C)
Seep	30/11/2017	7.6	2161	1405	185	6.44	28.5
Quarry Sump	30/11/2017	7.0	2694	1751	241	5.74	24.6
WHD 1	30/11/2017	8.0	1659	1078	187	9.95	25.1
WHD 2	30/11/2017	7.9	1289	838	200	4.32	26.8

[1] = TDS estimated from EC field measurements through following equation:

EC (µS/cm) X 0.65 = TDS (mg/L).

Annex E

Background Surface Water Monitoring Results (RMS, 2014-2017)



Pacific Highway Upgrade
Oxley Highway to Kempsey

NSW GOVERNMENT | Transport Roads & Maritime Services

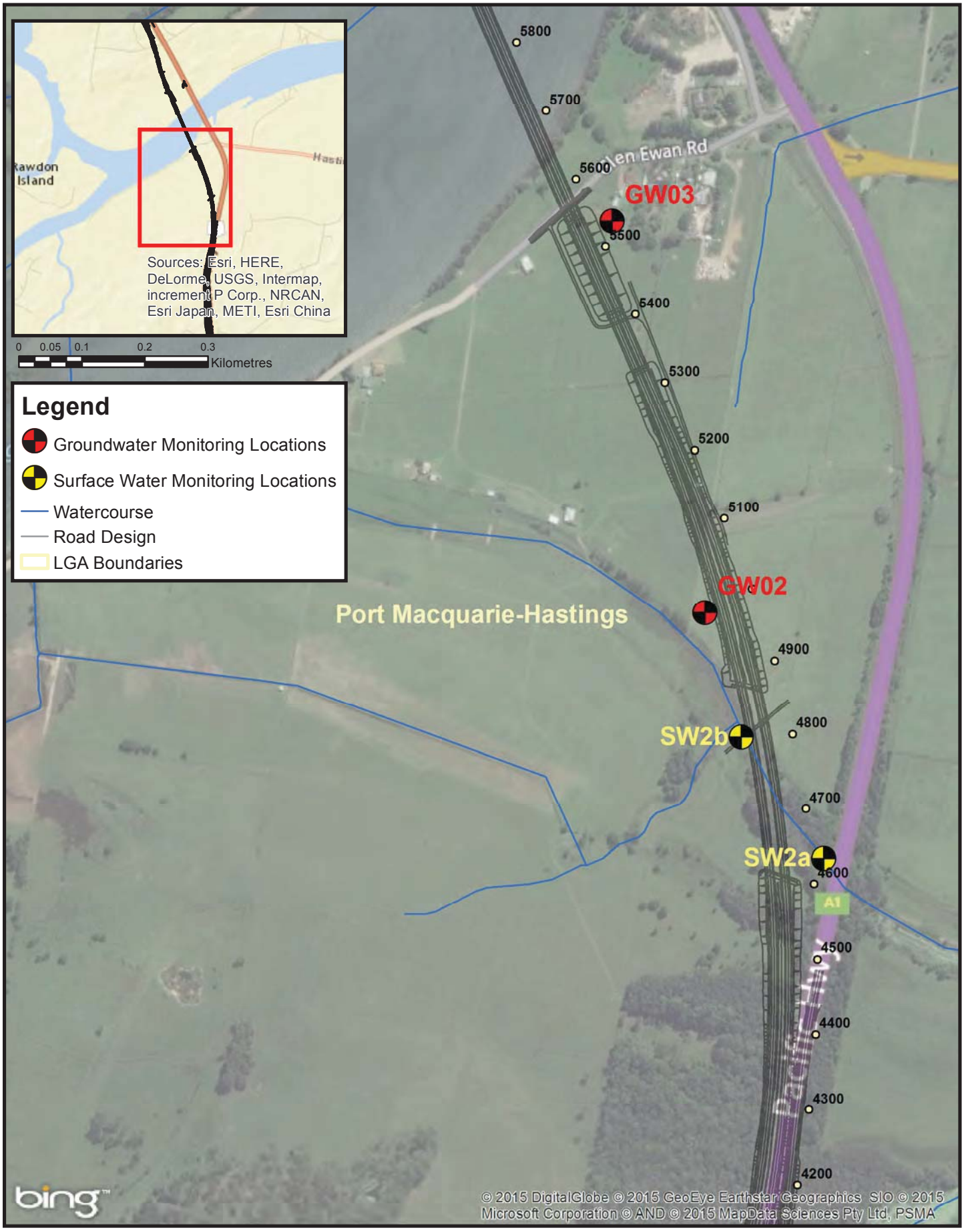
Surface & groundwater monitoring locations

Drawn By: Stuart Hill

Sheet 1 of 17

Prepared for: Roads and Maritime Services (Hunter)

Date: 22/04/2015



Pacific Highway Upgrade
Oxley Highway to Kempsey

NSW GOVERNMENT | Transport Roads & Maritime Services

Surface & groundwater monitoring locations

Drawn By: Stuart Hill

Sheet 2 of 17

Prepared for: Roads and Maritime Services (Hunter)

Date: 22/04/2015

Table 3-1 Construction surface water quality results by waterway

Parameter				Results									
	Unit	LOR / probe limit	ANZECC default trigger value	July 2014					August 2014				
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C		NA	4.9	23.6	14.4	12.3	11.2	5.2	23.4	12.5	12.7	13.1
Electrical conductivity (EC)	uS/cm		125-2200	788	1179	221	768	737	755	1048	233	480	441
Dissolved oxygen (DO)	%		85-110	35	95	38	24	22	35	93	36	34	32
pH			6.5-8	0.4	7.0	6.6	7.5	7.4	0.4	7.3	6.6	7.1	6.9
Turbidity	NTU		6-50	202	97	21	131	201	192	94	19	75	84
Total suspended solids (TSS)	mg/L	5	-	139	46	8	51	68	132	42	6	35	17
Aluminium (Al)	mg/L	0.01	0.055”	0.29	0.52	0.04	0.02	0.01	0.28	0.47	0.04	0.08	0.08
Arsenic (As)	mg/L	0.001	0.024	0.000	0.002	0.001	0.002	0.001	0.000	0.001	0.001	0.003	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0005	0.0010	0.0001	0.0001	0.0001	0.0004	0.0010	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.003	0.008	0.002	0.001	0.001	0.003	0.005	0.002	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	1.51	2.28	0.11	0.25	0.10	1.41	1.91	0.05	1.60	0.23
Lead (Pb)	mg/L	0.001	0.0034	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.147	0.345	0.033	0.107	0.148	0.137	0.282	0.029	0.236	0.138
Mercury (Hg)	mg/L	0.0001	0.0006	0.00009	0.00010	0.00001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.001	0.002	0.001	0.002	0.002	0.001	0.002	0.001	0.003	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.033	0.078	0.022	0.020	0.011	0.033	0.058	0.013	0.025	0.018
Total Nitrogen (TN)	mg/L	0.1	0.5	1.2	0.9	0.2	1.8	2.5	1.1	0.8	0.2	0.8	0.8
Total Phosphorous (TP)	mg/L	0.01	0.05	0.23	0.18	0.02	0.39	0.66	0.22	0.17	0.02	0.10	0.14

* Trigger values derived from 24 sampling events up to and including the month indicated. However, metals have not been sampled on 24 occasions. This limitation will be resolved during subsequent six monthly monitoring reports.

Note - Level of reporting raised for some sampling events due to matrix interference eg salinity. Samples diluted 10 times. Refer to individual results at Appendix C.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-2 Construction surface water quality results by waterway (cont.)

Parameter				Results									
	Unit	LOR / probe limit	ANZECC default trigger value	September 2014					October 2014				
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	5.1	23.4	12.7	14.2	14.1	5.1	23.0	12.5	16.0	15.9
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	728	874	238	639	698	762	915	268	773	786
Dissolved oxygen (DO)	%	0-200	85-110	34	92	33	41	38	35	88	20	27	19
pH		0-14	6.5-8	0.4	7.2	6.6	7.3	6.8	0.4	7.1	6.6	7.2	6.9
Turbidity	NTU	0-600	6-50	189	91	20	36	34	207	70	16	172	215
Total suspended solids (TSS)	mg/L	5	-	130	41	5	5	7	138	41	5	58	98
Aluminium (Al)	mg/L	0.01	0.055”	0.26	0.44	0.04	0.07	0.05	0.25	0.44	0.04	0.02	0.02
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	0.001	0.001	0.0003	0.001	0.001	0.002	0.002
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0004	0.0010	0.0001	0.0001	0.0001	0.0004	0.0010	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.0003	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.003	0.004	0.001	0.002	0.002	0.003	0.003	0.001	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	1.30	1.59	0.08	0.33	0.48	2.92	2.10	0.15	1.36	1.21
Lead (Pb)	mg/L	0.001	0.0034	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.135	0.219	0.021	0.068	0.088	0.135	0.272	0.023	0.234	0.258
Mercury (Hg)	mg/L	0.0001	0.0006	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.001	0.002	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.032	0.045	0.011	0.015	0.017	0.031	0.040	0.010	0.029	0.009
Total Nitrogen (TN)	mg/L	0.1	0.5	1.0	0.7	0.2	0.5	0.6	1.0	0.7	0.2	2.0	1.2
Total Phosphorous (TP)	mg/L	0.01	0.05	0.21	0.14	0.02	0.04	0.06	0.16	0.13	0.02	1.02	0.63

* Trigger values derived from 24 sampling events up to and including the month indicated. However, metals have not been sampled on 24 occasions. This limitation will be resolved during subsequent six monthly monitoring reports.

Note - Level of reporting raised for some sampling events due to matrix interference eg salinity. Samples diluted 10 times. Refer to individual results at Appendix C.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-3 Construction surface water quality results by waterway (cont.)

Parameter				Results									
	Unit	LOR / probe limit	ANZECC default trigger value	November 2014					December 2014				
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	4.9	22.8	13.1	20.9	20.6	4.8	22.3	13.3	21.3	21.6
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	778	1094	285	601	578	787	1279	285	376	393
Dissolved oxygen (DO)	%	0-200	85-110	35	85	11	12	5	35	80	8	5	2
pH		0-14	6.5-8	0.4	7.1	6.6	7.0	6.5	0.4	7.0	6.5	6.7	6.5
Turbidity	NTU	0-600	6-50	199	71	16	122	149	199	72	17	98	119
Total suspended solids (TSS)	mg/L	5	-	116	44	5	52	39	116	36	5	80	63
Aluminium (Al)	mg/L	0.01	0.055”	0.24	0.44	0.04	0.03	0.01	0.24	0.43	0.04	0.03	0.02
Arsenic (As)	mg/L	0.001	0.024	0.0003	0.001	0.001	0.002	0.003	0.0003	0.001	0.001	0.002	0.002
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0004	0.0010	0.0001	0.0001	0.0001	0.0004	0.0006	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.0002	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.003	0.004	0.001	0.007	0.001	0.003	0.004	0.001	0.002	0.002
Iron (Fe)	mg/L	0.05	ID	2.75	1.73	0.21	1.89	0.80	2.63	2.28	0.28	1.97	0.49
Lead (Pb)	mg/L	0.001	0.0034	0.001	0.001	0.001	0.004	0.001	0.001	0.001	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.129	0.263	0.026	0.332	0.338	0.131	0.296	0.028	0.258	0.236
Mercury (Hg)	mg/L	0.0001	0.0006	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.001	0.002	0.001	0.004	0.003	0.001	0.002	0.001	0.002	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.030	0.034	0.008	0.034	0.022	0.029	0.032	0.008	0.023	0.014
Total Nitrogen (TN)	mg/L	0.1	0.5	1.0	0.6	0.2	3.6	2.0	0.9	0.6	0.3	1.9	1.5
Total Phosphorous (TP)	mg/L	0.01	0.05	0.16	0.06	0.02	2.18	1.8	0.15	0.06	0.02	2.00	1.06

* Trigger values derived from 24 sampling events up to and including the month indicated. However, metals have not been sampled on 24 occasions. This limitation will be resolved during subsequent six monthly monitoring reports.

Note - Level of reporting raised for some sampling events due to matrix interference eg salinity. Samples diluted 10 times. Refer to individual results at Appendix C.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-4 Construction surface water quality results by waterway (cont.)

Parameter				Results									
	Unit	LOR / probe limit	ANZECC default trigger value	January 2015									
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	4.7	22.2	13.3	23.3	23.3					
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	762	1258	285	328	252					
Dissolved oxygen (DO)	%	0-200	85-110	33	51	6	12	60					
pH		0-14	6.5-8	0.5	7.1	6.5	6.8	6.8					
Turbidity	NTU	0-600	6-50	46	72	18	37	30					
Total suspended solids (TSS)	mg/L	5	-	19	34	5	30	22					
Aluminium (Al)	mg/L	0.01	0.055”	0.23	0.40	0.03	0.04	0.02					
Arsenic (As)	mg/L	0.001	0.024	0.0003	0.001	0.001	0.004	0.002					
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0004	0.0003	0.0001	0.0001	0.0001					
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.001					
Copper (Cu)	mg/L	0.001	0.0014	0.003	0.003	0.001	0.001	0.001					
Iron (Fe)	mg/L	0.05	ID	2.92	3.60	0.35	2.77	0.77					
Lead (Pb)	mg/L	0.001	0.0034	0.001	0.001	0.001	0.002	0.001					
Manganese (Mn)	mg/L	0.001	1.9	0.160	0.344	0.029	0.464	0.206					
Mercury (Hg)	mg/L	0.0001	0.0006	0.0001	0.0001	0.0001	0.0001	0.0001					
Nickel (Ni)	mg/L	0.001	0.011	0.001	0.002	0.001	0.002	0.001					
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001					
Zinc (Zn)	mg/L	0.005	0.008	0.028	0.031	0.007	0.037	0.017					
Total Nitrogen (TN)	mg/L	0.1	0.5	0.9	0.7	0.3	1.0	1.0					
Total Phosphorous (TP)	mg/L	0.01	0.05	0.15	0.07	0.02	0.20	0.16					

* Trigger values derived from 24 sampling events up to and including the month indicated. However, metals have not been sampled on 24 occasions. This limitation will be resolved during subsequent six monthly monitoring reports.

Note - Level of reporting raised for some sampling events due to matrix interference eg salinity. Samples diluted 10 times. Refer to individual results at Appendix C.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-5 Construction surface water quality results by waterway (cont.)

Parameter		Results							
	Unit	LOR / probe limit	ANZECC default trigger value	SW2b pre construction trigger values*			SW2a median values		
				Std dev	80th %	20th %	November 2014^	December 2014	January 2015
Temperature	^{0}C	-2-50	NA	4.1	24.0	18.3		DNS	23.6
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	286	893	405			840
Dissolved oxygen (DO)	%	0-200	85-110	27	90	57			53
pH		0-14	6.5-8	0.9	6.1	4.1			4.3
Turbidity (NTU)	NTU	0-600	6-50	180	97	14			34
Total suspended solids (TSS)	mg/L	5	-	786	235	12	13		20
Aluminium (Al)	mg/L	0.01	0.055”	12.22	1.11	0.10			0.14
Arsenic (As)	mg/L	0.001	0.024	0.012	0.004	0.001			0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0004	0.0010	0.0001			0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.021	0.002	0.001			0.001
Copper (Cu)	mg/L	0.001	0.0014	0.024	0.005	0.001			0.001
Iron (Fe)	mg/L	0.05	ID	75.07	23.34	0.50			0.95
Lead (Pb)	mg/L	0.001	0.0034	0.011	0.001	0.001			0.001
Manganese (Mn)	mg/L	0.001	1.9	1.761	2.416	0.204			0.512
Mercury (Hg)	mg/L	0.0001	0.0006	0.0001	0.0002	0.0001			0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.266	0.013	0.003			0.007
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001			0.001
Zinc (Zn)	mg/L	0.005	0.008	0.105	0.048	0.013			0.02
Total Nitrogen (TN)	mg/L	0.1	0.5	10.3	5.4	0.7	1.9		0.8
Total Phosphorous (TP)	mg/L	0.01	0.05	2.00	0.71	0.03	0.06		0.06

* Trigger values are typically derived from 24 sampling events up to and including the month indicated. However, this is not the case for SW2b due to the general absence of water during the pre-construction and first construction monitoring periods.

DNS – “Did not sample” during the month due to insufficient or no water.

^ - Water body too shallow to take in-field measurement.

Note - Level of reporting raised for some sampling events due to matrix interference eg salinity. Samples diluted 10 times. Refer to individual results at Appendix C.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-1 Construction surface water quality results by waterway

Parameter	Unit	LOR / probe limit	ANZECC default trigger value	Results									
				February 2015					March 2015				
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	4.4	21.8	13.2	24.5	24.1	4.6	22.5	13.2	22.9	22.7
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	757	1259	304	868	1072	664	1259	304	634	582
Dissolved oxygen (DO)	%	0-200	85-110	20	48	6	16	26	21	48	6	38	43
pH		0-14	6.5-8	0.4	7.1	6.5	7.0	6.8	0.5	7.1	6.4	6.8	6.7
Turbidity	NTU	0-600	6-50	36	54	17	35	21	36	54	17	52	62
Total suspended solids (TSS)	mg/L	5	-	20	36	5	12	6	20	36	5	25	23
Aluminium (Al)	mg/L	0.01	0.055”	0.22	0.38	0.03	0.02	0.01	0.41	0.42	0.03	0.59	0.44
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	0.003	0.001	0.000	0.001	0.001	0.005	0.002
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0003	0.0004	0.0001	0.0001	0.0001	0.0003	0.0003	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.003	0.003	0.001	0.001	0.001	0.003	0.003	0.001	0.002	0.002
Iron (Fe)	mg/L	0.05	ID	4.97	4.36	0.24	2.10	0.27	7.05	4.85	0.31	4.09	1.21
Lead (Pb)	mg/L	0.001	0.0034	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.222	0.377	0.031	0.833	0.982	0.282	0.380	0.029	0.517	0.443
Mercury (Hg)	mg/L	0.0001	0.0006	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.002	0.002	0.001	0.001	0.001	0.002	0.002	0.001	0.001	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.051	0.033	0.008	0.012	0.015	0.049	0.032	0.008	0.029	0.021
Total Nitrogen (TN)	mg/L	0.1	0.5	0.9	0.8	0.4	0.7	0.5	0.9	0.8	0.4	1.3	0.7
Total Phosphorous (TP)	mg/L	0.01	0.05	0.15	0.06	0.02	0.21	0.08	0.15	0.05	0.02	0.37	0.08

* Trigger values derived from 24 sampling events up to and including the month indicated. However, metals have not been sampled on 24 occasions. This limitation will be resolved during subsequent six monthly monitoring reports.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-2 Construction surface water quality results by waterway (cont.)

Parameter				Results									
	Unit	LOR / probe limit	ANZECC default trigger value	April 2015					May 2015				
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	3.7	22.5	16.0	21.5	21.4	3.4	22.5	16.9	16.9	16.8
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	490.4	1174.2	199.6	267	267	495.8	1170.4	176.8	511	584
Dissolved oxygen (DO)	%	0-200	85-110	24.2	54.8	6.1	70	66	26.2	64.5	6.1	79	73
pH		0-14	6.5-8	0.5	7.1	6.4	6.6	6.6	0.5	6.9	6.3	6.9	6.9
Turbidity	NTU	0-600	6-50	34.2	48.3	18.8	55	56	33.4	48.8	19.5	45	51
Total suspended solids (TSS)	mg/L	5	-	13.6	26.0	5.0	13	10	13.6	25.0	5.0	7	10
Aluminium (Al)	mg/L	0.01	0.055”	0.50	0.44	0.03	0.48	0.43	0.64	0.44	0.03	0.64	0.56
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0003	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.002	0.002	0.001	0.003	0.002	0.001	0.002	0.001	0.001	0.002
Iron (Fe)	mg/L	0.05	ID	7.06	4.85	0.31	0.74	0.69	7.06	4.10	0.31	0.98	0.71
Lead (Pb)	mg/L	0.001	0.0034	0.001	0.001	0.001	0.002	0.001	0.000	0.001	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.281	0.379	0.025	0.061	0.089	0.283	0.356	0.020	0.088	0.108
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.002	0.002	0.001	0.002	0.001	0.002	0.001	0.001	0.001	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.049	0.026	0.008	0.023	0.022	0.045	0.022	0.008	0.010	0.012
Total Nitrogen (TN)	mg/L	0.1	0.5	0.9	1.0	0.4	0.9	0.9	0.9	0.9	0.5	0.8	0.7
Total Phosphorous (TP)	mg/L	0.01	0.05	0.15	0.04	0.02	0.05	0.04	0.15	0.04	0.02	0.04	0.04

* Trigger values derived from 24 sampling events up to and including the month indicated. However, metals have not been sampled on 24 occasions. This limitation will be resolved during subsequent six monthly monitoring reports.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-3 Construction surface water quality results by waterway (cont.)

Parameter	Unit	LOR / probe limit	ANZECC default trigger value	Results									
				June 2015					July 2015				
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	3.7	22.5	16.9	13.2	13.0	3.9	22.5	16.9	11.8	11.4
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	491	1170	177	1039	1040	484	1170	177	1207	1027
Dissolved oxygen (DO)	%	0-200	85-110	27	65	6	14	23	27	65	6	11	16
pH		0-14	6.5-8	0.5	6.9	6.3	6.8	6.7	0.4	6.9	6.3	6.9	6.9
Turbidity	NTU	0-600	6-50	34	49	17	22	34	34	49	17	64	20
Total suspended solids (TSS)	mg/L	5	-	14	25	5	7	5	13	25	5	21	5
Aluminium (Al)	mg/L	0.01	0.055”	0.65	0.44	0.03	0.02	0.01	0.64	0.44	0.03	0.01	0.01
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	0.003	0.001	0.000	0.001	0.001	0.002	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.001	0.002	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	7.37	6.29	0.49	4.27	0.32	7.60	9.30	0.66	3.90	0.13
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.349	0.407	0.020	0.444	0.442	0.406	0.469	0.025	0.537	0.471
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.002	0.001	0.001	0.002	0.001	0.002	0.001	0.001	0.001	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.045	0.022	0.007	0.011	0.010	0.045	0.018	0.007	0.018	0.007
Total Nitrogen (TN)	mg/L	0.1	0.5	0.8	0.9	0.5	1.7	0.9	0.8	0.9	0.5	4.4	1.0
Total Phosphorous (TP)	mg/L	0.01	0.05	0.15	0.04	0.02	0.33	0.1	0.15	0.04	0.02	0.99	0.10

* Trigger values derived from 24 sampling events up to and including the month indicated. However, metals have not been sampled on 24 occasions. This limitation will be resolved during subsequent six monthly monitoring reports.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-4 Construction surface water quality results by waterway (cont.)

Parameter				Results											
	Unit	LOR / probe limit	ANZECC default trigger value	February 2015				March 2015				April 2015			
				SW2b*			SW2a	SW2b*			SW2a	SW2b*			SW2a
				Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median
Temperature	^{0}C	-2-50	NA	4.5	25.4	18.5	25.7	4.9	28.0	18.5	27.5	4.1	27.8	19.8	25.7
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	290	828	339	339	265	828	382	430	255	893	507	492
Dissolved oxygen (DO)	%	0-200	85-110	33	87	32	11	33	91	43	76	34	106	57	103
pH		0-14	6.5-8	1.0	6.3	4.1	6.7	1.0	6.3	4.1	6.4	1.1	6.5	4.1	6.4
Turbidity (NTU)	NTU	0-600	6-50	171	96	16	26	171	90	16	34	180	47	16	32
Total suspended solids (TSS)	mg/L	5	-	742	141	15	37	743	141	15	24	796	35	11	11
Aluminium (Al)	mg/L	0.01	0.055”	11.11	0.96	0.10	0.17	10.25	0.87	0.04	0.05	9.57	0.84	0.03	0.03
Arsenic (As)	mg/L	0.001	0.024	0.011	0.003	0.001	0.003	0.010	0.003	0.001	0.002	0.009	0.002	0.001	0.002
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0004	0.0010	0.0001	0.0001	0.0004	0.0008	0.0001	0.0001	0.0004	0.0005	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.019	0.001	0.001	0.001	0.017	0.002	0.001	0.001	0.016	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.022	0.004	0.001	0.002	0.021	0.004	0.001	0.001	0.019	0.003	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	68.00	15.64	0.56	6.13	62.71	10.32	0.64	3.79	58.59	8.97	0.75	1.33
Lead (Pb)	mg/L	0.001	0.0034	0.010	0.001	0.001	0.001	0.009	0.001	0.001	0.001	0.008	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	1.580	2.112	0.243	0.918	1.510	1.922	0.218	0.396	1.434	1.846	0.240	0.214
Mercury (Hg)	mg/L	0.0001	0.0006	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.241	0.012	0.003	0.003	0.223	0.011	0.002	0.002	0.207	0.009	0.002	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.097	0.047	0.009	0.029	0.090	0.042	0.007	0.016	0.084	0.031	0.007	0.007
Total Nitrogen (TN)	mg/L	0.1	0.5	9.6	5.4	0.7	2.9	9.3	5.4	0.7	3.1	9.7	3.2	0.7	1.3
Total Phosphorous (TP)	mg/L	0.01	0.05	1.86	0.79	0.03	0.58	1.80	0.71	0.04	0.29	1.88	0.41	0.03	0.08

* Trigger values derived from 24 sampling events up to and including the month indicated. However, metals have not been sampled on 24 occasions. This limitation will be resolved during subsequent six monthly monitoring reports.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-5 Construction surface water quality results by waterway (cont.)

Parameter				Results											
	Unit	LOR / probe limit	ANZECC default trigger value	May 2015				June 2015				July 2015			
				SW2b*			SW2a	SW2b*			SW2a	SW2b*			SW2a
				Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median
Temperature	^{0}C	-2-50	NA	4.6	27.6	18.8	17.0	5.2	27.6	18.3	11.9	5.4	27.3	18.0	10.8
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	270	875	446	338	274	875	446	387	277	946	450	434
Dissolved oxygen (DO)	%	0-200	85-110	34	101	57	59	33	96	57	50	33	99	57	40
pH		0-14	6.5-8	1.0	6.6	4.7	6.4	1.0	6.6	4.7	6	1.0	6.6	4.8	6.3
Turbidity (NTU)	NTU	0-600	6-50	177	46	16	20	177	46	15	12	174	44	12	28
Total suspended solids (TSS)	mg/L	5	-	781	33	8	7	781	33	6	5	765	32	5	5
Aluminium (Al)	mg/L	0.01	0.055”	9.00	0.80	0.02	0.08	8.75	0.68	0.02	0.02	8.52	0.56	0.02	0.03
Arsenic (As)	mg/L	0.001	0.024	0.009	0.002	0.001	0.001	0.009	0.002	0.001	0.001	0.008	0.002	0.001	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0004	0.0001	0.0001	0.0001	0.0003	0.0001	0.0001	0.0001	0.0003	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.015	0.001	0.001	0.001	0.015	0.001	0.001	0.001	0.014	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.018	0.003	0.001	0.001	0.018	0.003	0.001	0.001	0.017	0.003	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	55.17	7.62	0.86	0.88	53.72	7.50	0.64	0.68	52.37	7.39	0.50	1.23
Lead (Pb)	mg/L	0.001	0.0034	0.008	0.001	0.001	0.001	0.008	0.001	0.001	0.001	0.007	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	1.364	1.770	0.224	0.177	1.343	1.740	0.210	0.056	1.307	1.710	0.214	0.131
Mercury (Hg)	mg/L	0.0001	0.0006	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.195	0.007	0.002	0.002	0.190	0.007	0.002	0.001	0.185	0.007	0.002	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.079	0.021	0.006	0.006	0.077	0.020	0.006	0.006	0.075	0.020	0.006	0.008
Total Nitrogen (TN)	mg/L	0.1	0.5	9.5	3.1	0.7	0.6	9.5	3.1	0.7	0.6	9.3	3.1	0.7	0.6
Total Phosphorous (TP)	mg/L	0.01	0.05	1.8	0.37	0.04	0.06	1.84	0.37	0.03	0.04	1.81	0.33	0.03	0.04

* Trigger values derived from 24 sampling events up to and including the month indicated. However, metals have not been sampled on 24 occasions. This limitation will be resolved during subsequent six monthly monitoring reports.

Note – Since April 2014 the upper limit of Electrical Conductivity (EC) is 8000 uS/cm due to in-field equipment range limitations.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

ID – Insufficient representative data (ANZECC).

Table 3-1 Construction surface water quality results by waterway

Parameter				Results									
	Unit	LOR / probe limit	ANZECC default trigger value	August 2015					September 2015				
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	4.3	22.4	15.2	14.2	13.9	4.3	22.4	15.5	16.5	17.0
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	474	1167	180	1495	975	442	1092	180	530	529
Dissolved oxygen (DO)	%	0-200	85-110	26	62	8	76	39	28	70	8	87	85
pH		0-14	6.5-8	0.4	6.9	6.3	7.1	7.2	0.4	6.9	6.2	6.7	6.9
Turbidity	NTU	0-600	6-50	33	49	17	19	32	31	45	18	49	91
Total suspended solids (TSS)	mg/L	5	-	13	23	5	8	16	10	19	5	5	12
Aluminium (Al)	mg/L	0.01	0.055”	0.64	0.44	0.02	0.01	0.01	0.63	0.44	0.03	0.13	0.09
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.001	0.002	0.001	0.001	0.001	0.001	0.002	0.001	0.002	0.002
Iron (Fe)	mg/L	0.05	ID	7.60	9.30	0.66	0.13	0.22	7.59	9.30	0.69	0.27	0.36
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.416	0.660	0.025	0.166	0.303	0.420	0.660	0.022	0.085	0.102
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.002	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.045	0.016	0.007	0.008	0.008	0.045	0.016	0.008	0.006	0.013
Total Nitrogen (TN)	mg/L	0.1	0.5	0.3	0.9	0.4	0.6	1.1	0.2	0.9	0.5	1.0	1.0
Total Phosphorous (TP)	mg/L	0.01	0.05	0.03	0.04	0.02	0.04	0.07	0.03	0.04	0.01	0.03	0.05

* Trigger values derived from 24 sampling events up to and including the month indicated.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-2 Construction surface water quality results by waterway (cont.)

Parameter				Results									
	Unit	LOR / probe limit	ANZECC default trigger value	October 2015					November 2015				
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	4.3	22.4	15.5	20.1	20.0	4.1	21.4	15.5	20.1	24.9
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	411	993	174	997	839	379	737	183	437	508
Dissolved oxygen (DO)	%	0-200	85-110	27	70	10	68	55	26	70	15	75	84
pH		0-14	6.5-8	0.5	6.9	6.2	6.9	7.4	0.4	6.8	6.1	6.7	6.7
Turbidity	NTU	0-600	6-50	31	45	18	27	62	18	43	20	33	35
Total suspended solids (TSS)	mg/L	5	-	10	17	5	7	6	5	13	5	5	12
Aluminium (Al)	mg/L	0.01	0.055”	0.63	0.39	0.03	0.18	0.11	0.65	0.50	0.03	0.37	0.13
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	0.001	0.002	0.000	0.001	0.001	0.001	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.001	0.002	0.001	0.001	0.002	0.001	0.002	0.001	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	7.59	9.30	0.69	0.82	0.34	7.48	6.29	0.69	0.71	0.43
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.416	0.694	0.026	0.532	0.490	0.418	0.703	0.026	0.150	0.118
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.002	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.045	0.016	0.007	0.006	0.010	0.045	0.020	0.007	0.007	0.008
Total Nitrogen (TN)	mg/L	0.1	0.5	0.2	0.9	0.5	0.8	0.6	0.2	0.9	0.5	0.8	0.8
Total Phosphorous (TP)	mg/L	0.01	0.05	0.03	0.04	0.01	0.03	0.05	0.02	0.03	0.01	0.03	0.03

* Trigger values derived from 24 sampling events up to and including the month indicated.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-3 Construction surface water quality results by waterway (cont.)

Parameter				Results									
	Unit	LOR / probe limit	ANZECC default trigger value	December 2015					January 2016				
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	3.7	21.2	15.5	24.1	25.8	3.7	21.1	15.5	22.4	22.6
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	325	702	183	792	1104	253	662	207	658	744
Dissolved oxygen (DO)	%	0-200	85-110	25	70	20	61	65	25	69	20	55	75
pH		0-14	6.5-8	0.4	6.8	6.1	7.0	7.0	0.4	6.9	6.2	6.9	7.2
Turbidity	NTU	0-600	6-50	19	49	26	61	121	19	52	26	49	73
Total suspended solids (TSS)	mg/L	5	-	5	13	5	19	36	5	12	5	7	18
Aluminium (Al)	mg/L	0.01	0.055”	0.65	0.50	0.03	0.06	0.01	0.65	0.62	0.04	0.34	0.31
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	7.39	6.29	0.72	0.21	0.72	8.47	10.78	0.71	0.86	0.42
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.416	0.754	0.026	0.280	0.354	0.466	0.908	0.022	0.362	0.331
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.002	0.001	0.001	0.001	0.002	0.002	0.001	0.001	0.001	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.045	0.020	0.005	0.008	0.014	0.045	0.020	0.006	0.006	0.008
Total Nitrogen (TN)	mg/L	0.1	0.5	0.8	0.9	0.4	2.3	1.6	0.8	0.9	0.4	0.5	0.6
Total Phosphorous (TP)	mg/L	0.01	0.05	0.03	0.04	0.01	0.06	0.1	0.03	0.04	0.01	0.02	0.04

* Trigger values derived from 24 sampling events up to and including the month indicated.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-4 Construction surface water quality results by waterway (cont.)

Parameter				Results											
	Unit	LOR / probe limit	ANZECC default trigger value	August 2015				September 2015				October 2015			
				SW2b*			SW2a	SW2b*			SW2a	SW2b*			SW2a
				Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median
Temperature	^{0}C	-2-50	NA	5.9	26.7	16.4	12.7	5.9	26.7	16.0	20.1	5.8	26.2	16.2	20.7
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	319	1026	441	512	335.9	1070.6	441.2	526	315	958	480	518
Dissolved oxygen (DO)	%	0-200	85-110	32	96	53	28	33.6	100.5	53.4	52	34	99	45	21
pH		0-14	6.5-8	1.1	6.6	4.5	6.3	1.2	6.6	4.0	6.0	1.3	6.6	3.7	5.9
Turbidity (NTU)	NTU	0-600	6-50	17	38	10	22	16.5	34.5	10.0	22	16	34	11	15
Total suspended solids (TSS)	mg/L	5	-	10	21	5	10	10.0	20.8	5.0	5	10	21	5	5
Aluminium (Al)	mg/L	0.01	0.055”	8.11	0.37	0.02	0.02	7.75	0.44	0.02	0.04	7.58	0.41	0.02	0.08
Arsenic (As)	mg/L	0.001	0.024	0.008	0.002	0.001	0.001	0.008	0.002	0.001	0.001	0.008	0.002	0.001	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0003	0.0001	0.0001	0.0001	0.0003	0.0001	0.0001	0.0001	0.0003	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.014	0.001	0.001	0.001	0.013	0.001	0.001	0.001	0.013	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.016	0.002	0.001	0.001	0.016	0.002	0.001	0.001	0.015	0.002	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	49.87	7.16	0.47	0.62	47.70	6.61	0.64	0.71	46.79	4.82	0.68	1.025
Lead (Pb)	mg/L	0.001	0.0034	0.007	0.001	0.001	0.001	0.007	0.001	0.001	0.001	0.007	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	1.827	2.112	0.210	0.488	1.865	2.704	0.232	0.675	1.845	3.292	0.239	0.108
Mercury (Hg)	mg/L	0.0001	0.0006	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.176	0.006	0.002	0.001	0.168	0.007	0.002	0.002	0.164	0.007	0.002	0.002
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.072	0.020	0.006	0.006	0.068	0.025	0.006	0.006	0.067	0.024	0.006	0.010
Total Nitrogen (TN)	mg/L	0.1	0.5	1.2	1.9	0.7	1.6	0.9	1.7	0.6	0.8	0.9	1.6	0.4	0.8
Total Phosphorous (TP)	mg/L	0.01	0.05	0.22	0.14	0.03	0.05	0.22	0.14	0.03	0.06	0.22	0.14	0.03	0.04

* Trigger values derived from 24 sampling events up to and including the month indicated. However, metals had not been sampled on 24 occasions for the months of August and September 2015. This limitation has been resolved for subsequent months with sampling of metals completed on at least 24 occasions.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-5 Construction surface water quality results by waterway (cont.)

Parameter				Results											
	Unit	LOR / probe limit	ANZECC default trigger value	November 2015				December 2015				January 2016			
				SW2b*			SW2a	SW2b*			SW2a	SW2b*			SW2a
				Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median
Temperature	^{0}C	-2-50	NA	5.5	25.7	18.3	20.4	5.0	24.9	18.3	21.8	4.4	24.5	18.3	23.1
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	306	925	420	372	276	925	514	533	293	925	484	402
Dissolved oxygen (DO)	%	0-200	85-110	35	101	35	17	34	101	44	11	35	96	26	7
pH		0-14	6.5-8	1.3	6.6	3.7	6.1	1.3	6.6	3.7	6.4	1.3	6.6	3.7	6.7
Turbidity (NTU)	NTU	0-600	6-50	14	38	12	17	14	35	12	15	13	32	12	20
Total suspended solids (TSS)	mg/L	5	-	10	20	5	5	7	18	5	5	8	18	5	8
Aluminium (Al)	mg/L	0.01	0.055”	7.44	0.29	0.02	0.09	0.23	0.24	0.02	0.03	0.20	0.21	0.02	0.035
Arsenic (As)	mg/L	0.001	0.024	0.007	0.001	0.001	0.001	0.000	0.001	0.001	0.002	0.000	0.001	0.001	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0002	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.013	0.001	0.001	0.011	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.015	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	45.72	4.47	0.72	2.09	2.62	4.47	0.84	0.95	2.57	4.47	0.97	1.73
Lead (Pb)	mg/L	0.001	0.0034	0.006	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	1.827	3.148	0.247	0.307	1.638	2.728	0.300	0.574	1.653	2.728	0.300	0.539
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.161	0.006	0.002	0.002	0.003	0.006	0.002	0.0015	0.003	0.005	0.002	0.002
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.066	0.022	0.006	0.005	0.012	0.019	0.005	0.005	0.010	0.018	0.005	0.005
Total Nitrogen (TN)	mg/L	0.1	0.5	0.9	1.7	0.4	0.8	0.6	1.5	0.4	0.8	0.5	1.5	0.4	0.6
Total Phosphorous (TP)	mg/L	0.01	0.05	0.22	0.14	0.03	0.06	0.06	0.12	0.03	0.04	0.06	0.13	0.03	0.07

* Trigger values derived from 24 sampling events up to and including the month indicated.

Note – Since April 2014 the upper limit of Electrical Conductivity (EC) is 8000 uS/cm due to in-field equipment range limitations.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

ID – Insufficient representative data (ANZECC).

Table 3-1 Construction surface water quality results by waterway

Parameter	Unit	LOR / probe limit	ANZECC default trigger value	Results									
				February 2016					March 2016				
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	4.0	22.4	15.5	24.6	24.5	3.9	22.5	15.8	22.9	23.0
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	248	662	221	580	618	291	702	221	1576	928
Dissolved oxygen (DO)	%	0-200	85-110	26	67	16	91	81	26	64	14	76	31
pH		0-14	6.5-8	0.4	6.9	6.2	7.1	7.1	0.4	6.8	6.2	7.4	7.5
Turbidity	NTU	0-600	6-50	20	59	26	27	63	20	59	26	15	37
Total suspended solids (TSS)	mg/L	5	-	11	13	5	5	6	12	14	5	7	15
Aluminium (Al)	mg/L	0.01	0.055”	0.73	0.89	0.05	0.67	1.20	0.73	0.89	0.05	0.01	0.01
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.002
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	9.61	15.18	0.71	0.71	0.58	9.10	10.83	0.71	0.15	0.18
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.514	1.000	0.018	0.147	0.128	0.512	0.974	0.018	0.440	0.467
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.002	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.046	0.020	0.006	0.011	0.006	0.011	0.015	0.006	0.005	0.012
Total Nitrogen (TN)	mg/L	0.1	0.5	0.8	0.9	0.4	0.6	0.4	0.8	0.9	0.4	0.3	0.3
Total Phosphorous (TP)	mg/L	0.01	0.05	0.03	0.04	0.01	0.02	0.03	0.03	0.04	0.01	0.01	0.13

* Trigger values derived from 24 sampling events up to and including the month indicated.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-2 Construction surface water quality results by waterway (cont.)

Parameter	Unit	LOR / probe limit	ANZECC default trigger value	Results									
				April 2016					May 2016				
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	2.5	22.5	18.5	20.9	21.2	2.4	22.5	19.2	17.0	18.8
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	292	702	221	1316	979	292	702	221	1094	1321
Dissolved oxygen (DO)	%	0-200	85-110	26	64	16	74	42	24	60	16	76	57
pH		0-14	6.5-8	0.5	7.1	6.2	7.9	7.8	0.5	7.1	6.4	7.2	7.2
Turbidity	NTU	0-600	6-50	19	64	30	19	59	24	64	30	30	66
Total suspended solids (TSS)	mg/L	5	-	12	15	5	5	15	11	15	5	18	36
Aluminium (Al)	mg/L	0.01	0.055”	0.68	0.62	0.04	0.02	0.02	0.63	0.43	0.03	0.08	0.02
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	7.86	5.75	0.33	0.08	0.14	7.88	5.75	0.33	0.27	0.11
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.495	0.804	0.022	0.122	0.197	0.489	0.804	0.026	0.260	0.642
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.000	0.001	0.001	0.001	0.002	0.000	0.001	0.001	0.001	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.012	0.016	0.006	0.007	0.013	0.012	0.016	0.005	0.005	0.005
Total Nitrogen (TN)	mg/L	0.1	0.5	0.9	0.9	0.4	0.5	0.4	0.9	0.9	0.4	0.9	1.1
Total Phosphorous (TP)	mg/L	0.01	0.05	0.02	0.04	0.01	0.02	0.07	0.02	0.04	0.01	0.02	0.04

* Trigger values derived from 24 sampling events up to and including the month indicated.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-3 Construction surface water quality results by waterway (cont.)

Parameter	Unit	LOR / probe limit	ANZECC default trigger value	Results									
				June 2016					July 2016				
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	2.7	22.5	19.2	16.0	16.0	3.4	22.5	17.7	10.0	11.2
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	295	666	180	826	718	290	666	205	1049	1659
Dissolved oxygen (DO)	%	0-200	85-110	25	64	19	86	75	25	64	19	64	58
pH		0-14	6.5-8	0.4	7.1	6.5	7.0	7.2	0.4	6.9	6.5	7.4	7.4
Turbidity	NTU	0-600	6-50	24	59	28	33	21	25	59	27	5	13
Total suspended solids (TSS)	mg/L	5	-	11	15	5	6	5	11	15	5	5	6
Aluminium (Al)	mg/L	0.01	0.055”	0.51	0.43	0.02	0.08	0.15	0.51	0.43	0.02	0.01	0.01
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	0.001	0.002	0.000	0.001	0.001	0.001	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	7.93	5.75	0.21	0.15	0.30	7.64	4.04	0.21	0.38	0.05
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.493	0.804	0.026	0.107	0.109	0.466	0.742	0.026	0.156	0.248
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.012	0.014	0.005	0.006	0.017	0.012	0.014	0.005	0.005	0.008
Total Nitrogen (TN)	mg/L	0.1	0.5	0.9	0.9	0.4	0.4	0.5	0.9	0.9	0.3	0.1	0.1
Total Phosphorous (TP)	mg/L	0.01	0.05	0.02	0.04	0.01	0.02	0.03	0.02	0.04	0.01	0.01	0.04

* Trigger values derived from 24 sampling events up to and including the month indicated.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-4 Construction surface water quality results by waterway (cont.)

Parameter	Unit	LOR / probe limit	ANZECC default trigger value	Results											
				February 2016				March 2016				April 2016			
				SW2b*			SW2a	SW2b*			SW2a	SW2b*			SW2a
				Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median
Temperature	^{0}C	-2-50	NA	4.2	23.7	19.0	24.0	4.0	23.3	19.7	22.3	3.0	23.3	19.8	20.4
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	298	917	479	415	276	925	486	523	266	892	486	567
Dissolved oxygen (DO)	%	0-200	85-110	34	90	25	22	35	85	11	6	32	64	7	4
pH		0-14	6.5-8	1.3	6.6	3.7	6.5	1.3	6.6	3.7	6.4	1.4	6.7	3.7	7.2
Turbidity (NTU)	NTU	0-600	6-50	13	34	12	44	14	37	12	12	42	49	16	23
Total suspended solids (TSS)	mg/L	5	-	9	18	5	12	17	24	5	12	27	40	7	14
Aluminium (Al)	mg/L	0.01	0.055”	0.20	0.21	0.02	0.02	0.12	0.17	0.01	0.03	0.12	0.17	0.01	0.04
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	0.002	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	2.57	4.47	0.95	0.62	4.06	4.79	1.08	4.81	5.26	5.53	1.08	7.135
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.00	0.00	0.00	0.001
Manganese (Mn)	mg/L	0.001	1.9	1.652	2.728	0.309	0.570	1.652	2.728	0.309	1.141	1.62	2.73	0.31	0.885
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.002	0.004	0.002	0.001	0.002	0.003	0.001	0.001	0.005	0.004	0.001	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.010	0.018	0.005	0.005	0.007	0.016	0.005	0.005	0.007	0.016	0.005	0.006
Total Nitrogen (TN)	mg/L	0.1	0.5	0.5	1.4	0.4	0.5	0.8	1.5	0.4	0.9	1.0	1.6	0.5	1.3
Total Phosphorous (TP)	mg/L	0.01	0.05	0.05	0.11	0.03	0.05	0.13	0.13	0.03	0.13	0.20	0.20	0.04	0.23

* Trigger values derived from 24 sampling events up to and including the month indicated. However, metals had not been sampled on 24 occasions for the months of August and September 2015. This limitation has been resolved for subsequent months with sampling of metals completed on at least 24 occasions.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-5 Construction surface water quality results by waterway (cont.)

Parameter	Unit	LOR / probe limit	ANZECC default trigger value	Results											
				May 2016				June 2016				July 2016			
				SW2b*			SW2a	SW2b*			SW2a	SW2b*			SW2a
				Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median
Temperature	^{0}C	-2-50	NA	2.9	23.3	19.7	15.2	3.5	23.3	18.8	15.5	4.2	22.9	17.7	9.0
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	218	808	486	887	175	767	483	684	169	767	483	1028
Dissolved oxygen (DO)	%	0-200	85-110	32	58	7	21	23	50	7	37	22	47	7	55
pH		0-14	6.5-8	1.3	6.8	3.9	7.0	1.0	6.8	6.1	6.7	0.8	6.8	6.1	7.1
Turbidity (NTU)	NTU	0-600	6-50	42	53	17	32	42	53	19	22	42	53	19	8
Total suspended solids (TSS)	mg/L	5	-	27	45	7	15	27	45	9	8	27	45	9	5
Aluminium (Al)	mg/L	0.01	0.055”	0.12	0.17	0.01	0.03	0.12	0.17	0.01	0.05	0.12	0.17	0.01	0.02
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	5.78	6.89	0.95	2.81	5.81	6.89	0.95	0.35	5.87	6.89	0.74	0.21
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	1.605	2.752	0.452	0.912	1.572	2.752	0.533	0.136	1.581	2.752	0.533	0.092
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.005	0.004	0.001	0.001	0.005	0.004	0.001	0.002	0.005	0.004	0.001	0.002
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.007	0.014	0.005	0.005	0.007	0.014	0.005	0.005	0.007	0.014	0.005	0.005
Total Nitrogen (TN)	mg/L	0.1	0.5	1.0	1.6	0.7	1.2	1.0	1.6	0.6	0.4	1.0	1.6	0.6	0.3
Total Phosphorous (TP)	mg/L	0.01	0.05	0.20	0.26	0.04	0.22	0.19	0.26	0.05	0.04	0.19	0.26	0.05	0.01

* Trigger values derived from 24 sampling events up to and including the month indicated.

Note – Since April 2014 the upper limit of Electrical Conductivity (EC) is 8000 uS/cm due to in-field equipment range limitations.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

ID – Insufficient representative data (ANZECC).

Table 3-1 Construction surface water quality results by waterway

Parameter				Results									
	Unit	LOR / probe limit	ANZECC default trigger value	August 2016					September 2016				
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	4.1	22.5	14.6	13.7	15.4	4.1	22.5	14.2	15.0	17.1
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	287	656	187	794	1138	284	656	187	1128	1071
Dissolved oxygen (DO)	%	0-200	85-110	27	73	16	90	92	27	73	19	82	80
pH		0-14	6.5-8	0.4	6.9	6.5	7.0	7.1	0.4	6.9	6.4	7.1	7.3
Turbidity	NTU	0-600	6-50	25	59	26	25	30	25	59	26	15	87
Total suspended solids (TSS)	mg/L	5	-	11	15	5	5	5	11	15	5	12	41
Aluminium (Al)	mg/L	0.01	0.055”	0.55	0.62	0.03	0.36	0.29	0.55	0.62	0.03	0.01	0.02
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0004
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	7.29	3.67	0.33	0.35	0.29	7.27	3.67	0.48	0.10	0.11
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.417	0.613	0.022	0.053	0.037	0.417	0.613	0.022	0.172	0.302
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.002
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.012	0.010	0.005	0.006	0.005	0.009	0.010	0.005	0.005	0.034
Total Nitrogen (TN)	mg/L	0.1	0.5	0.9	0.9	0.3	0.3	0.6	0.9	0.8	0.3	0.2	0.6
Total Phosphorous (TP)	mg/L	0.01	0.05	0.02	0.04	0.01	0.01	0.03	0.02	0.04	0.01	0.02	0.24

* Trigger values derived from 24 sampling events up to and including the month indicated.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-2 Construction surface water quality results by waterway (cont.)

Parameter				Results										
	Unit	LOR / probe limit	ANZECC default trigger value	October 2016					November 2016					
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	4.1	22.0	14.2	15.7	16.1	3.8	21.2	14.2	19.9	20.1
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	303	656	187	837	984	293	726	238	700	718
Dissolved oxygen (DO)	%	0-200	85-110	26	73	19	68	62	25	64	19	65	71
pH		0-14	6.5-8	0.3	6.9	6.4	7.4	7.7	0.3	6.8	6.4	7.0	7.4
Turbidity	NTU	0-600	6-50	24	54	24	110	72	32	59	27	120	194
Total suspended solids (TSS)	mg/L	5	-	12	20	5	21	21	16	23	5	27	49
Aluminium (Al)	mg/L	0.01	0.055”	0.55	0.62	0.02	0.02	0.02	0.56	0.41	0.02	0.03	0.02
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.002
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.000	0.001	0.001	0.002	0.002	0.000	0.001	0.001	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	7.27	3.67	0.40	0.08	0.05	7.25	4.04	0.40	0.21	0.06
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.410	0.613	0.028	0.318	0.108	0.406	0.613	0.040	0.330	0.136
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.000	0.001	0.001	0.001	0.002	0.000	0.001	0.001	0.001	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.014	0.010	0.005	0.005	0.011	0.014	0.011	0.005	0.005	0.028
Total Nitrogen (TN)	mg/L	0.1	0.5	0.3	0.6	0.2	0.3	0.6	0.3	0.6	0.2	0.3	0.6
Total Phosphorous (TP)	mg/L	0.01	0.05	0.01	0.02	0.01	0.02	0.12	0.02	0.02	0.01	0.02	0.05

* Trigger values derived from 24 sampling events up to and including the month indicated.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-3 Construction surface water quality results by waterway (cont.)

Parameter				Results									
	Unit	LOR / probe limit	ANZECC default trigger value	December 2016					January 2017				
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	3.6	21.1	14.2	22.7	22.9	3.7	21.2	14.2	22.6	22.6
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	275	785	357	796	713	246	772	357	879	1013
Dissolved oxygen (DO)	%	0-200	85-110	22	53	19	57	58	22	53	22	53	41
pH		0-14	6.5-8	0.3	6.8	6.4	7.0	7.2	0.3	6.8	6.4	7.2	7.1
Turbidity	NTU	0-600	6-50	33	63	27	46	99	52	99	27	17	14
Total suspended solids (TSS)	mg/L	5	-	13	20	5	11	19	16	20	5	5	6
Aluminium (Al)	mg/L	0.01	0.055”	0.53	0.17	0.01	0.03	0.03	0.53	0.17	0.01	0.01	0.01
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	0.001	0.002	0.000	0.001	0.001	0.002	0.002
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.002
Iron (Fe)	mg/L	0.05	ID	7.30	4.04	0.24	0.21	0.10	7.36	1.75	0.15	0.24	0.06
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.403	0.595	0.051	0.404	0.230	0.399	0.489	0.051	0.317	0.533
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.002
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.012	0.011	0.005	0.005	0.007	0.012	0.011	0.005	0.008	0.016
Total Nitrogen (TN)	mg/L	0.1	0.5	0.3	0.6	0.2	0.4	0.7	0.3	0.6	0.3	0.2	0.2
Total Phosphorous (TP)	mg/L	0.01	0.05	0.02	0.02	0.01	0.02	0.06	0.02	0.02	0.01	0.01	0.01

* Trigger values derived from 24 sampling events up to and including the month indicated.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-4 Construction surface water quality results by waterway (cont.)

Parameter				Results											
	Unit	LOR / probe limit	ANZECC default trigger value	August 2016				September 2016				October 2016			
				SW2b*			SW2a	SW2b*			SW2a	SW2b*			SW2a
				Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median
Temperature	^{0}C	-2-50	NA	4.7	22.5	13.5	12.8	4.7	22.5	13.5	16.3	4.4	22.0	13.5	16.0
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	159	719	479	482	172	736	479	591	246	795	483	670
Dissolved oxygen (DO)	%	0-200	85-110	19	45	7	77	19	45	7	79	40	51	7	53
pH		0-14	6.5-8	0.3	6.8	6.3	7.1	0.3	6.8	6.4	7.2	0.4	7.0	6.4	7.6
Turbidity (NTU)	NTU	0-600	6-50	42	50	19	15	43	50	15	7	43	52	16	27
Total suspended solids (TSS)	mg/L	5	-	27	45	9	5	27	45	9	6	44	56	11	7
Aluminium (Al)	mg/L	0.01	0.055”	0.12	0.17	0.01	0.05	0.12	0.12	0.01	0.01	0.08	0.07	0.01	0.03
Arsenic (As)	mg/L	0.001	0.024	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	5.84	6.89	0.94	0.23	5.89	6.89	0.76	0.34	5.90	6.89	0.76	0.40
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	1.589	2.752	0.533	0.059	1.375	2.656	0.448	0.080	1.077	2.316	0.448	0.278
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.005	0.004	0.001	0.001	0.005	0.004	0.001	0.001	0.005	0.002	0.001	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.007	0.014	0.005	0.009	0.007	0.010	0.005	0.005	0.006	0.007	0.005	0.005
Total Nitrogen (TN)	mg/L	0.1	0.5	1.0	1.6	0.6	0.5	1.0	1.6	0.6	0.4	1.3	2.7	0.6	0.7
Total Phosphorous (TP)	mg/L	0.01	0.05	0.19	0.26	0.08	0.02	0.19	0.26	0.08	0.02	0.20	0.43	0.10	0.03

* Trigger values derived from 24 sampling events up to and including the month indicated.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-5 Construction surface water quality results by waterway (cont.)

Parameter				Results											
	Unit	LOR / probe limit	ANZECC default trigger value	November 2016				December 2016				January 2017			
				SW2b*			SW2a	SW2b*			SW2a	SW2b*			SW2a
				Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median
Temperature	^{0}C	-2-50	NA	4.3	22.0	13.5	19.8	4.3	22.0	13.5	22.5	4.3	22.0	13.5	-
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	246	902	498	722	246	902	498	947	246	902	498	-
Dissolved oxygen (DO)	%	0-200	85-110	42	60	10	56	42	60	10	82	42	60	10	-
pH		0-14	6.5-8	0.4	7.0	6.4	7.4	0.4	7.0	6.4	7.8	0.4	7.0	6.4	-
Turbidity (NTU)	NTU	0-600	6-50	43	53	16	31	43	53	16	14	43	53	16	-
Total suspended solids (TSS)	mg/L	5	-	45	65	11	9	45	65	11	10	45	65	11	-
Aluminium (Al)	mg/L	0.01	0.055”	0.04	0.02	0.01	0.01	0.04	0.02	0.01	0.02	0.04	0.02	0.01	-
Arsenic (As)	mg/L	0.001	0.024	0.001	0.002	0.001	0.002	0.001	0.002	0.001	0.001	0.001	0.002	0.001	-
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	-
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	-
Copper (Cu)	mg/L	0.001	0.0014	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	-
Iron (Fe)	mg/L	0.05	ID	5.95	6.89	0.63	0.28	5.95	6.89	0.63	0.18	5.95	6.89	0.63	-
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	-
Manganese (Mn)	mg/L	0.001	1.9	0.982	2.010	0.448	1.144	0.982	2.010	0.448	0.410	0.982	2.010	0.448	-
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	-
Nickel (Ni)	mg/L	0.001	0.011	0.005	0.002	0.001	0.002	0.005	0.002	0.001	0.002	0.005	0.002	0.001	-
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	-
Zinc (Zn)	mg/L	0.005	0.008	0.002	0.006	0.005	0.005	0.002	0.006	0.005	0.005	0.002	0.006	0.005	-
Total Nitrogen (TN)	mg/L	0.1	0.5	1.4	3.2	0.7	0.9	1.4	3.2	0.7	1.2	1.4	3.2	0.7	-
Total Phosphorous (TP)	mg/L	0.01	0.05	0.20	0.45	0.10	0.015	0.20	0.45	0.10	0.05	0.20	0.45	0.10	-

* Trigger values derived from 24 sampling events up to and including the month indicated.

Note -SW2a was dry for all monitoring events in January 2017.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

ID – Insufficient representative data (ANZECC).

Table 3-1 Construction surface water quality results by waterway

Parameter				Results										
	Unit	LOR / probe limit	ANZECC default trigger value	February 2017					March 2017					
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	4.1	22.3	14.2	24.0	25.0	4.1	22.4	14.7	22.3	22.8
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	244	772	390	818	903	248	772	321	850	807
Dissolved oxygen (DO)	%	0-200	85-110	21	45	23	57	47	19	42	24	66	60
pH		0-14	6.5-8	0.2	6.8	6.4	7.2	7.3	0.2	6.8	6.4	6.9	7.2
Turbidity	NTU	0-600	6-50	58	111	27	19	22	58	105	23	14	43
Total suspended solids (TSS)	mg/L	5	-	16	20	5	5	7	16	20	5	5	5
Aluminium (Al)	mg/L	0.01	0.055”	0.52	0.10	0.01	0.01	0.01	0.33	0.13	0.01	0.04	0.04
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	0.001	0.003	0.000	0.001	0.001	0.001	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.002	0.002
Iron (Fe)	mg/L	0.05	ID	5.67	1.62	0.15	0.54	0.05	1.70	1.44	0.15	0.17	0.20
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.317	0.420	0.076	0.999	0.202	0.204	0.321	0.071	0.088	0.109
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.002
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.012	0.011	0.005	0.011	0.007	0.011	0.012	0.005	0.010	0.008
Total Nitrogen (TN)	mg/L	0.1	0.5	0.3	0.6	0.3	0.4	0.3	0.3	0.7	0.3	0.8	0.6
Total Phosphorous (TP)	mg/L	0.01	0.05	0.02	0.02	0.01	0.01	0.04	0.02	0.03	0.01	0.02	0.04

* Trigger values derived from 24 sampling events up to and including the month indicated.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-2 Construction surface water quality results by waterway (cont.)

Parameter	Unit	LOR / probe limit	ANZECC default trigger value	Results									
				April 2017					May 2017				
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	3.6	22.4	15.2	17.9	19.3	3.1	22.4	16.5	16.5	16.8
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	235	772	366	1026	959	238	772	333	934	904
Dissolved oxygen (DO)	%	0-200	85-110	16	42	21	76	59	14	42	20	58	63
pH		0-14	6.5-8	0.3	6.8	6.4	7.1	7.2	0.3	6.8	6.3	7.2	6.9
Turbidity	NTU	0-600	6-50	59	105	22	9	31	60	105	20	7	22
Total suspended solids (TSS)	mg/L	5	-	16	20	7	5	18	15	23	7	5	12
Aluminium (Al)	mg/L	0.01	0.055”	0.33	0.19	0.01	0.09	0.07	0.33	0.19	0.01	0.05	0.05
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	0.001	0.002	0.000	0.001	0.001	0.001	0.002
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	3.83	1.44	0.17	0.25	0.34	4.65	1.75	0.26	0.20	0.11
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.251	0.321	0.051	0.086	0.139	0.297	0.489	0.051	0.085	0.092
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.011	0.012	0.005	0.006	0.012	0.011	0.012	0.005	0.005	0.010
Total Nitrogen (TN)	mg/L	0.1	0.5	0.3	0.8	0.3	0.2	0.4	0.3	0.8	0.4	0.1	0.4
Total Phosphorous (TP)	mg/L	0.01	0.05	0.02	0.03	0.01	0.01	0.02	0.02	0.03	0.01	0.01	0.02

* Trigger values derived from 24 sampling events up to and including the month indicated.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-3 Construction surface water quality results by waterway (cont.)

Parameter	Unit	LOR / probe limit	ANZECC default trigger value	Results									
				June 2017					July 2017				
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80th %	20th %	Median	Median	Std dev	80th %	20th %	Median	Median
Temperature	^{0}C	-2-50	NA	3.2	22.4	16.6	DNS	14.2	4.0	22.4	15.8	DNS	11.8
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	233	720	287	DNS	630	233	720	287	DNS	1070
Dissolved oxygen (DO)	%	0-200	85-110	20	43	20	DNS	87	19	43	20	DNS	81
pH		0-14	6.5-8	0.3	6.8	6.3	DNS	7.0	0.3	6.8	6.3	DNS	7.0
Turbidity	NTU	0-600	6-50	61	105	18	DNS	46	60	99	14	DNS	16
Total suspended solids (TSS)	mg/L	5	-	15	21	7	DNS	23	11	20	6	DNS	7
Aluminium (Al)	mg/L	0.01	0.055”	0.36	0.25	0.01	DNS	0.20	0.31	0.19	0.02	DNS	0.01
Arsenic (As)	mg/L	0.001	0.024	0.000	0.001	0.001	DNS	0.001	0.000	0.001	0.001	DNS	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0000	0.0001	0.0001	DNS	0.0001	0.0000	0.0001	0.0001	DNS	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	DNS	0.001	0.000	0.001	0.001	DNS	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.000	0.001	0.001	DNS	0.001	0.000	0.001	0.001	DNS	0.001
Iron (Fe)	mg/L	0.05	ID	4.64	2.35	0.26	DNS	0.29	4.61	3.90	0.32	DNS	0.15
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	DNS	0.001	0.000	0.001	0.001	DNS	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.285	0.420	0.044	DNS	0.123	0.276	0.420	0.071	DNS	0.136
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	DNS	0.0001	0.0000	0.0001	0.0001	DNS	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.000	0.001	0.001	DNS	0.001	0.000	0.001	0.001	DNS	0.001
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	DNS	0.001	0.000	0.001	0.001	DNS	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.011	0.012	0.005	DNS	0.018	0.011	0.012	0.005	DNS	0.020
Total Nitrogen (TN)	mg/L	0.1	0.5	0.3	0.8	0.4	DNS	0.6	0.2	0.7	0.4	DNS	0.3
Total Phosphorous (TP)	mg/L	0.01	0.05	0.02	0.03	0.01	DNS	0.02	0.02	0.02	0.01	DNS	0.11

* Trigger values derived from 24 sampling events up to and including the month indicated.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-4 Construction surface water quality results by waterway (cont.)

Parameter				Results											
	Unit	LOR / probe limit	ANZECC default trigger value	February 2017				March 2017				April 2017			
				SW2b*			SW2a	SW2b*			SW2a	SW2b*			SW2a
				Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median
Temperature	^{0}C	-2-50	NA	4.3	22.0	13.5	DNS	4.4	22.3	13.5	22.7	4.1	20.7	13.5	18.9
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	246	902	498	DNS	251	902	497	424	241	902	553	466
Dissolved oxygen (DO)	%	0-200	85-110	42	60	10	DNS	42	60	14	64	41	60	17	54
pH		0-14	6.5-8	0.4	7.0	6.4	DNS	0.4	7.0	6.4	5.7	0.4	7.0	6.4	6.5
Turbidity (NTU)	NTU	0-600	6-50	43	53	16	DNS	43	53	15	11	43	53	15	51
Total suspended solids (TSS)	mg/L	5	-	45	65	11	DNS	45	65	11	8	45	56	9	11
Aluminium (Al)	mg/L	0.01	0.055”	0.04	0.02	0.01	DNS	0.05	0.02	0.01	0.18	0.05	0.04	0.01	0.10
Arsenic (As)	mg/L	0.001	0.024	0.001	0.002	0.001	DNS	0.001	0.002	0.001	0.001	0.001	0.002	0.001	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0000	0.0001	0.0001	DNS	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	DNS	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.000	0.001	0.001	DNS	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	5.95	6.89	0.63	DNS	6.09	9.29	0.63	0.80	6.41	13.32	0.63	2.93
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	DNS	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.982	2.010	0.448	DNS	0.933	1.830	0.448	1.330	0.945	2.002	0.462	0.422
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	DNS	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.005	0.002	0.001	DNS	0.005	0.002	0.001	0.007	0.005	0.002	0.001	0.003
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	DNS	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.002	0.006	0.005	DNS	0.003	0.006	0.005	0.047	0.003	0.006	0.005	0.011
Total Nitrogen (TN)	mg/L	0.1	0.5	1.4	3.2	0.7	DNS	1.4	3.2	0.7	2.2	1.3	3.2	0.7	1.00
Total Phosphorous (TP)	mg/L	0.01	0.05	0.20	0.45	0.10	DNS	0.22	0.46	0.10	0.07	0.26	0.46	0.10	0.09

* Trigger values derived from 24 sampling events up to and including the month indicated.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

“ for pH >6.5. Insufficient data for pH <6.5.

ID – Insufficient representative data (ANZECC).

Table 3-5 Construction surface water quality results by waterway (cont.)

Parameter				Results											
	Unit	LOR / probe limit	ANZECC default trigger value	May 2017				June 2017				July 2017			
				SW2b*			SW2a	SW2b*			SW2a	SW2b*			SW2a
				Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median	Std dev	80th %	20th %	Median
Temperature	^{0}C	-2-50	NA	3.9	19.0	13.5	16.7	3.9	18.8	13.2	14.6	4.1	18.8	12.5	11.1
Electrical conductivity (EC)	uS/cm	0-8000	125-2200	248	933	553	470	250	933	553	416	223	933	615	457
Dissolved oxygen (DO)	%	0-200	85-110	38	66	23	50	36	75	26	60	36	81	29	59
pH		0-14	6.5-8	0.6	7.0	6.2	6.3	1.0	6.9	6.0	5.5	1.1	6.9	5.1	5.7
Turbidity (NTU)	NTU	0-600	6-50	42	52	14	59	16	43	10	15	16	43	9	14
Total suspended solids (TSS)	mg/L	5	-	42	34	9	12	43	29	6	7	43	29	5	5
Aluminium (Al)	mg/L	0.01	0.055”	0.06	0.08	0.01	0.13	0.10	0.09	0.01	0.18	0.10	0.11	0.01	0.07
Arsenic (As)	mg/L	0.001	0.024	0.001	0.002	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.002	0.001	0.001
Cadmium (Cd)	mg/L	0.0001	0.0002	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001
Chromium (Cr)	mg/L	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Copper (Cu)	mg/L	0.001	0.0014	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Iron (Fe)	mg/L	0.05	ID	6.50	13.32	0.61	3.56	6.57	13.32	0.61	1.23	6.60	13.32	0.61	1.59
Lead (Pb)	mg/L	0.001	0.0034	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Manganese (Mn)	mg/L	0.001	1.9	0.934	2.002	0.462	0.157	0.889	2.002	0.570	0.489	0.872	2.002	0.650	0.164
Mercury (Hg)	mg/L	0.0001	0.0006	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001
Nickel (Ni)	mg/L	0.001	0.011	0.005	0.002	0.001	0.002	0.005	0.005	0.001	0.004	0.005	0.006	0.001	0.002
Silver (Ag)	mg/L	0.001		0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Zinc (Zn)	mg/L	0.005	0.008	0.004	0.007	0.005	0.007	0.012	0.011	0.005	0.025	0.013	0.016	0.005	0.021
Total Nitrogen (TN)	mg/L	0.1	0.5	1.3	3.0	0.6	1.1	1.4	3.0	0.5	0.5	1.4	3.0	0.4	0.7
Total Phosphorous (TP)	mg/L	0.01	0.05	0.26	0.37	0.07	0.08	0.27	0.37	0.03	0.03	0.27	0.37	0.02	0.03

* Trigger values derived from 24 sampling events up to and including the month indicated.

Note -SW2a was dry for all monitoring events in January 2017.

Colour red - Represents the calculated median result being either above the 80th percentile or below the 20th percentile at the downstream sampling location.

ID – Insufficient representative data (ANZECC).

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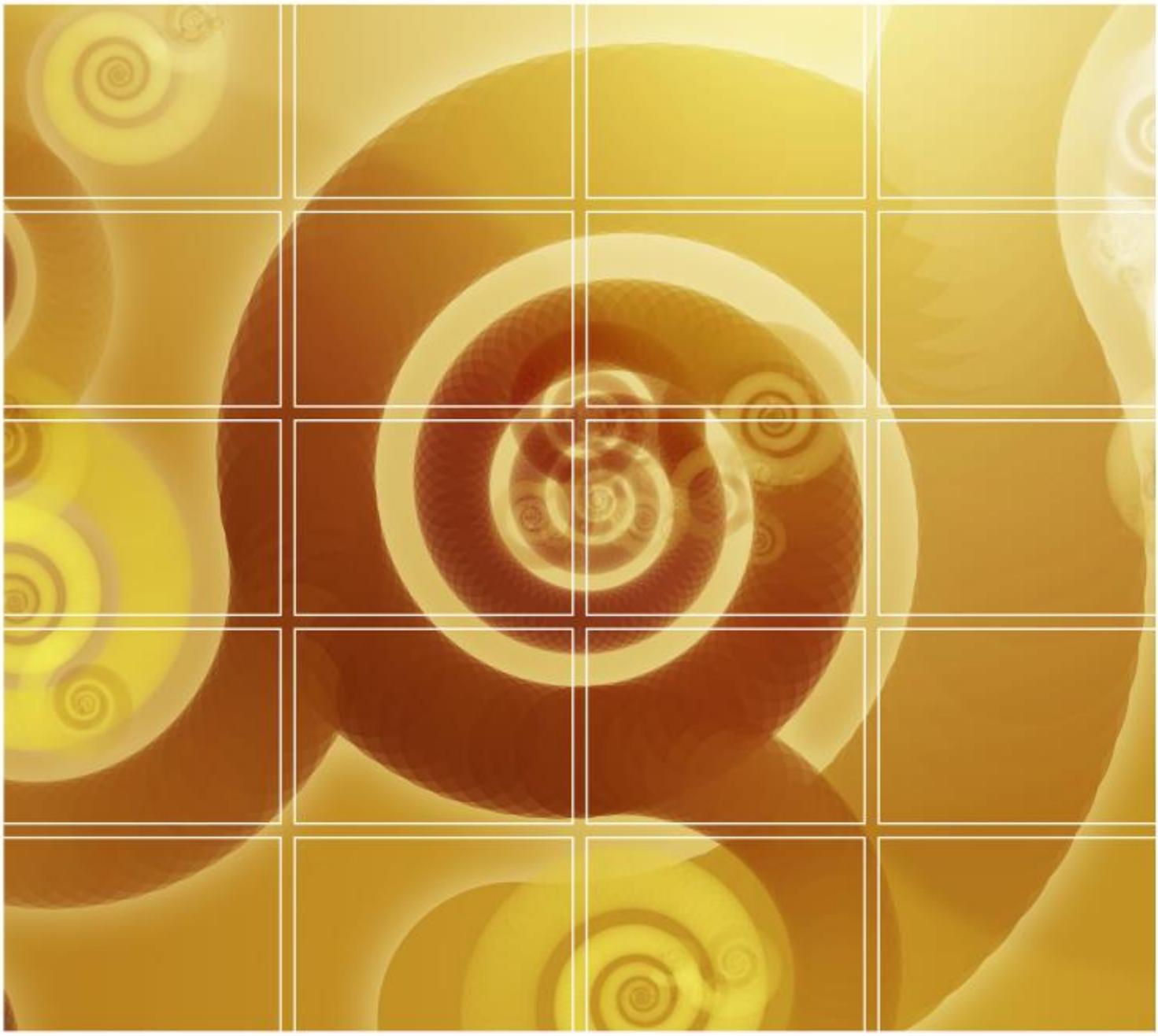
Annex F

Groundwater Assessment



Sancrox Quarry Expansion
Groundwater Assessment

Hanson Construction Materials Pty Ltd

August 2019

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Sancrox Quarry Expansion

Groundwater Assessment

Hanson Construction Materials Pty Ltd (Hanson)

August 2019

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Approved by:	*Thomas Buchan*
Position:	Project Manager
Signed:	
Date:	*28 August, 2019*
Approved by:	*Murray Curtis*
Position:	Partner Director
Signed:	
Date:	*28 August 2019*

Environmental Resources Management Australia Pty Ltd

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1 INTRODUCTION

1.1 BACKGROUND

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Hanson Construction Materials Pty Ltd (Hanson) to conduct a Groundwater Assessment to inform the Environmental Impact Assessment (EIA) for the proposed Sancrox Quarry Expansion Project (the Project). The Project is a State Significant Development (SSD #7293) and therefore the planning approvals process is regulated under the *Environmental Planning and Assessment Act 1979* (the EP&A Act), which requires Department of Planning and Environment (DP&E) approval for development consent, supported by an Environmental Impact Statement (EIS).

The Project will extend the life of Sancrox Quarry (the quarry site) by expanding the approved extraction boundary and increasing approved extraction limits. The Project proposes to increase the current approved annual maximum extraction limit from 455, 000 tonnes per annum (tpa) to 750 000 tpa. The Project will involve an upgrade and relocation of the existing infrastructure area including the processing plant, offices, weighbridge and workshop. The Project also includes the construction of a new concrete batching plant, concrete recycling facility, asphalt production plant and pug mill on site.

Note that the groundwater modelling presented in this report was based on the original final pit extent as presented on *Figure 3.1*. Following completion of the groundwater modelling works, the pit design needed to be altered to prevent potential surface water inflow during a probable maximum flood event as identified through the Hydrology Assessment. The revised pit design was selected to avoid additional design work as well as mitigating visual impacts due to the retention of some forest, providing a visual screen from parts of the residential property to the west of the quarry.

As the revised pit design has a smaller footprint and volume than the original design, the groundwater modelling results presented in this report is seen as conservative. Note that all references to the final pit extent in this report refer to the "Original Final Pit Extent" shown on the figures (with the figures also showing the "Revised Final Pit Extent" for comparison purposes.

1.2 OBJECTIVES AND SCOPE OF WORKS

The objective of this Groundwater Assessment is to meet the requirements of the Secretary's Environmental Assessment Requirements (SEARs). Water related SEARs are outlined below:

Table 1.1 Groundwater Assessment Requirements

Item	SEARs	Where addressed
1	A detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures	Hydrology Assessment
2	Identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*	*Section 2* and Hydrology Assessment
3	Demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP)	Hydrology Assessment
4	A description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo	Hydrology Assessment
5	An assessment of any likely flooding impacts of the development; an assessment of the likely impacts on the quality and quantity of existing surface and groundwater resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives	*Section 6* and Hydrology Assessment
6	An assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users	*Section 6.1* and Hydrology Assessment
7	A detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts	*Section 6.2* and Hydrology Assessment

Of the 7 items outlined above, items 1, 3 and 4 relate predominantly to the surface water assessment given the dynamics of the quarry site and the Project and these SEARS are addressed in the Hydrology Assessment (ERM, 2018). In order to meet the objectives of the groundwater related aspects of items 2 and 5 through to 7 outlined above (and to provide input to the site water balance) ERM conducted the following scope of works:

- A desktop assessment to describe the environmental site setting, including a search for groundwater users (both registered groundwater bores and groundwater dependant ecosystems) using publically available database sources;

- A groundwater field program to undertake aquifer parameter testing and groundwater and surface water sampling to characterise the aquifer system underlying the Project site; and

- Groundwater modelling to evaluate groundwater inflow rates into the expanded quarry as well as potential groundwater drawdown proximal to the quarry and the potential magnitude of drawdown at identified groundwater users.

1.3 REPORT STRUCTURE

The report is organized as follows:

Section 2 – Regulatory Considerations outlines regulatory framework and describes the impact assessment requirements of the New South Wales (NSW) Aquifer Interference Policy.

Section 3 - Site Setting provides a description of the quarry site, the environmental setting as well as identified groundwater use within the vicinity of the quarry site.

Section 4 - Fieldwork Program outlines the field methodology and results of the fieldwork undertaken which included groundwater level gauging, pumping tests on available bores and water quality sampling.

Section 5 – Groundwater Flow Modelling describes the methodology and results of the groundwater flow modelling undertaken to assess the potential impact of the quarry expansion.

Section 6 – Assessment Outcomes and Monitoring Recommendations summarises the groundwater assessment that follows from the groundwater modelling and stipulates the recommended monitoring requirements for the Project.

Section 7 – References provides the list of references cited in this report.

2 REGULATORY CONSIDERATONS

2.1 REGULATORY FRAMEWORK

2.1.1 Water Act 1912

Section 10 of the *Water Act 1912* requires that:

(1) Any occupier of land whereon any work to which this Part extends (not being a joint water supply scheme) is constructed or used, or is proposed to be constructed or used, for the purpose of:

(a) water conservation, irrigation, water supply or drainage, or

(b) (Repealed)

(c) changing the course of a river

May apply to the Ministerial Corporation in the form prescribed for a licence to construct and use the said work, and to take and sue for the purposes specified in the application the water, if any, conserved or obtained thereby, and to dispose of such water for the use of occupiers of land for any purpose.

Implications for the Project

In addition to Section 10 of the *Water Act 1912* outline above, the NSW Aquifer Interference Policy (see *Section 2.2* of this report) specifies that a water licence is required irrespective of whether water is taken for consumptive use (i.e. for water supply purposes) or whether water is taken incidentally in the course of undertaking the activity. Aquifer interference activities taking water outside of Water Sharing Plan (WSP) areas require a license under the *Water Act 1912* and the water take estimation provided by the groundwater modelling (see *Section 5.3*) should be taken into consideration during the water licence application process. Hanson currently hold a Water Access Licence (WAL42524) for water supply works undertaken on site. The predicted water take of the quarry extension would be compared to the current licence allowance prior to submitting a request for a revised or new licence.

2.1.2 Water Management Act 2000

The *Water Management Act 2000* (WMA) was introduced to provide for a comprehensive singular piece of legislation to effectively manage and regulate access, and use of, the State's water resources. The objectives of the WMA include:

- to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and the water quality; and
- to recognise and foster the significant social and economic benefits to the state that result from the sustainable and efficient use of water.

The sections of the Act that pertain to groundwater related aspects of the Project are outlined below.

Activity Approvals

Section 91 of the WMA states the following in relation to activity approvals:

(1) There are two kinds of activity approvals, namely, controlled activity approvals and aquifer interference approvals.

(2) A controlled activity approval confers a right on its holder to carry out a specified controlled activity at a specified location in, on or under waterfront land.

(3) An aquifer interference approval confers a right on its holder to carry out one or more specified aquifer interference activities at a specified location, or in a specified area, in the course of carrying out specified activities.

Chapter 3 part 3 of the WMA requires that approval be granted for works that are classified as "controlled activities" within waterfront land (generally being land within 40m of a waterway). A controlled activity is defined as:

(a) the erection of a building or the carrying out of a work (within the meaning of the Environmental Planning and Assessment Act 1979), or

(b) the removal of material (whether or not extractive material) or vegetation from land, whether by way of excavation or otherwise, or

(c) the deposition of material (whether or not extractive material) on land, whether by way of landfill operations or otherwise, or

(d) the carrying out of any other activity that affects the quantity or flow of water in a water source.

Section 91E (1) of the WMA states:

A person:

(a) who carries out a controlled activity in, on or under waterfront land, and

(b) who does not hold a controlled activity approval for that activity, is guilty of an offence.

An aquifer interference activity means an activity involving any of the following:

(a) the penetration of an aquifer,

(b) the interference with water in an aquifer,

(c) the obstruction of the flow of water in an aquifer,

(d) the taking of water from an aquifer in the course of carrying out mining, or any other activity prescribed by the regulations,

(e) the disposal of water taken from an aquifer as referred to in paragraph (d).

Implications for the Project

Part 4 Division 4.1 Section 89 (J)(g) of the EP&A Act states that authorisations are not required should the Project be granted SSD approval, including:

- *a water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the Water Management Act 2000.*

Therefore the Project is exempt under Section 89(J) of the EP&A Act for the need to obtain all water approvals, except for an aquifer interference approval. As the Project will involve the penetration of an aquifer and extraction of water from the aquifer through the dewatering effect of the quarry expansion, an aquifer interference approval will be required from the NSW Office of Water. Requirements of the NSW Aquifer Interference Policy are described further in *Section 2.2*.

Water Sharing Plans

The draft WSP for the Hastings Unregulated and Alluvial Water Sources 2016 under the Water Management Act 2000 includes proposed rules for protecting the environment, water extractions, managing licence holders' water accounts, and water trading in the plan area. The draft plan area comprises all streams and alluvial aquifers within the Hastings River Valley.

Since 1 July 2004 licensing and approvals under the WMA has been in effect in specific areas of NSW covered by operational WSPs. These areas cover most of the State's major regulated river systems. Currently, outside these areas, licensing provisions of the *Water Act 1912* are still in force.

Implications for the Project

The Project does not currently fall within a gazetted WSP area[1], therefore any access to groundwater would be applied for under the *Water Act 1912*.

[1]http://www.water.nsw.gov.au/water-management/water-sharing/plans_commenced

2.2 *AQUIFER INTERFERENCE POLICY*

The NSW Aquifer Interference Policy (NSW DPI, 2012) describes the assessment process for protecting and managing potential impacts of aquifer interference activities on the water resources of NSW. The three key parts to the Policy include:

1. All water taken during the activity must be accounted for (and the project proponent must be able to appropriately licence this take where required);

2. The activity must address minimal impact considerations (as defined in the Policy) for impacts on water levels, water pressure and water quality; and

3. Planning measures are required in the event that actual impacts are greater than predicted, with planning measures including sufficient monitoring requirements.

These parts are described further below.

2.2.1 *Water Take - Licencing Requirements*

The Policy specifies that all water taken during the aquifer interference activity must be accounted for, and that a water licence is required irrespective of whether the water is taken for consumptive use (i.e. for water supply purposes) or whether water is taken incidentally in the course of undertaking the activity.

Implications for the Project

Incidental water take from an aquifer through quarrying below the pre-activity water table presents an aquifer interference activity (which includes consideration of water flow into a void as a result of evaporation). In line with the WMA, aquifer interference activities taking water outside of water sharing plan areas require a license under the *Water Act 1912*.

As part of this assessment, potential water take was accounted for by groundwater modelling, with the take estimation providing supporting information for the water licence requirements.

2.2.2 *Minimal Impact Considerations*

The assessment criteria that are specified within the Policy are called "minimal impact considerations" and include criteria for assessing potential impact on water table levels, water pressure levels (i.e. potentiometric levels) and water quality. Impacts on water-dependent assets should be considered including water supply bores, groundwater-dependent ecosystems and culturally significant sites that are dependent on groundwater.

The Policy distinguishes between so called "highly productive" and "less productive" groundwater resources, with highly productive groundwater resources requiring groundwater with total dissolved solids (TDS) concentrations of less than 1 500 mg/L and water supply works that can yield water at a rate greater than 5 L/sec. Based on the relatively elevated salinity of groundwater and the low permeability of the underlying aquifer system (see *Section 4.2.3* and *4.2.2* respectively), the groundwater resources underlying the site is classified as less productive.

The relevant assessment criteria for the Project are summarised in *Table 2.1*.

Table 2.1 Minimal Impact Considerations for Aquifer Interference Activities[1]

Water Table	Water Pressure	Water Quality
1. Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any: a) high priority groundwater dependant ecosystem; or b) high priority culturally significant site; c) listed in the schedule of the relevant water sharing plan. A maximum of a 2m decline cumulatively at any water supply network. 2. If more than 10% cumulative variation in cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any: a) high priority groundwater dependant ecosystem; or b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan if appropriate studies demonstrate to the Minister's satisfaction that the variation will not prevent the long term viability pf the dependant ecosystem or significant site. If more than a 2m decline cumulatively at any water supply work then make good provisions would apply	1. A cumulative pressure head decline of not more than a 2m decline, at any water supply work. 2. If the predicted pressure head decline is greater than requirement 1 above, then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline will not present the long term viability of the affected water supply works unless make good provisions apply.	1. Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity. 2. If condition 1 is not met than appropriate studies will need to demonstrate to the Minister's satisfaction that the change in groundwater quality will not prevent the long term viability of the dependent ecosystem, significate site or affected water supply works.

[1]Minimum requirements for *Porous and Fractured Rock Water Resources - Less Productive Groundwater Resources* as per the NSW Aquifer Interference Policy (NSW DPI, 2012).

Implications for the Project

Based on the Policy specifications the minimal impact considerations summarised above form the basis of the groundwater assessment. The groundwater flow modelling was undertaken to assess potential impacts against these considerations.

2.2.3 *Monitoring*

Monitoring requirements will be specified to enable the monitoring of actual impacts compared to predicted impacts. Contingency plans can then be enacted in a timely manner if actual impacts are higher than predicted and these impacts are found to be significant.

Implications for the Project

Monitoring requirements in-line with the specifications outlined above will be developed for the Project.

2.3 *CONSULTATION*

The SEARs require consultation with relevant local, State and Commonwealth Government authorities. These agencies as relevant to the groundwater assessment are outlined in *Table 2.2*, along with the response received.

Table 2.2 Stakeholder Consultation

Relevant Stakeholder	Consultation Method	Response
Environment Protection Agency	Letter advising that the EIS process is underway and the assessment will address the SEARs. Request for additional comments made.	No further comments at this stage.
Department of Primary Industries (Office of Water)	Same as above.	No further comments at this stage.

3 SITE SETTING

3.1 SITE DESCRIPTION

The site is an operational hard rock quarry, located in Sancrox approximately 8 km to the west of Port Macquarie. The quarry has been owned and operated by Hanson since 1998. Hanson owns approximately 145 ha of land, of which approximately 12 ha has been in use for the extraction, processing and storage of aggregates. Infrastructure associated with the existing quarry includes the processing plant, offices, weighbridge and workshop.

The Study Area includes the existing quarry site, the area identified for the quarry expansion and a 2 km radius from the perimeter of the final pit to identify groundwater users that may be impacted by the proposed activity. The eastern portion of the Study Area has been disturbed by active quarrying activities while the west and northwest portions of the Study Area are largely undisturbed and predominantly covered with remnant woodland vegetation and some smaller sections of ground covering pasture. *Figure 3.1* shows the location of the existing quarry site in relation to the proposed final footprint of the quarry expansion.

3.2 ENVIRONMENTAL SETTING

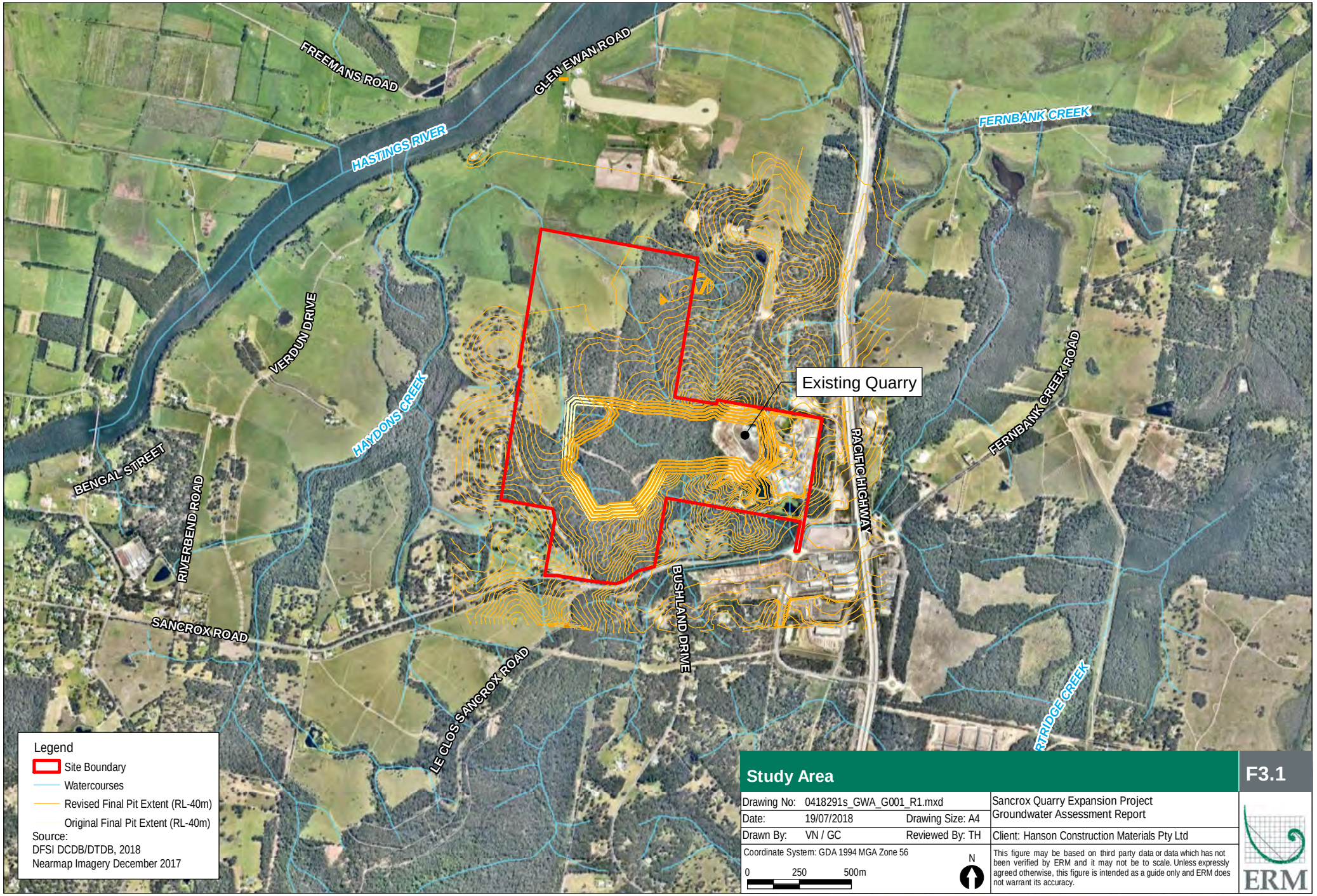
3.2.1 Climate

Long-term climate data is available from a Bureau of Meteorology (BoM) weather station located in Telegraph Point (Farrawells Road, 060031), approximately 11 km north of the site. The weather station has been operational since 1910 and has a weather record of over a 100 years. While the Port Macquarie Airport BoM weather station is located closer to the site (approximately 5 km east of the site) the Airport weather station has been in operation for 22 years and the Telegraph Point weather station is considered to have a more robust dataset reflective of long-term conditions. Note that the annual rainfall averages at both locations are similar, with 1,315 mm reported for the Telegraph Point station and 1,428 mm reported for the Port Macquarie Airport weather station.

The nearest BoM weather station with mean monthly evaporation data available was Yarras (Mount Seaview, 060085), approximately 44 km to the south west of the site. The mean annual evaporation rate reported for the Yarras weather station is 960 mm.

3.2.2 Topography

The topography surrounding the Study Area is characterised by flood plains and low lying hills up to approximately 60m Australian Height Datum (mAHD) which is the highest point of the Study Area. The eastern portion of the Study Area has been disturbed by active quarrying activities while, the west and northwest portions of the Study Area are largely undisturbed.


FREEMANS ROAD
GLEN EWAN ROAD
HASTINGS RIVER
FERNBANK CREEK
VERDUN DRIVE
HAYDONS CREEK
Existing Quarry
BENGAL STREET
RIVERBEND ROAD
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
SANCROX ROAD
BUSHLAND DRIVE
LE CLOS SANCROX ROAD
RTRIDGE CREEK
Legend
Site Boundary
Watercourses
Revised Final Pit Extent (RL-40m)
Original Final Pit Extent (RL-40m)
Source:
DFSI DCDB/DTDB, 2018
Nearmap Imagery December 2017
Study Area
F3.1
Drawing No: 0418291s_GWA_G001_R1.mxd
Date: 19/07/2018
Drawing Size: A4
Drawn By: VN / GC
Reviewed By: TH
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Groundwater Assessment Report
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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3.2.3 Geology

The regional geological map indicates that the Study Area is underlain by the Byabbara Beds of the Carboniferous Period. Regionally the Byabbara Beds consists of interbedded lithic sandstone, siltstone, tuff, shale and limestone. Towards the Hastings River, to the north and west of the Study Area, Quaternary age alluvial sediments consisting of sand, silt, mud and gravel overlie the Byabbara Beds (Brunker et al., 1970). The surface expression of the aforementioned geological units, as drawn from the regional geological map, is presented in *Figure 3.2*.

The sedimentary units comprising the Byabbara Beds have undergone a degree of metamorphosis. Drilling undertaken at the Study Area indicates that the geology comprises a sequence of meta-sediments dipping at 70 degrees to the north to north northeast. The meta-sediments are further considered to be weathered to a depth of approximately 10 to 30 metres (Hanson, 2016).

The existing pit has a defined fault line trending southwest to northeast, and the approximate location of the fault line (Hanson, 2016) is presented in *Figure 3.2* along with the regional surface geology as drawn from Brunker et al (1970). The Byabbara Beds geology has been inferred to comprise conglomerate, sandstone and siltstone to the north of the fault line and predominantly shale to the south of the fault line. Drilling completed at the Study Area further suggests that there are fault zones at depth as indicated by intervals of breccia identified in the rock core (Hanson, 2016). Borelogs for monitoring bores SA1501 – SA1503 are presented in *Annex A*.

3.2.4 Hydrogeology

The meta-sediments of the Byabbara Beds underlying the Study Area are considered to present a fractured rock aquifer, with groundwater storage and flow largely controlled by secondary porosity. While at a regional scale the groundwater flow direction would be expected to be similar to the slope of the topography. Influence on local groundwater flow directions would include the orientation and connectivity of the fracture network, as well as the influence of the existing open pit on hydrodynamics. Quarrying in the existing open pit has proceeded to below the groundwater level in the surrounding bedrock (see *Section 4.2.1)* and groundwater flow in the immediate vicinity of the quarry workings would be towards the pit. According to site management, no active dewatering takes place at the pit with groundwater seepage into the pit being negligible, indicating that the permeability of the meta-sediments is low.

The Quaternary alluvial sediments overlying the Byabbara Beds sediments to the north and west of the Study Area (in proximity to the Hastings River) present an unconsolidated aquifer where water storage and flow is governed by the primary porosity of the sediments.

The alluvial sediments would be expected to be in direct hydraulic connection with surface water features such as the Hastings River, with the direction of water flow controlled by relative water levels in the surface water features and surrounding alluvial sediments. When compared the Quaternary alluvial sediments would be expected to present a significantly more productive aquifer than the consolidated meta-sediments.

Legend

- Site Boundary
- Revised Final Pit Extent (RL -40m)
- Original Final Pit Extent (RL -40m)
- Inferred Fault Line
- Qa - Quaternary Alluvial Sediments (Sand, Silt, Mud, Gravel)
- Cb - Byabbara Beds (Lithic Sandstone, Siltstone, Tuff, Shale, Limestone)

Sources:

- Geology map reference: Brunker R.L., Offenberg A.C. and Cameron R.G., 1970: Hastings 1:250 000 Geological Sheet SH/56-14, 1st edition, Geological Survey of New South Wales, Sydney.
- Reference for inferred fault line: Hanson, 2016: Geology Report - Geology, Drill Results and Resources 2015. Sancrox Quarry, NSW.

Regional Surface Geology

F 3.2

Drawing No: 0418291s_GWA_C002_R0.cdr		**Sancrox Quarry Expansion Project Groundwater Assessment Report**
Date: 19/07/2018	Drawing size: A4	
Drawn by: GC	Reviewed by: WG	Client: Hanson Construction Materials Pty Ltd
Drawing Not to Scale	N	This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

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3.2.5 Hydrology

The existing quarry and the proposed expansion area fall within the Hastings River catchment, with the Hastings River flowing towards the coast in a north-easterly direction to the north of the quarry site. The Hastings River is located approximately 1.3 km to the northeast of the perimeter of the final pit at its closest point.

Haydon's Creek presents the closest waterway to the proposed expansion area, located approximately 650 m to the west of the perimeter of the final pit at its closest point. Haydon's Creek drains in a northerly direction and forms a tributary to the Hastings River.

A more detailed description of the site hydrology and catchment characteristics is provided in the Hydrology Assessment (ERM, 2018).

3.3 GROUNDWATER USE

3.3.1 Groundwater Bores

A desktop search was conducted to identify existing groundwater users through the NSW Department of Primary Industries (DPI) Office of Water Groundwater Bore Database (NSW DPI, 2018). The search area included a 2 km radius from the perimeter of the final pit.

A total of 13 registered groundwater bores were identified as summarised in *Table 3.1*. The locations of the bores relative to the quarry are presented in *Figure 3.3*.

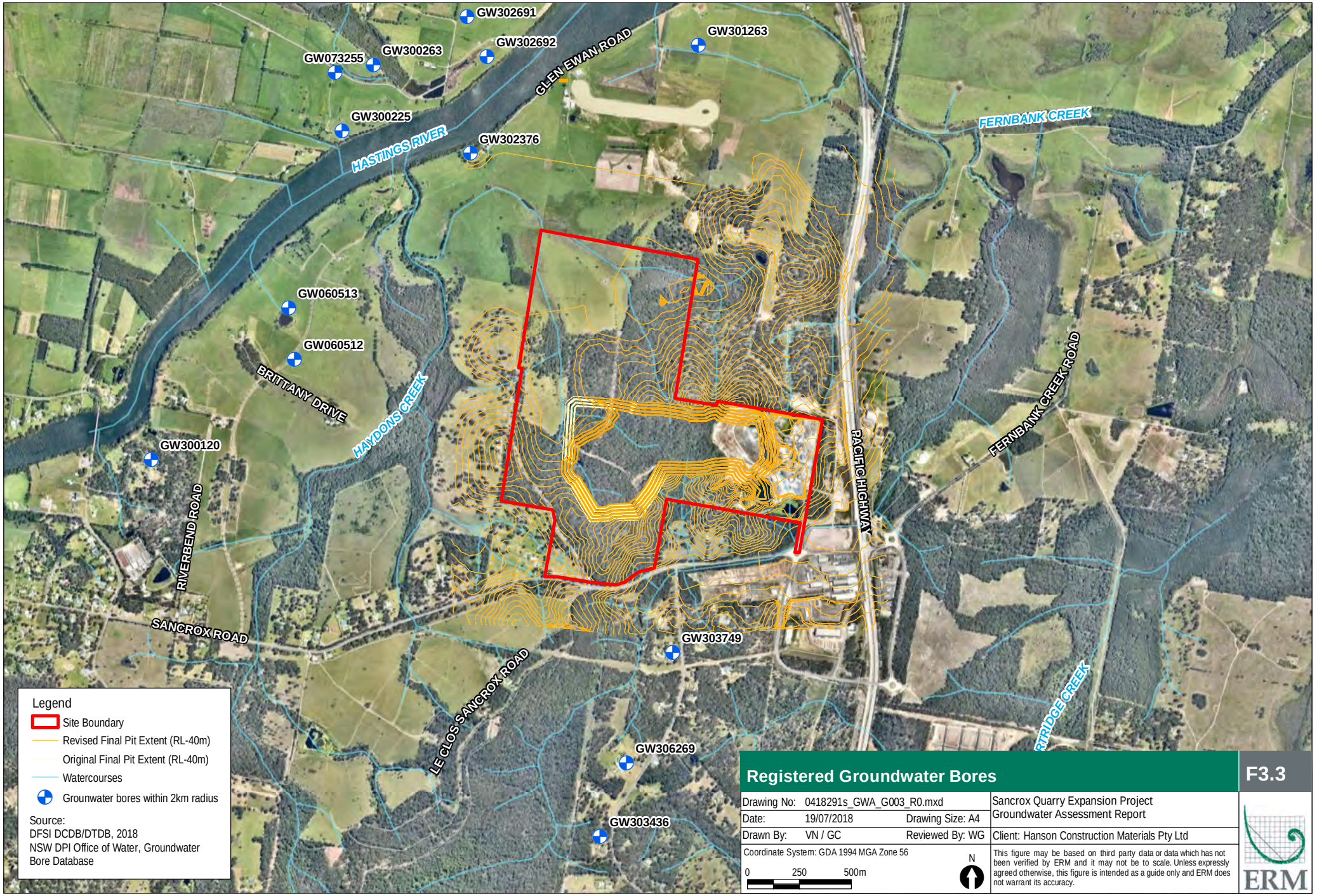
GW302691
GW302692
GW301263
GW073255
GW300263
GLEN EWAN ROAD
GW300225
HASTINGS RIVER
GW302376
FERNBANK CREEK
GW060513
GW060512
BRITTANY DRIVE
HAYDONS CREEK
GW300120
RIVERBEND ROAD
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
SANCROX ROAD
GW303749
LE CLOS SANCROX ROAD
GW306269
GW303436
Legend
Site Boundary
Revised Final Pit Extent (RL-40m)
Original Final Pit Extent (RL-40m)
Watercourses
Grounwater bores within 2km radius
Source:
DFSI DCDB/DTDB, 2018
NSW DPI Office of Water, Groundwater Bore Database
Registered Groundwater Bores
F3.3
Drawing No: 0418291s_GWA_G003_R0.mxd
Date: 19/07/2018
Drawing Size: A4
Drawn By: VN / GC
Reviewed By: WG
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Table 3.1 Groundwater Bores Identified within 2km radius of final pit perimeter

Bore ID	Registered Use	Distance and Direction		Depth (m)
		Distance (km)	Direction	
GW060512	Stock Watering/Domestic	1.32	WNW	25
GW060513	Stock Watering/Domestic	1.42	WNW	4.6
GW073255	Stock Watering	1.94	NW	15.5
GW300120	Domestic	1.97	W	38
GW300225	Stock Watering/Domestic	1.7	NW	20
GW300263	Stock Watering	1.87	NW	15.5
GW301263	Stock Watering (potential Domestic)	1.72	N	10
GW302376	Stock Watering/Domestic	1.27	NW	23
GW302691	Stock Watering	1.92	NNW	-
GW302692	Stock Watering	1.7	S	-
GW303436	Domestic	1.5	S	40.5
GW303749	Stock Watering/Domestic	0.6	S	34.5
GW306269	Domestic	1.1	S	30

3.3.2 Groundwater Dependent Ecosystems

The Australian groundwater dependent ecosystems (GDE) toolbox (National Water Commission, 2011) identifies the following three types of GDEs:

- Type 1 – Aquifer and Cave Ecosystems (inhabited by subterranean fauna including troglofauna and stygofauna).
- Type 2 – Ecosystems Dependent on the Surface Expression of Groundwater (such as wetlands and creeks/rivers fed by baseflow).
- Type 3 – Ecosystems Dependent on the Subsurface Expression of Groundwater (with groundwater typically encountered within the rooting zone).

The BoM Atlas of GDEs (BoM, 2018) was used for the identification of groundwater environmental receptors in the Study Area. The Atlas was used to search a 2 km radius from the perimeter of the final pit and the following GDEs were identified:

- Type 2 – Ecosystems: The Hastings River, located approximately 1.3 km to the northwest of the perimeter of the final pit (at its closest distance from the pit).

- Type 3 – Ecosystems: Multiple ecosystems with high to moderate GDEs potential including:

    - Several areas of Paperbark ecosystems with the closest located approximately 500 m to the west of the outer perimeter of the final pit (and adjacent to Haydon's Creek). Additional occurrences of Paperbark ecosystems have been mapped by BoM approximately 800 m to the north east, 900 m to the east north east and 1,700 m east south east of the perimeter of the final pit.

    - Low Relief Coastal Blackbutt ecosystems located approximately 1,100 m to the east and 1,300 m to the south east on the perimeter of the final pit.

No Type 1 ecosystems were identified through the BoM GDE Atlas.

While the Project does not currently fall within a gazetted WSP area, a *Draft Water Sharing Plan for the Hastings Unregulated and Alluvial Water Sources 2016* (NSW Government, 2016) has been developed which includes a *High priority Groundwater-Dependent Ecosystem Map* (GDE011_Version 1). This map was reviewed as part of the groundwater assessment and no high priority GDEs were identified within a 2km radius of the perimeter of the final pit. Note that groundwater dependent culturally significant sites were under investigation at the time of the development of the draft WSP and the locations of any such sites had not been identified.

4 FIELDWORK PROGRAM

4.1 FIELD METHODOLOGY

4.1.1 Pre-Pumping Test Groundwater Level Gauging

ERM undertook manual water level gauging of static water levels (SWLs) with a dip meter prior to the pumping tests commencing on 28 November 2017. In addition to the water level data gathered through manual gauging, Hanson deployed pressure transducers (automated level loggers) in three monitoring bores (SA1501 – SA1503) for the collection of long-term baseline groundwater levels. The locations of the monitoring bores are presented in *Figure 4.1*.

Based on data files made available by Hanson, the level loggers were deployed from:

- October 2015 to September 2017 for SA1501.
- December 2016 to September 2017 for SA1502.
- December 2016 to July 2017 for SA1503.

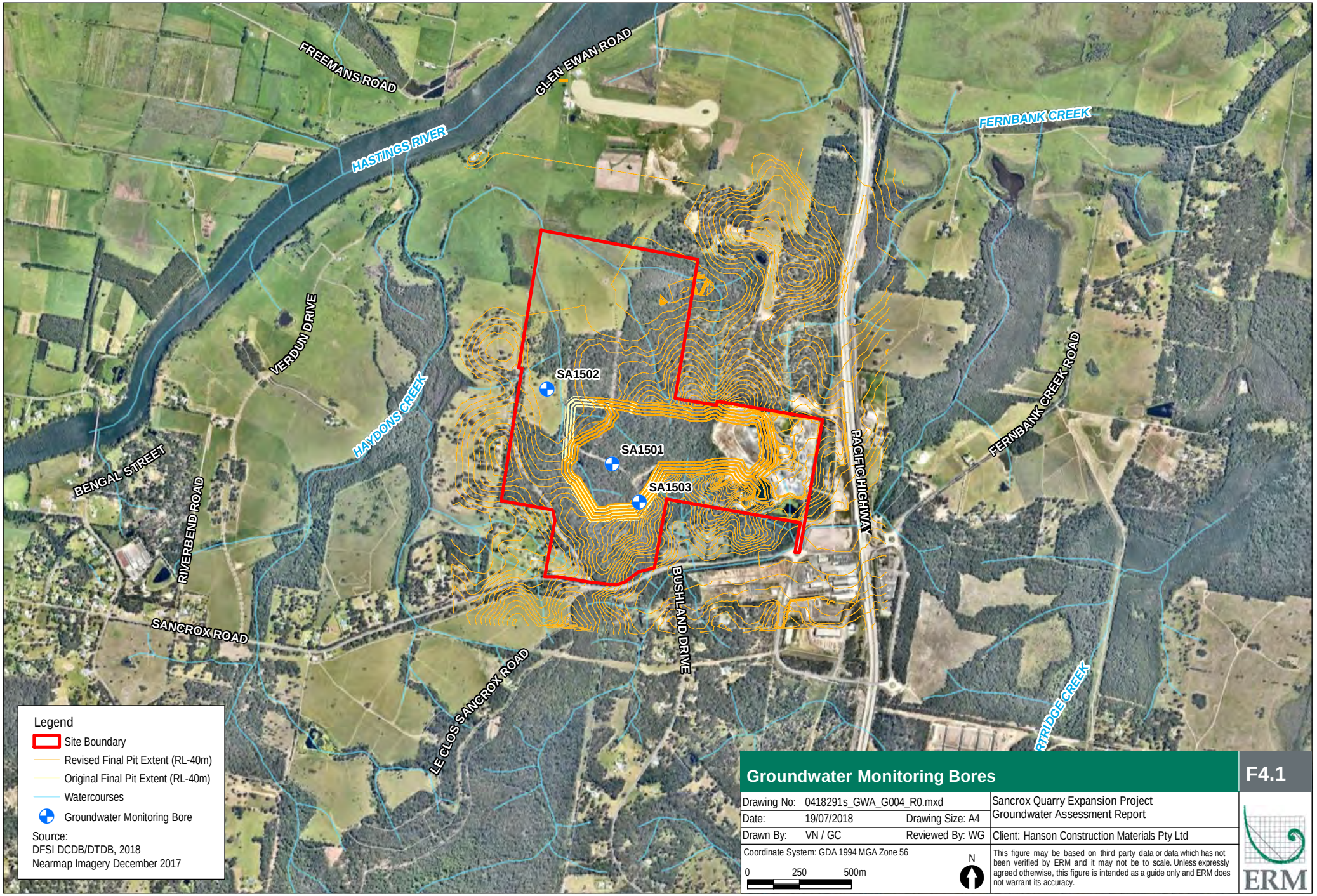
At all three locations, the level loggers were programmed to collect water level measurements at 12 hour intervals.

Water level data collected manually and through the level loggers are summarised in *Section 4.2.1.*

4.1.2 Pumping Tests

Two short-term constant discharge pumping tests and associated recovery tests were undertaken at the site to estimate aquifer hydraulic properties. Of the three available monitoring bores, SA1502 and SA1503 were originally earmarked for test pumping. In the field, monitoring bore SA1503 had a blockage at approximately 6 metres below ground level (m bgl) that prevented the pump from being lowered to below the standing water level. For this reason, pumping tests were undertaken on bores SA1501 and SA1502.

Prior to the first constant discharge pumping test commencing, a preliminary pumping test was undertaken at SA1502 on 28 November 2017 as an equipment test and to assess an appropriate pumping rate for the constant discharge test. The pumping equipment included a Grundfos MP1 electrical submersible pump suitable for the 50 mm diameter monitoring bore casing, a variable frequency drive to control pumping rates and a mobile generator to power the pump.


FREEMANS ROAD
GLEN EWAN ROAD
HASTINGS RIVER
FERNBANK CREEK
VERDUN DRIVE
HAYDONS CREEK
SA1502
SA1501
SA1503
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
BUSHLAND DRIVE
LE CLOS SANCROX ROAD
Legend
Site Boundary
Revised Final Pit Extent (RL-40m)
Original Final Pit Extent (RL-40m)
Watercourses
Groundwater Monitoring Bore
Source:
DFSI DCDB/DTDB, 2018
Nearmap Imagery December 2017
Groundwater Monitoring Bores
F4.1
Drawing No: 0418291s_GWA_G004_R0.mxd
Date: 19/07/2018
Drawing Size: A4
Drawn By: VN / GC
Reviewed By: WG
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Groundwater Assessment Report
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

The constant discharge pumping test at SA1502 was undertaken on 28 November 2017 and the constant discharge test at SA1501 on 29 November 2017. Both constant discharge tests were run for a period of 3 hours, at pumping rates of 1 L/minute and 3 L/minute at SA1502 and SA1501 respectively. At this point in the pumping tests, respective groundwater level drawdowns of 28.02 and 4.89 m had been achieved in SA1502 and SA1501. To maximise drawdown in the aquifer for the recovery tests, the pumping rate for the SA1502 test was increased to approximately 3 L /min for a duration of 15 minutes (achieving a total drawdown of 43.73 m), while the pumping rate for the SA1501 test was increased to 6 L/min for a further 2 hours (achieving a total drawdown of 22.49 m). From the total drawdown depths, the time period for 90% recovery to pre-test static water levels were approximately 30 minutes for the test conducted at SA1501 and 4 hours 20 minutes for the test conducted at SA1502.

Groundwater level responses during pumping and during recovery following the cessation of pumping were measured using down-hole absolute (i.e. non-vented) pressure transducers. In-Situ Level TROLL pressure transducers were pre-programmed to collect data at 30 second intervals and an In-Situ Baro TROLL was used to collect data for barometric pressure corrections. The barometric pressure correction completed post testing assumed 100% efficiency and instantaneous response (i.e. the full barometric pressure was subtracted from the water level pressure).

The Level TROLL pressure transducers were deployed in the pumping bores as well as observation bores. During the pumping of monitoring bore SA1501, SA1502 and SA1503 were utilised as observations bores and during the pumping of SA1502, SA1501 and SA1503 were utilised as observations bores. In addition, manual water level measurements were taken with a dip meter from the pumping bores for real time monitoring of water levels during the tests. Flow rates were measured periodically with a stopwatch, 0.5 L container and a graduated water bucket.

The pumping test data interpretation and results are presented in *Section 4.2.2.*

4.1.3 Groundwater Sampling

Monitoring bores SA1501 and SA1502 were sampled during the pumping tests, with samples taken once field parameters measured during pumping (which included pH, electrical conductivity [EC], oxidation reduction potential [ORP], dissolved oxygen [DO] and temperature) had stabilised.

Due to a blockage encountered in SA1503, this monitoring bore could not be sampled with the submersible pump and this specific bore was sampled with a single use disposable bailer. Due to purging limitations posed by the bailer method, the sample taken with the bailer effectively represents a grab sample.

In addition to the groundwater monitoring bores, surface water samples were taken from the two surface water holding ponds/dams on site, the in-pit sump, and a water seep located to the northeast of the existing aggregate processing and storage area. The surface water holding pond samples were taken from the western most dam in the south eastern corner of the site (sample ID: Holding Pond 1) and the eastern most dam in the south eastern corner of the site (sample ID: Holding Pond 2).

Stabilised field parameters and laboratory results of the groundwater and surface water sampling are presented in *Section 4.2.3*.

4.2 RESULTS

4.2.1 Water Level Gauging

The pre-pumping tests water levels gauged on 28 November 2017 are summarised in *Table 4.1* below.

Table 4.1 Pre-Pumping Test Groundwater Levels

Monitoring Bore	Date	Groundwater Level	
		m BTOC[1]	m BGL[2]
SA1501	28 / 11 / 2017	11.54	10.72
SA1502	28 / 11 / 2017	2.32	1.53
SA1503	28 / 11 / 2017	12.15	11.43

1 = metres below top of casing

2 = metres below ground level

Baseline water level data collected with the level loggers are summarised in *Table 4.2*. This table includes water elevation data relative to the AHD. The available groundwater level elevation data indicate a groundwater flow direction towards the northwest. While monitoring bores SA1501 - SA1503 are located in a near straight line (see *Figure 4.1*), which is not ideal for tri-angulating and inferring groundwater flow direction, the inferred groundwater flow direction does align with general expectations of regional groundwater flow which would be from elevated elevations towards the Hastings River.

Table 4.2 ***Level Logger Baseline Groundwater Levels***

Monitoring Bore	Date Range	Groundwater Level					
		m BGL[1]			m AHD[2]		
		Min Depth	Max Depth	Av Depth	Min Depth	Max Depth	Av Depth
SA1501	10/2015 – 9/2017	9.69	10.67	10.52	12.81	11.83	11.98
SA1502	12/2016 – 9/2017	1.42	2.26	1.74	1.98	1.14	1.66
SA1503	12/2016 – 7/2017	0.39	12.11	9.69	32.61	20.89	23.31

1 = metres below top of casing

2 = metres Australian Height Datum (approximate values with an accuracy of ~1m).

Given that survey co-ordinates were not available for the monitoring bores, monitoring bore elevation levels were derived by plotting available GPS co-ordinates on to a high resolution 1 m contour topographic map and estimating elevation levels for the three monitoring bores. The GPS coordinates along with the estimated elevations levels are provided in *Table 4.3*.

Table 4.3 ***GPS Coordinates and Estimated Elevations for Monitoring Bores***

Monitoring Bore	Coordinates[1]		
	East	South	Elevation (m AHD)[2]
SA1501	482014	6521966	22.5
SA1502	481703	6522327	3.4
SA1503	482145	6521786	33

1 = UTM 56J

2 = metres Australian Height Datum (approximate values with an accuracy of ~1m).

4.2.2 Pumping Tests

Data Interpretation

No pumping related water level changes were seen in observations bores during the pumping tests (with observations bores being located >>100m from a pumping well). The data interpretation was therefore focussed on deriving aquifer parameter estimates from water level changes in the pumping bores only. As pumping induced water level changes in observations bores are required to estimate aquifer storativity (S) values, the data interpretation focussed on deriving transmissivity (T) estimates based on the pumping test data. Hydraulic conductivity (K) values where then also estimated from the transmissivity values while factoring in the assumed aquifer thickness (b), with K = T/b.

Data collected during the pumping tests were interpreted utilising methods incorporated in the AQTESOLV Professional (version 4.50) software application. This included curve matching performed using type-curve methods on log-log plots as well as straight-line methods on semi-log plots of water level change over time.

As noted in *Section 3.2.3* the borelogs (showing geology encountered during drilling) are presented in *Annex A*. With measured water levels in the bores being well above the depth of the water bearing zones encountered during drilling (refer to the Form A particulars in *Annex B*), indications are that the interbedded meta-sediments of the Byabbara Beds present a confined aquifer system and confined aquifer methods were therefore utilised to interpret the pumping test data as described below. While the aquifer is fractured in nature with primary porosity expected to be limited due to the metamorphic nature of the meta-sediments, the aquifer was treated as an equivalent porous medium. This approach is typically adopted as industry standard, particularly for bores with long screens interesting multiple fractures.

For the pumping phase of the tests, the confined aquifer data interpretation methods applied included the straight line Cooper and Jacob method (Cooper & Jacob, 1946) and the Theis method (Theis, 1935) as extended by Hantush (1961) to allow for partially penetrating bores.

For the recovery stage of the tests, the residual drawdown data were interpreted using the Theis method for recovery data (Theis, 1935) and the straight line Cooper and Jacob method (Cooper, & Jacob, 1946) applied to the Agarwal transformation (Agarwal, 1980).

Bore construction details were drawn from the Form A particulars associated with the completion of the drilling work as presented in *Annex B*. The aquifer thickness values used for SA1501 and SA1502 (70 m and 36 m respectively) are based on the water bearing zones presented on the *Form A* documents. Note that monitoring bore SA1501 has two separate screen lengths intersecting two zones identified as water bearing, from 20 – 50 m bgl and 70 to 110 m below ground level. These were added together when specifying the aquifer thickness and screen length for the pumping test interpretation. The hydraulic conductivity anisotropy ratio (Kz/Kr) was set as 1, assuming that the folded nature of the meta-sediments would have negated the relatively higher horizontal conductivity that is typical of planar (unfolded) sedimentary units.

Pumping Test Results

The results of the pumping test data interpretation are summarised in *Table 4.4* below. The groundwater level displacement-time graphs with associated curve matching are provided in *Annex C*.

Table 4.4 *Pumping Test Data Interpretation Results*

Monitoring Bore	Transmissivity Estimate (m²/day)#				
	Pumping Stage		Recovery Stage		Range
	Cooper Jacob[1]	Theis/Hantush[2]	Cooper Jacob[3]	Theis Recovery[4]	
SA1501	0.06*	NV	0.07	0.07	0.06 – 0.07
SA1502	0.007	0.006	0.01	0.01	0.006 – 0.01

#All values reported to one significant figure

1 Cooper and Jacob straight line method (Cooper & Jacob, 1946)

2 Theis method (Theis, 1935) as extended by Hantush (1961)

3 Cooper and Jacob method (Cooper, & Jacob, 1946) applied to the Agarwal transformation (Agarwal, 1980)

4 Theis method for recovery data (Theis, 1935)

* For SA1501 the constant discharge pumping displacement – time graph did not provide the means for reasonable type curve fitting using the Cooper Jacob method. A composite displacement – time graph did however result in a reasonable type curve fit with the second stage of pumping (6 L/sec) and the value presented here is based on that fit (refer to Annex C to view the composite displacement – time graph and associated type curve fit).

NV = No value as neither the first stage of pumping or the composite pumping displacement – time graphs provided the means for reasonable type curve fitting for the pumping test conducted at SA1501 using the Theis/Hantush method.

Higher reliance can be placed on the recovery results compared to the constant discharge pumping results, as the recovery data interpretation is not dependant on the maintenance of a constant pumping rate which is approximated in the field. Recovery data is also not influenced by bore storage affects. Nevertheless, as can be seen in *Table 4.4* the results derived from the pumping stages compared to recovery stages of the tests align relatively well for the tests.

When comparing the recovery stage derived transmissivity results at the two monitoring bores the results indicate a transmissivity value approximately a factor of seven higher for the test undertaken at SA1501 compared to the pumping test conducted at SA1502. The comparative results of the pumping tests undertaken at SA1501 and SA1502 align with the field observations, with groundwater level drawdown being significantly more rapid in SA1502 compared to SA1501 (even when pumping SA1502 at a lower rate than SA1501). Relatively speaking, groundwater level recovery following cessation of pumping in SA1502 was also significantly slower than the observed recovery in SA1501.

Based on the recovery phase derived transmissivity values of 0.07 m^2/day and 0.01 m^2/day and assumed aquifer thicknesses of 70 m and 36 m for SA1501 and SA1502 respectively, the estimated hydraulic conductivity of the screened lithology at SA1501 would be 0.001 m/day and 0.0003 m /day at SA1502. In units of m/sec this would equate to hydraulic conductivities of approximately 1×10^{-8} m/sec and 3×10^{-9} m/sec for the tests conducted at SA1501 and SA1502 respectively. These low hydraulic conductivity values align with the observations from the existing pit where groundwater seepage to the pit is

reportedly negligible with no active dewatering required according to site management.

4.2.3 Groundwater Sampling

The field parameters measured during sampling are summarised in *Table 4.5.*

Table 4.5 Water Quality Field Parameters

Monitoring Bore	Date	pH	EC (µS/cm)	TDS[1] (mg/L)	ORP (mV)	DO (mg/L)	Temperature (°C)
SA1501	29/11/2017	6.6	2513	1633	111	<0.1	20.8
SA1502	28/11/2017	6.9	4563	2966	909	<0.1	22.3
SA1503	30/11/2017	6.9	1912	1243	223	6.39	20.4
Seep	30/11/2017	7.6	2161	1405	185	6.44	28.5
Quarry Sump	30/11/2017	7.0	2694	1751	241	5.74	24.6
Holding Pond 1	30/11/2017	8.0	1659	1078	187	9.95	25.1
Holding Pond 2	30/11/2017	7.9	1289	838	200	4.32	26.8

[1] = TDS estimated from EC field measurements through following equation:
EC (µS/cm) X 0.65 = TDS (mg/L).

The pH values for all water samples were circum-neutral, ranging between 6.6 and 8.0. EC measurements ranged between 1 289 to 4 563 µS/cm, with TDS concentrations estimated from EC measurements ranging between 838 to 2,966 mg/L. Indications are that groundwater sampled from SA1501 – SA1503, the seep location and water sampled from the quarry sump was brackish with the water samples from the holding ponds being less saline in comparison. DO measurements indicate that, with the exception of the grab sample taken from SA1503, groundwater in the Byabbara Beds is anoxic. In comparison the measurements indicate that surface expressions of water are well oxygenated.

The laboratory results for major ions, alkalinity and TDS are provided in *Table 4.6* and the trace metal results are provided in *Table 4.7*. Given the registered use for domestic supply and stock watering of identified groundwater bores (see *Section 3.3.1*) the results were compared to the Australian drinking water guidelines (NHMRC NRMMC, 2011) and livestock drinking water quality criteria (ANZECC/ARMCANZ, 2000).

Table 4.6 Reported Major Ions (in mg/L) for Samples taken on 30 November 2017

AC[1] / Sample ID[2]	Ca	Mg	Na	K	Cl	Alk	SO_4^{2-}	NO_3^-	TDS
DC[3]	NV[5]	NV	180*	NV	250*	NV	NV	50	600/1200*
LC[4]	1 000	NV[5]	NV	NV	NV	NV	1 000	400	V[6]
SA1501	132	57	299	6	673	299	142	<0.05	1690
SA1502	267	136	475	4	1250	311	1	<0.05	3520
SA1503	18	3	20	2	15	70	52	<0.05	133
SEEP	176	97	176	9	111	165	816	0.09	1550
Quarry Sump	235	117	225	7	148	255	1140	17.2	1980
Holding Pond 1	129	78	116	6	60	104	588	17.1	1150
Holding Pond 2	106	59	83	6	41	143	447	<0.05	888

1 = Assessment Criteria

2 = Sample Identification`

3 = Drinking Water Criteria - Human Health and/or Aesthetic* Criteria (NHMRC NRMMC, 2011). For TDS, 600 mg/L presents the good palpability threshold and 1 200 mg/L the unacceptable threshold

4 = Livestock Drinking Water Quality Criteria (ANZECC/ARMCANZ, 2000)

5 = No Value

6 = Variable as TDS dependant on livestock type: No adverse effects for beef cattle, (0 – 4 000 mg/L), dairy cattle (0 – 2 500 mg/L), sheep (0 – 5 000 mg/L), horses (0 – 4 000 mg/L), pigs (0 – 4 000 mg/L) and poultry (0 – 2 000 mg/L)

With the exception of the reported results for groundwater sampled from SA1503, laboratory results for TDS align relatively strongly with TDS concentrations estimated from EC measurements taken during sampling. As noted in Section *4.1.3*, the sample from SA1503 was effectively a grab sample due to the casing blockage not allowing the pump to be lowered to the water column within the bore casing. Of the samples taken from the monitoring bores, the samples taken from SA1501 and SA1502 are therefore seen as being most representative of groundwater conditions.

Of the major ions, reported sodium and chloride concentrations exceeded aesthetic drinking water criteria in water sampled from SA1501 and SA1502. TDS concentrations exceeded the good palpability threshold of 600 mg/L in all samples, while the unacceptable threshold of 1 200 mg/L threshold was exceeded in all samples except SA1503 (noted as an anomaly when considering the field EC measurement) and the surface water samples taken from Holding Pond 1 and Holding Pond 2. For the livestock drinking water criteria, exceedances are limited to criteria for poultry and dairy cattle when considering TDS concentrations for SA1502.

Table 4.7 ***Reported Trace Metal Concentrations (in mg/L) for Samples taken on 30 November 2017***

AC[1] / Sample ID[2]	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
DC[3]	0.01	0.002	0.05	2	0.01	0.001	0.02	NV[5]
LC[4]	0.5	0.01	1	NV	0.1	0.002	1	20
SA1501	0.003	<0.0001	<0.001	<0.001	<0.001	<0.0001	<0.001	<0.005
SA1502	0.001	<0.0001	<0.001	<0.001	<0.001	<0.0001	0.001	<0.005
SA1503	<0.001	<0.0001	0.001	0.003	<0.001	<0.0001	0.008	0.061
SEEP	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.0001	<0.001	0.007
Quarry Sump	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.0001	0.002	<0.005
Holding Pond 1	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.0001	<0.001	<0.005
Holding Pond 2	0.001	<0.0001	<0.001	<0.001	<0.001	<0.0001	<0.001	<0.005

1 = Assessment Criteria

2 = Sample Identification

3 = Drinking Water Criteria - Human Health Criteria (NHMRC NRMMC, 2011)

4 = Livestock Drinking Water Quality Criteria (ANZECC/ARMCANZ, 2000)

5 = No Value

For trace metal analysis, the majority of results were below the laboratory limit of reporting (LoR). Where detected above the LoR, reported concentrations were well below the assessment criteria for groundwater and surface water samples.

5 GROUNDWATER FLOW MODELLING

5.1 APPROACH

Groundwater flow modelling was undertaken to address the impact assessment requirements of the NSW Aquifer Interference Policy. This included:

- Estimating water take through groundwater inflows to the pit; and
- Predicting groundwater level drawdown associated with pit development at groundwater user locations (both registered groundwater bores and the closest identified groundwater dependent ecosystem).

While the Project will include the expansion of the existing pit in multiple stages, the modelling was undertaken for a steady state scenario taking into consideration the full extent of the final planned pit void (at which stage steady state groundwater flow to the pit will be greatest and potential groundwater level drawdown proximal to the quarry will be greatest).

The conceptual hydrogeological model on which the numerical groundwater flow model is based is outlined in *Section 5.2*, while the methodology and results of the numerical model are presented in *Section 5.3.*

5.2 CONCEPTUAL HYDROGEOLOGICAL MODEL

5.2.1 Aquifer Framework

The bedrock aquifer comprising the meta-sediments of the Byabbara Beds underlying the Study Area is considered to be fractured in nature, with groundwater storage and flow controlled by secondary porosity. To the north and west of the Study Area, a Quaternary alluvial aquifer overlies the Byabbara Beds. Water storage and flow in the unconsolidated aquifer is governed by the primary porosity of the sediments. Regionally the Quaternary alluvial sediments consist of sand, silt, mud and gravel (Brunker et al., 1970) and the most productive sections of the aquifer will consist of the courser grained sediments including sand and gravel.

5.2.2 Hydraulic Properties

Pumping tests undertaken as part of the groundwater assessment indicates that transmissivity values for the meta-sediments comprising the bedrock aquifer range between 0.01 m^2/day and 0.07 m^2/day (based on the recovery phase of the tests which are considered to present the most reliable data).

When factoring in the assumed aquifer thicknesses of 70 m and 36 m at monitoring bores SA1501 and SA1502 respectively, the estimated hydraulic conductivity ranges between be 0.001 m/day at SA1501 and 0.0003 m /day at SA1502. In units of m/sec, this would equate to hydraulic conductivities of approximately 1 X 10^{-8} m/sec and 3 X 10^{-9} m/sec for the tests conducted at SA1501 and SA1502 respectively.

No aquifer parameter testing has been undertaken for the alluvial sediments located to the north and west of the Study Area. As these sediments fall within the modelling domain, hydraulic properties were sourced from literature sources. These values can vary by severed orders of magnitude; for instance, Freeze and Cherry (1979) cites a hydraulic conductivity range of 10^{-7} m/sec to 10^{-3} m/sec for silty sand and Domenico and Schwartz (1990) references a range of 2 X 10^{-7} m/sec to 2 X 10^{-4} m/sec for fine sand. As the more permeable sand and gravel layers within the sediments are likely to control groundwater flow, a high-end hydraulic conductivity value (8 m/day, or ~ 9 X 10^{-5} m/sec) relative to the aforementioned literature values was used for the modelling.

5.2.3 Groundwater Flow Direction

The groundwater monitoring bore network from which to infer groundwater flow directions are limited to SA1501 through to SA1503 and available groundwater level elevation data indicate a groundwater flow direction towards the northwest. While monitoring bores SA1501 – SA1502 are located in a near straight line (see *Figure 4.1*), which is not ideal for tri-angulating and inferring groundwater flow direction, the inferred groundwater flow direction does align with general expectations of regional groundwater flow which would be from elevated elevations towards the Hastings River.

5.2.4 Influence of Structural Features

As noted in *Section 0*, the existing quarry pit has a fault line trending south west to northeast, and the available borelogs suggest that there are fault zones at depth as indicated by intervals of breccia identified in the rock core (Hanson, 2016).

Depending on the nature of the fault zones, these structural features could act as groundwater flow conduits (e.g. if faulting has significantly increased secondary porosity) or as groundwater flow barriers (e.g. if fractures are closed or infilled by low permeability material). With no specific hydraulic testing data available for the fault zones, the modelling assumes that the structural features do not significantly affect the groundwater flow field in the model.

5.2.5 *Aquifer Interconnectivity*

Available aquifer characterisation data are restricted to the meta-sediments comprising the Byabbara Beds. While a level of interconnectivity between the Byabbara Beds and adjoining Quaternary alluvial sediments would be expected, the degree of connectivity is unknown. For the purpose of the modelling the Byabbara Beds and alluvial sediments are considered to be hydraulically connected.

Given the nature of the unconsolidated sediments comprising the Quaternary alluvial sediments and the direct association of these sediments with the surface water features adjacent to the Study Area, the degree of groundwater-surface water connectivity between these sediments and the surface water features would be expected to be high.

5.2.6 *Groundwater Chemistry*

The water quality sampling results indicate that the geology intersected by the quarry and targeted during quarry expansion (based on sampling results from SA1501 – SA1503) is largely inert, with no acidity impact identified at the existing quarry operations and no exceedances of trace metals in any of the samples identified.

Potential water quality impacts are considered to be associated primarily with salinity, with the groundwater sampling indicating that groundwater within the Byabbara Beds is brackish. As the groundwater flow model focusses on physical processes, the potential water quality related impacts associated with encountering brackish groundwater during quarry pit expansion is considered further in *Section 6.1.3.*

5.2.7 *Groundwater Users*

The identified groundwater users are summarised in *Section* 3.23.3. These include groundwater bores registered for stock watering and domestic use. A total of 13 groundwater bores were identified within a 2 km radius from the perimeter of the final pit, with one of these located within a 1 km radius of the final pit. The closest registered bore, GW303749 (registered for stock water and domestic use), is located approximately 600 m to the south of the perimeter of the final pit.

From a GDE perspective, several areas of Paperbark ecosystems were identified with the closest located approximately 500 m to the west of the perimeter of the final pit (and adjacent to Haydon's Creek). No high priority GDEs (as specified in the *Draft Water Sharing Plan for the Hastings Unregulated and Alluvial Water Sources 2016*) were identified within a 2km radius of the perimeter of the final pit. Note that groundwater dependent culturally significant sites were under investigation at the time of the development of the draft WSP and the locations of any such sites had not been identified.

5.3 GROUNDWATER MODELLING

5.3.1 Approach and Objectives

A numerical groundwater flow model (Model) was created to simulate the current hydrogeologic conditions and at final quarry expansion. The modelling activities were based on the conceptual model as presented above.

The objectives of the Model were to:

- Create a calibrated 3-Dimensional numerical groundwater flow model to existing static water levels at monitoring bores SA1501, SA1502 and SA1503.
- Simulate the final quarry expansion to -40 m AHD.
- Predict the seepage rate into the pit at steady state conditions associated with the final pit extent.
- Predict the water level drawdown at identified groundwater users including the closest identified GDE associated with the final pit extent (when groundwater drawdown proximal to the quarry would be at its greatest).

5.3.2 Code Selection

MODFLOW-NWT (Niswonger et. al., 2011), a Newton formulation of MODFLOW-2005 (Harbaugh, 2005) was selected to simulate groundwater flow at the Site. MODFLOW-NWT linearization approach uses a continuous function of groundwater head to solve the system of non-linear equations representing an unconfined aquifer with the Upstream-Weighting (UPW) Package rather than the drying and rewetting discrete method used in other packages provided in MODFLOW-2005.

MODFLOW-NWT does not set dewatered cells as no-flow, or inactive, so rewetting variables are not necessary. The UPW Package maintains a smooth and continuous function by using the upstream head to calculate the flow between cells so that flow from a dewatered cell is not possible and creating inactive cells is not necessary. This code was selected because of the drain cells will dry the overlaying two layers.

The USGS MODFLOW code and associated packages have been widely used and accepted for simulated groundwater flow. Documentation can be found at https://water.usgs.gov/ogw/modflow/.

The Graphical User Interface (GUI) Visual MODFLOW Classic (Waterloo Hydrogeologic version 4.6, 2015) was used for model construction, calibration and output interpretation.

5.3.3 *Model Domain and Grid*

The model domain is 4400 m x 4400 m and encompasses 19.36 km^2. The model domain is aligned with the primary groundwater flow direction across the Site towards the Hastings River. The grid is constructed of 4 layers, 220 rows, and 220 columns, evenly spaced resulting in 20 m square cells. Land surface elevations are from a detailed digital elevation map (DEM) with 2 m resolution. Layer 1 was set to a constant 10 m thickness to represent quaternary alluvium and weathered meta-sediments. Layers 2 and 3 are a combined 100 m to represent the fractured meta-sediments, the full depth of the monitoring bores. Layer 4 is a constant 20 m thickness to allow for interaction of deeper meta-sediments if simulated pumping of the monitoring bores is required.

5.3.4 *Boundary Conditions*

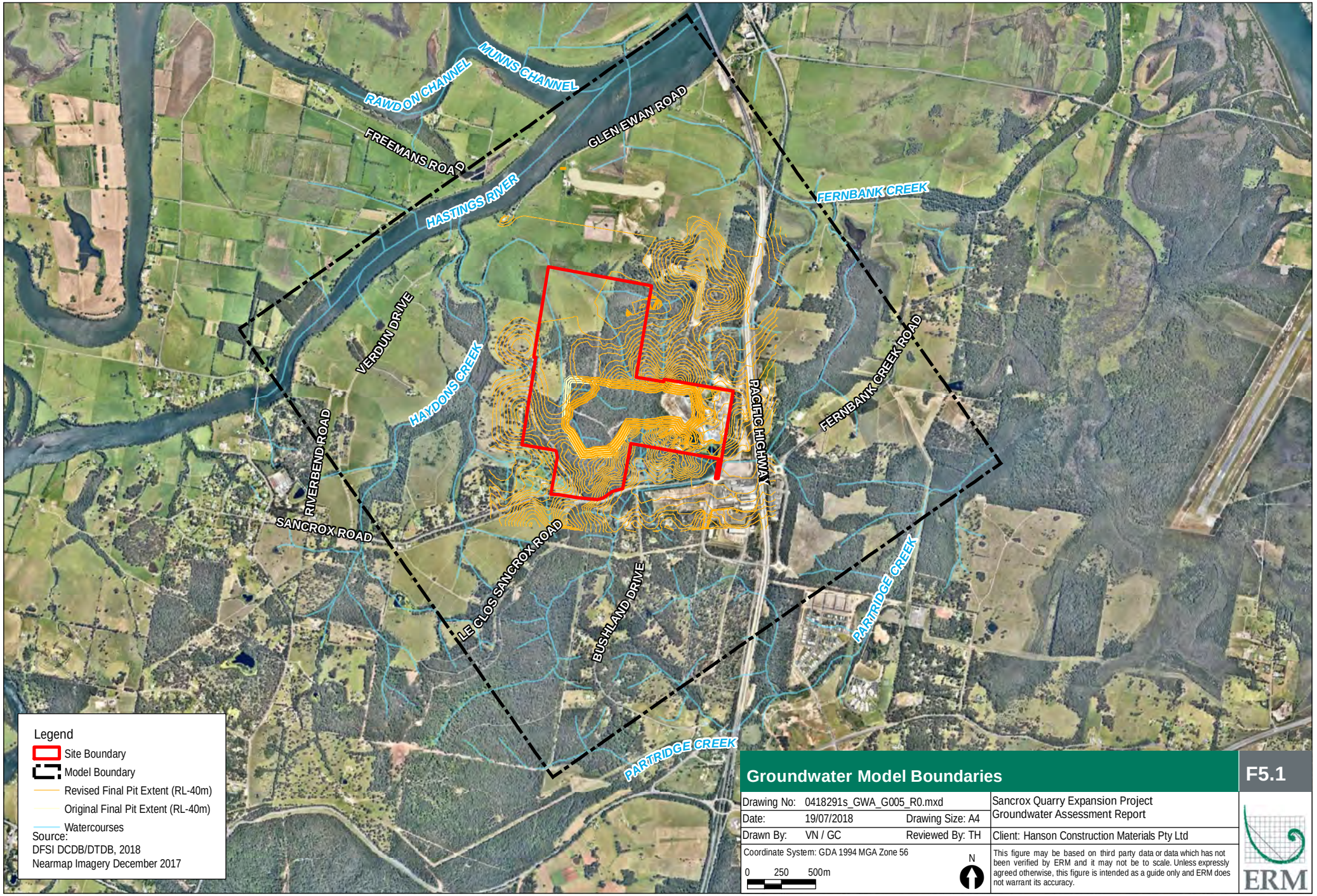
Boundary conditions are an essential component of a groundwater flow model and represent the external hydrology outside the model domain. The boundary conditions establish the external geometry for the model domain and control the inflow and outflow of the model. The solution to the groundwater flow equation, the head at a given point in space and time, must satisfy the equation and the boundary conditions (Franke et al. 1987).

The boundary conditions used for the Model are: no-flow, constant head, drain, and constant flux (recharge) boundaries. The locations of the boundaries can be seen in the *Figure 5.1*. No-flow boundaries are set as the bottom of the layer 4 and the northwest, southwest, and southeast boarders. A constant head boundary (CHB) is set in layer 1 as the domain outflow on the northwest boundary of the model domain to represent discharge to the Hastings River and the southwest corner to represent discharge to quaternary materials. Inactive cells are used to the northwest of this boundary. The drain boundary condition was used to represent the quarry expansion to -40 m AHD. Details of these boundaries are provided below.

The Model was calibrated and run as a steady state simulation, assuming that water table condition variations during the year do not affect the long-term average gradients.

5.3.5 *Model Inflow*

The groundwater inflow into the model is represented with aerial recharge over the terrestrial domain. It is common to use a recharge rate of approximately 5-10% of the mean annual precipitation. However, the model is very sensitive to the recharge rate and, due to the low permeability of the meta-sedimentary units, a lower recharge rates was used. Recharge rates of 2.7 and 40 mm/year were determined during model calibration over the meta-sedimentary and quaternary alluvial units respectively.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VERDUN DRIVE
HAYDONS CREEK
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FERNBANK CREEK ROAD
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PARTRIDGE CREEK
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Legend
Site Boundary
Model Boundary
Revised Final Pit Extent (RL-40m)
Original Final Pit Extent (RL-40m)
Watercourses
Source:
DFSI DCDB/DTDB, 2018
Nearmap Imagery December 2017
Groundwater Model Boundaries
F5.1
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Date: 19/07/2018
Drawing Size: A4
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5.3.6 *Model Outflow*

In the conceptual model, groundwater flow leaves the model domain through discharges to the Hastings River (eventually discharging to the ocean). Numerically, flows out of the model are represented with constant head cells and drain cells. A constant head cell is used where the head at the corresponding cell is known and does not change as a result of the flow solution (Harbaugh, 2005). As much water as required may enter or leave the domain through this cell to maintain this specified head. The constant head boundaries are set in layer 1 to represent groundwater discharge to the Hastings River and the quaternary alluvium in the southwest corner of the model.

The drain boundary removes water from the aquifer above a specified elevation. The flow to the drain is calculated as the difference between the head in the aquifer and the drain elevation multiplied by a drain conductance used to limit the flow to the drain (Harbaugh, 2005). A drain boundary in layer 3 was used to represent the full expansion extent of the bottom of the quarry pit to by setting the drain elevation to -40 m ADH. The drain conductance was set to 40,000 m^2/day (conductance per unit area of 100 day^{-1} times the area of the cell bottom), which allows for water to be readily removed and accounted for in the mass balance.

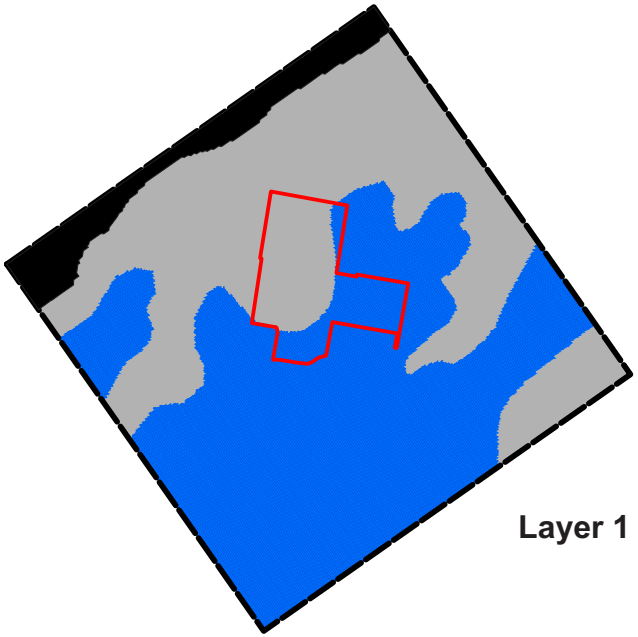
5.3.7 *Model Properties*

The Model hydraulic conductivities were originally determined from the aquifer tests conducted at SA1501 and SA1502 and then adjusted during Model calibration. The hydraulic conductivity geometric mean calculated from aquifer test data is 0.00053 m/day for fractured meta-sedimentary units. The geologic report prepared by Hanson (2015) shows an increased amount of shale present to the south of a fault trending northwest. Although no borings were hydraulically tested south of the fault, the material was represented in the Model as having lower hydraulic conductivity to reflect this conceptualisation.

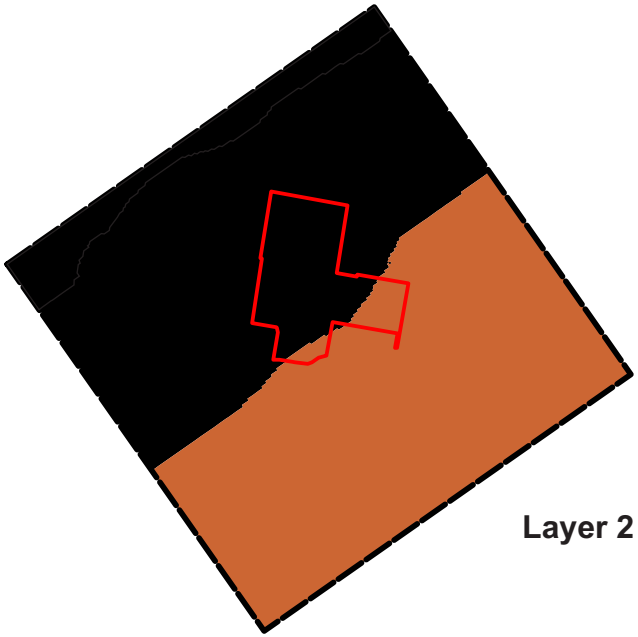
Aquifer storage and porosity are not used in steady state groundwater flow simulations. The base case Model hydraulic conductivities are presented in *Table 5.1* and in *Figure 5.2*.

Table 5.1 Base Case Model Hydraulic Conductivity

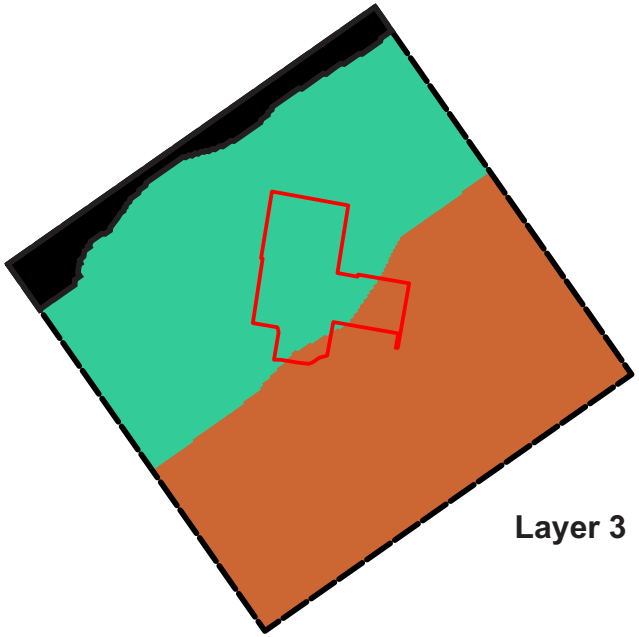
Kx (m/day)	Layer	Hydrostratigraphic Unit
8	1	Quaternary Alluvium
0.012	1	Weathered Meta-Sedimentary
0.00085	2	Meta-Sedimentary (upper)
0.00049	3	Meta Sedimentary (lower)
0.0002	2&3	Meta Sedimentary (increased shale)
0.001	4	Meta Sedimentary (deep)



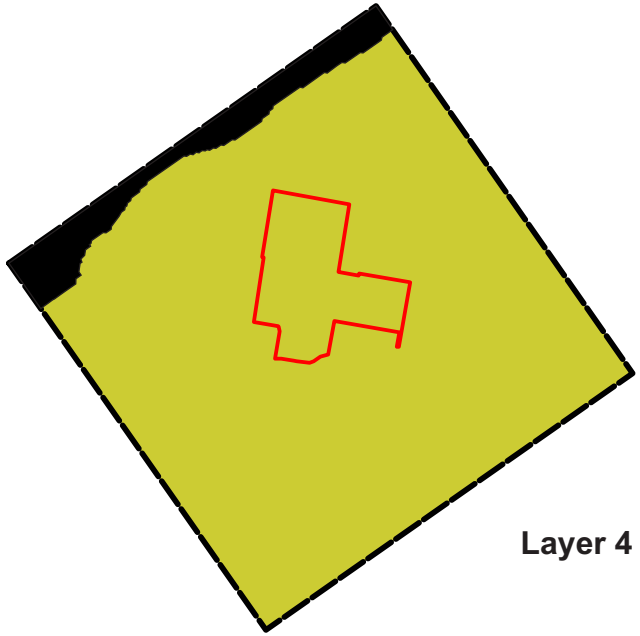
Layer 1



Layer 2



Layer 3



Layer 4

Conductivity				
Zone		Kx [m/d]	Ky [m/d]	Kz [m/d]
	1	8	8	4
	2	0.028	0.028	0.028
	3	0.00049	0.00049	0.00049
	4	0.001	0.001	0.001
	5	0.0002	0.0002	0.0002
	6	0.00085	0.00085	0.00085

Legend

Site Boundary

Model Boundary

Model Hydraulic Conductivities for Base Case

F5.2

Drawing No:	0418291s_GWA_C001_R1.cdr		**Sancrox Quarry Expansion Project Groundwater Assessment Report**
Date:	19/07/2018	Drawing size: A4	
Drawn by:	GC	Reviewed by: WG	Client: Hanson Construction Materials Pty Ltd

Drawing Not to Scale

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Model properties were implemented in the model using regional property zones that pertain to the hydrostratigraphic units as presented in lithologic bore logs and the available regional geological map (Brunker et al., 1970). Within these zones, properties are kept the same (i.e. piecewise constant zonation). Location and values for these zones were modified during model calibration.

5.3.8 Model Calibration

Model calibration is the process of adjusting model boundaries and properties within reason to produce a satisfactory match of the model simulation to field observation data (Anderson, 2015). In a steady state model, a satisfactory match is met when summary statistics quantitatively expressing the goodness of fit between the measured water level elevations and the modelled potentiometric surface are minimized. When plotting measured water level elevations against simulated water levels a perfect fit would represent a straight line with a slope of one.

The Model was calibrated to static groundwater elevation data collected prior to the start of the pumping tests conducted on 28 November 2017. Model parameters were adjusted by hand to increase the goodness of fit until a reasonable model was constructed. Results of the model calibration indicate a good match between calculated and observed groundwater elevations at the existing site monitoring wells. Model basic statistical measures are within the typically industry accepted parameters, including a low mean residual error, and a normalized root mean squared (NRMS) error of 3.28% (the target NRMS is 10% or less for most sites). The Model summary statistics are presented in *Figure 5.3*.

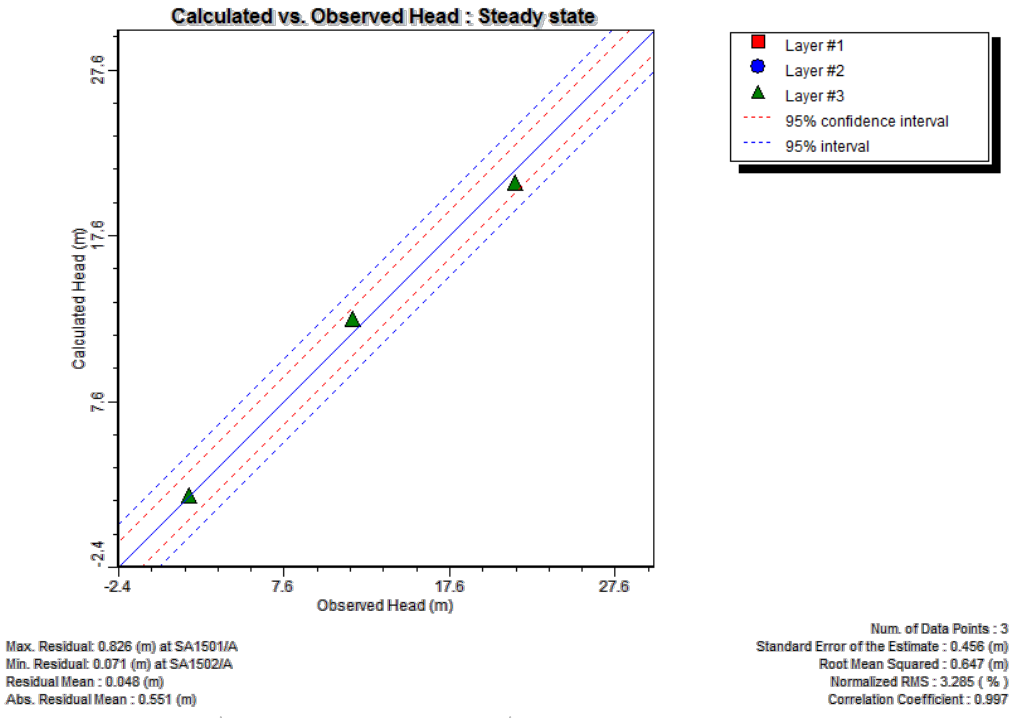


Figure 5.3 Calculated versus Observed Head

5.3.9 *Flow Model Results*

Simulated groundwater equipotentials for the fractured rock aquifer are presented in *Figure 5.4*. The results of the calibrated flow model provide a reasonable fit to measured water level elevations. The Model was calibrated based on groundwater elevations at three monitoring bores which are situated in a line. This prevents the three-point estimation method for determining a precise groundwater flow direction and calculation of groundwater gradient. However, conceptually speaking, it is reasonable for local groundwater flow in the near surface fractured rock aquifer to discharge to the Hastings River.

As described in *Section 1.1*, the groundwater modelling was completed prior to the change in pit design with the revised final pit extent covering a smaller area than the original final pit design that the modelling outcomes are based on. The results, in terms of inflow predictions and extent of groundwater drawdown proximal to the pit, should therefore be seen as being conservative.

5.3.10 *Quarry Expansion Simulation Results*

The simulated steady state drawdown created by the addition of the pit is presented in *Figure 5.5.* Due to the low permeability of the meta-sedimentary unit, the drawdown gradient is steep and does not extend significantly away from the pit. The higher permeability materials associated with the quaternary alluvium do not have significant water level changes because water in these units are sourced primarily from local recharge and runoff (i.e. streams). According to the Model, on average approximately 40 m^3/day of groundwater will seep into the final pit expansion. This does not include surface water run-off into the pit.

The simulated predicted drawdown at identified groundwater users and the closest sensitive ecosystem is presented in the *Table 5.2* below.

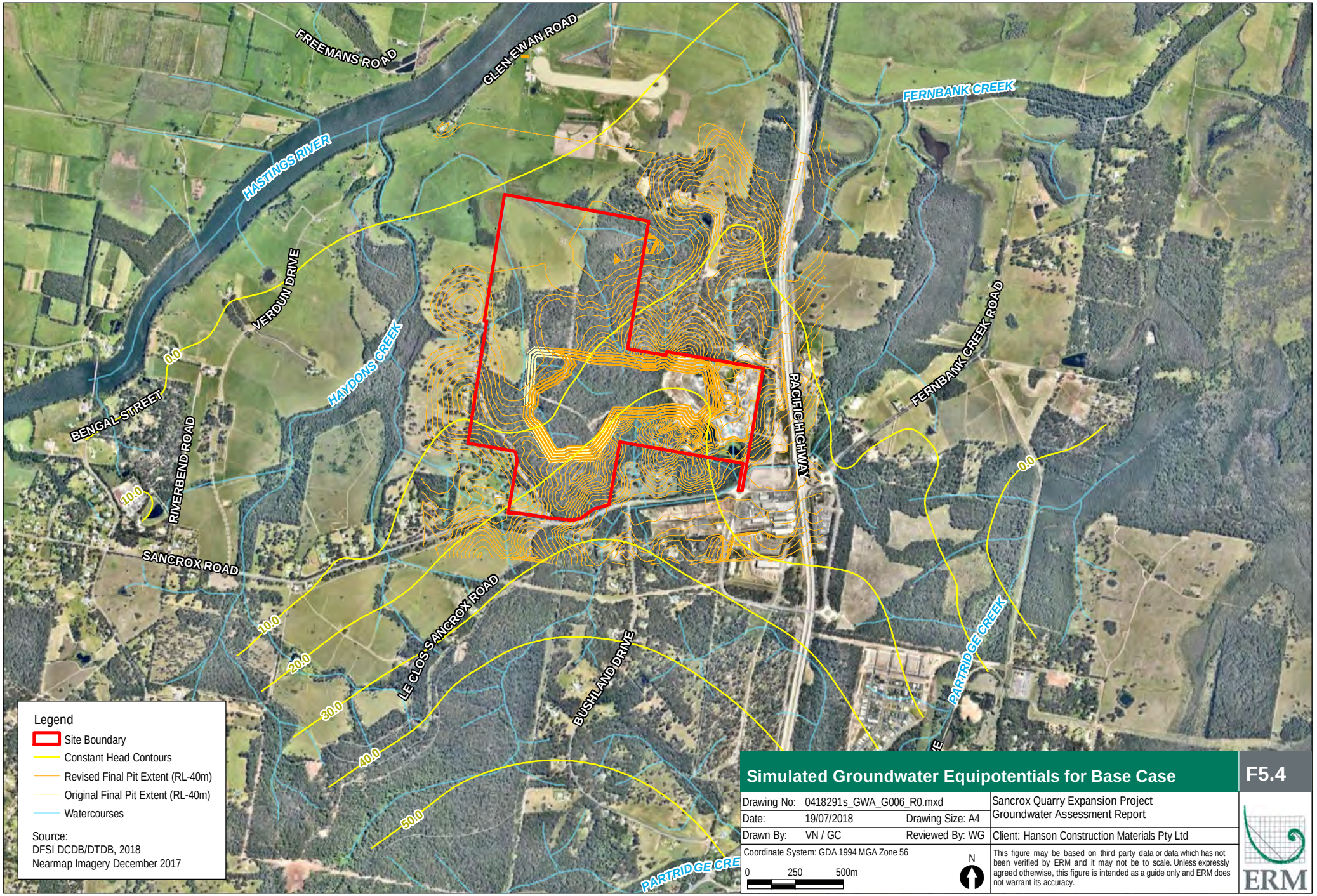
Table 5.2 Simulated Water Levels at identified Groundwater Users and the closest GDE

Bore ID	Simulated Current Water Level Elevation (m)	Simulated Pit Expansion Water Level Elevation (m)	Simulated Drawdown Impact from Pit Expansion (m)
GW060512	1.04	0.96	0.08
GW060513	-0.71	-0.77	0.06
GW300120	-0.113	-0.114	0.001
GW301263	-0.68	-0.73	0.05
GW302376	-1.38	-1.43	0.05
GW303436	49.59	48.98	0.62
GW303749	34.04	31.14	2.90
GW306269	44.35	43.42	0.93
GDE	1.56	1.38	0.18

5.3.11 Sensitivity Analysis

A limited sensitivity analysis was run to determine the effects of parameter uncertainty on model predictions. The most important parameters in this model that control pit inflows or modify the predicted drawdown extents are the recharge rate and hydraulic conductivities of the meta-sedimentary unit.

The model was run to simulate higher hydraulic conductivities in the meta-sedimentary unit reflecting the maximum hydraulic conductivity calculated from the pumping test presented in *Table 5.3*.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GLEN EWAN ROAD
FERNBANK CREEK
HASTINGS RIVER
VERDUN DRIVE
HAYDONS CREEK
BENGAL STREET
RIVERBEND ROAD
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PARTRIDGE CREEK
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Legend
Site Boundary
Constant Head Contours
Revised Final Pit Extent (RL-40m)
Original Final Pit Extent (RL-40m)
Watercourses
Source:
DFSI DCDB/DTDB, 2018
Nearmap Imagery December 2017
Simulated Groundwater Equipotentials for Base Case
F5.4
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Drawing Size: A4
Drawn By: VN / GC
Reviewed By: WG
Coordinate System: GDA 1994 MGA Zone 56
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Sancrox Quarry Expansion Project
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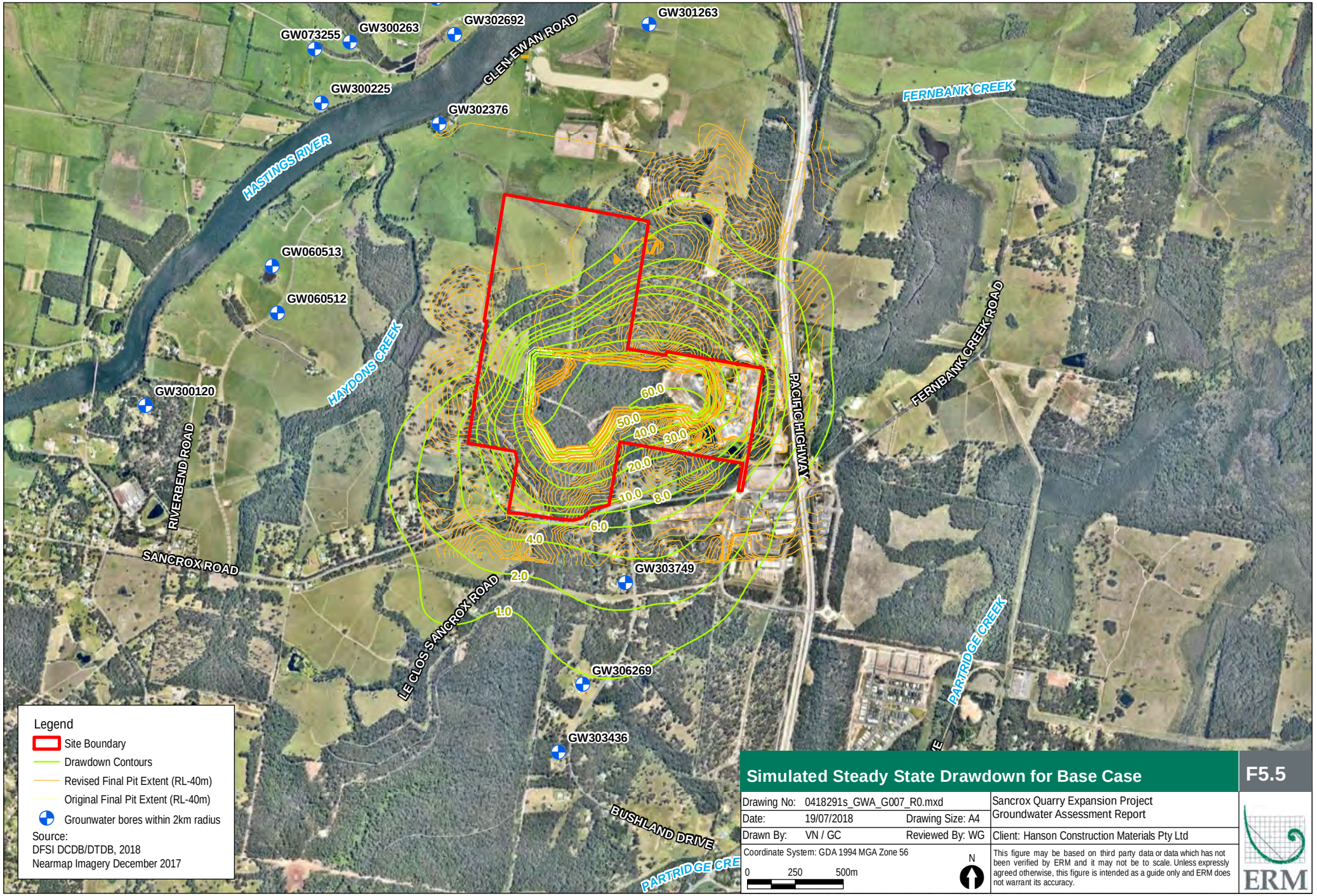
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GW300263
GW302692
GW301263
GW300225
GW302376
GW060513
GW060512
GW300120
GW303749
GW306269
GW303436
GLEN EWAN ROAD
HASTINGS RIVER
FERNBANK CREEK
HAYDONS CREEK
RIVERBEND ROAD
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LE CLOS SANCROX ROAD
PACIFIC HIGHWAY
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1.0
Legend
Site Boundary
Drawdown Contours
Revised Final Pit Extent (RL-40m)
Original Final Pit Extent (RL-40m)
Grounwater bores within 2km radius
Source:
DFSI DCDB/DTDB, 2018
Nearmap Imagery December 2017
Simulated Steady State Drawdown for Base Case
F5.5
Drawing No: 0418291s_GWA_G007_R0.mxd
Date: 19/07/2018
Drawing Size: A4
Drawn By: VN / GC
Reviewed By: WG
Coordinate System: GDA 1994 MGA Zone 56
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Table 5.3 ***Model Hydraulic Conductivity***

Kx (m/day)	Layer	Hydrostratigraphic Unit
8	1	Quaternary Alluvium
0.01	1	Weathered Meta-Sedimentary
0.0014	2	Meta-Sedimentary (upper)
0.001	3	Meta-Sedimentary (lower)
0.0005	2&3	Meta-Sedimentary (increased shale)
0.001	4	Meta-Sedimentary (deep)

The Model was expanded 1,000 m to the southwest and southeast because the increased drawdown of the sensitivity run was impacted by the no flow boundary at the model domain. The recharge rate was maintained the same as the base model and the resulting NRMS error was 3.61%. The change in hydraulic conductivity did not significantly decrease model fit.

The drawdown contours from this sensitivity run are shown in *Figure 5.6*. The drawdown from this simulation expands to the south where quaternary alluvium is not present. According to the sensitivity run, on average approximately 60 m^3/day of groundwater will seep into the final pit expansion.

The simulated predicted drawdown for the sensitivity run at identified groundwater users and the closest sensitive ecosystem is presented in the *Table 5.4* below.

Table 5.4 ***Comparison of Simulated Drawdown from Pit Expansion***

Bore ID	Drawdown from base model (m)	Drawdown from sensitivity model (m)
GW060512	0.08	0.11
GW060513	0.06	0.09
GW300120	0.001	0.001
GW301263	0.05	0.08
GW302376	0.05	0.08
GW303436	0.62	1.52
GW303749	2.90	7.23
GW306269	0.93	2.65
Ecosystem	0.18	0.25

5.3.12 Modelling Limitations and Assumptions

The limitations to the Model are provided below:

- The measured hydraulic conductivities were extrapolated throughout the model domain with the assumption that there are no structural or other geological features present with hydraulic characteristics significantly different to the pumping test results.

- Hydraulic conductivity of weathered rock and quarrying impacted rock and its effect on recharge rates are unknown.

- The rate of recharge was determined during model calibration and has significant uncertainty.

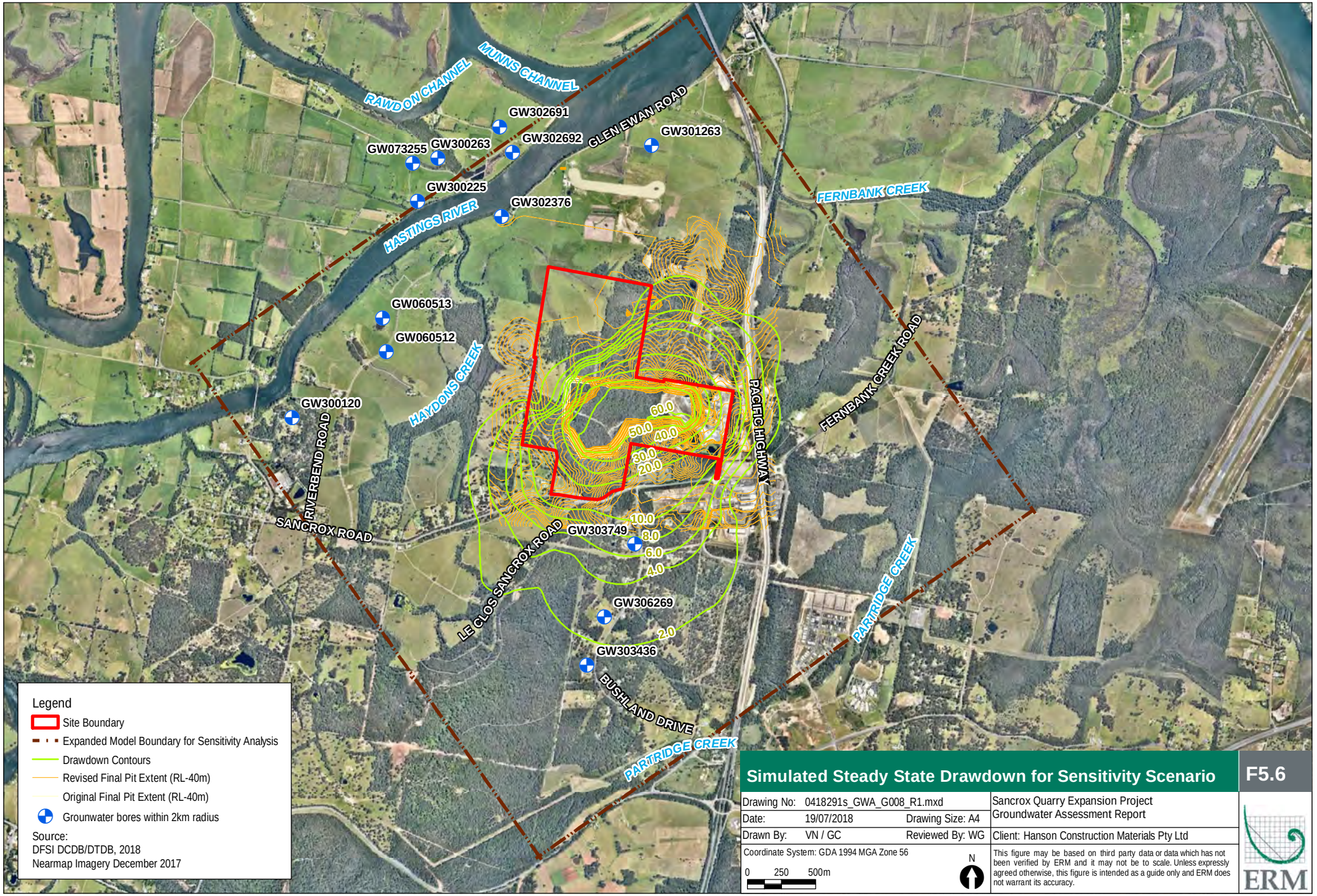
- A topographic high occurs in the southern portion of the domain which may present a groundwater flow divide creating flow to the southwest as well as towards the Hastings River. There is no groundwater elevation information in this portion of the model to establish model outflows boundaries. This may result in overly elevated heads in the southwest portion of the Model.

- This model does not include a transient analysis (groundwater level and flow estimates varying over time). Therefore, the model-calculated pit inflows are stabilized, long-term values that do not include groundwater in storage effects. These storage effects, although temporary, could increase the current estimates significantly within the initial stages of the quarry expansion where large amounts may be released from aquifer storage.

- Similarly, the drawdown estimates are long-term, stabilized estimates that represent the largest cone to be formed by the quarry dewatering. In reality, the cone of depression will expand gradually over time.

- Pit inflow estimates are based on groundwater seepage only, and do not include directly precipitated waters or surface water runoff into pit, with direct precipitation through rainfall likely being the major component of pit dewatering requirements.

- The current model is not sufficiently detailed to identify pit wall-groundwater issues, and does not include additional estimates for pit slope pore pressure reduction. Should such systems (e.g. horizontal pit wall wells) be required, groundwater flows would be higher than current estimates. A more detailed analysis including transient flows and more detailed pit geometry configuration would be required to assess such issues.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GW302692
GW300225
GW302376
HASTINGS RIVER
FERNBANK CREEK
GW060513
GW060512
HAYDONS CREEK
GW300120
RIVERBEND ROAD
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
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GW303749
LE CLOS SANCROX ROAD
GW306269
GW303436
BUSHLAND DRIVE
PARTRIDGE CREEK
PARTRIDGE CREEK
Legend
Site Boundary
Expanded Model Boundary for Sensitivity Analysis
Drawdown Contours
Revised Final Pit Extent (RL-40m)
Original Final Pit Extent (RL-40m)
Grounwater bores within 2km radius
Source:
DFSI DCDB/DTDB, 2018
Nearmap Imagery December 2017
Simulated Steady State Drawdown for Sensitivity Scenario
F5.6
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Date: 19/07/2018
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6 ASSESSMENT OUTCOMES AND MONITORING RECOMMENDATIONS

6.1 ASSESSMENT OUTCOMES

6.1.1 Estimated Water Take and Licencing Considerations

The groundwater flow modelling indicates a steady state groundwater inflow rate of approximately 40 to 60 m^3/day to the final pit void, which equates to approximately 15 to 22 ML/year. The predicted steady state inflows are modest for a pit void of the proposed size, and the relatively low predicted inflow rates align with observations from the existing quarry where no active dewatering takes place and groundwater seepage into the pit is reportedly negligible.

The NSW Aquifer Interference Policy specifies that all water taken during an activity must be accounted for, and that a water licence is required irrespective of whether the water is taken for consumptive use or whether water is taken incidentally in the course of undertaking the activity. In line with the WMA, aquifer interference activities taking water outside of water sharing plan areas require a license under the *Water Act 1912*. Depending on specifics of licences currently held by Hanson (WAL42524), a new licence may need to be applied for.

6.1.2 Water Levels / Potentiometric Levels

Taking into consideration the impact assessment requirements of the NSW Aquifer Interference Policy, the predicted 2 m level drawdown contour for the stabilised cone of depression is of particular significance (as the minimal impact considerations specify a maximum of a 2 m decline at any water supply network). The modelling indicates that at its furthest extent (from the outer perimeter of the final pit) the 2 m drawdown contour may

extend to approximately 800 to 1,100 m from the final pit (based on the base case and sensitivity run scenarios respectively).

When considering the locations of the identified groundwater bores, 1 of the 13 bores fall within the footprint of the > 2 m drawdown contour for the base case scenario (GW303749, see *Figure 5.5*), and 2 of the 13 bores for the sensitivity run scenario (GW303749 and GW306269, see *Figure 5.6*). The modelling outputs indicate that the magnitude of drawdown may vary between approximately 3 m and 7 m at GW303749, and 1 m to 3 m at GW306269 (see *Table 5.2* and *Table 5.4*). The likely impacts of this potential drawdown would depend on the:

- pump installation specifics at each bore (specifically pump depth in relation to the pre-quarry water level and total bore depth);
- intensity of use of the bore (the rates the bore is pumped at and how frequently water is drawn from the bore); and
- remaining water column within the bore following potential drawdown.

Potential impacts may vary from negligible (if drawdown does not affect the operation and use of the bore) to significant if water level drawdown is such that it affects the useability of the bore. Mitigation measures would vary (as deemed necessary) from lowering the bore pump in the bore casing, drilling a deeper bore, or providing an alternative water source as part of "make good" arrangements.

The predicted drawdown at the GDE located closest to the Project is considered negligible.

6.1.3 Water Quality

The water quality sampling results indicate that the geology intersected by the quarry and targeted during quarry expansion (based on sampling results from SA1501 – SA1503) is largely inert, with no acidity impact identified at the existing quarry operations and no exceedances of trace metals in any of the samples identified.

Potential water quality impacts are considered to be associated primarily with salinity, with the groundwater sampling indicating that groundwater within the Byabbara Beds is brackish. If off-site discharge of groundwater seepage to the pit was required, this would potentially impact on beneficial use categories off site (i.e. if the water was disposed to offsite surface water features).

To get a sense for potential impact on water quality a simplified mass balance approach was applied, recognising that groundwater would not be the only source of water (and solutes) to the pit. With dissolved solute mass flux to the pit mainly attributed to groundwater inflow and precipitation, the mass balance can be specified in terms of Equation 1:

$$Ct \text{ X } Vt = (Cgw \text{ X } Vgw) + (Crf \text{ X } Vrf)$$

Where:
- Ct = Concentration in the total volume
- Vt = Total volume
- Cgw = Concentration groundwater
- Vgw = Groundwater volume
- Crf = Concentration rainfall
- Vrf = Rainfall volume

Re-arranging the above equation to solve for Ct provides Equation 2:

$$Ct = \frac{(Cgw \text{ X } Vgw) + (Crf \text{ X } Vrf)}{Vt}$$

Input parameters for the mass balance estimation are specified in *Table 6.1.*

Table 6.1 1 Final Pit Mass Balance Estimation Input Parameters

Descriptor	Unit	Value	Comments
Groundwater volume	m^3/year	15,267	Base Case groundwater flow model prediction
Estimated footprint of final pit	m^2	257,856	Estimate based on quarry extension plans provided by Hanson
Annual rainfall	mm/year	1,315	Sourced from closest weather station (see Section 3.2.1)
Rainfall volume	m^3/year	339,081	Annual rainfall times footprint of final pit
GW concentration	mg/L	3,520	Highest reported TDS concentration 3,520 mg/L for groundwater sampled from SA1502.
Concentration rainfall	mg/L	20	TDS of rainfall is typically < 20 mg/L

When factoring in the above specified input parameters to Equation 2, the estimated average TDS concentration in water within the pit would be approximately 170 mg/L. While other processes (such as solute leaching from exposed material in the pit) would further contribute to TDS levels, the mass balance calculation demonstrates the relatively low contribution of salinity by groundwater in itself, with the total volumetric contribution of groundwater to the pit presenting approximately 4.5% of the volume contributed by rainfall. Brackish groundwater seeping into the pit is therefore expected to have limited impact on the overall quality of water that may be discharged from the Project.

6.2 MONITORING RECOMMENDATIONS

6.2.1 Development of Monitoring Plan

The NSW Aquifer Interference Policy specifies that monitoring requirements need to be developed that allow for the monitoring of actual impacts compared to predicted impacts, allowing for contingency plans to be enacted in a timely manner if actual impacts are higher than predicted and these impacts are found to be significant. It is recommended that a groundwater monitoring plan be developed that includes specifics of such a monitoring program, including threshold trigger values as well as a contingency strategy if triggers are exceeded. While the development of such a plan falls outside the scope of this assessment, recommendations for monitoring requirements are outlined in *Section 6.2.2* through to *Section 6.2.4*.

6.2.2 *Water Take*

Where predicted inflow rates are low, and a substantial volume of water may be lost to evaporation on pit walls, monitoring of the water take is challenging in practice. It is recommended that monitoring of inflows be undertaken to the extent feasible as part of water balance activities. This can be done by metering water being pumped from the in-pit sumps. An estimation of rainfall contribution to water being pumped from the in-pit sumps can then be made on an annual basis by factoring in rainfall data and the pit extent after which the groundwater component can be estimated. Groundwater take would be estimated and reported in this manner on an annual basis.

It is important to identify and monitor unusually high inflows to the quarry during the quarry extension, especially if structural features are encountered during quarrying that carry high inflows. Such occurrences would be documented with the magnitude and duration of high flows compared to trigger values specified in the groundwater monitoring plan.

If geological/hydrogeological observations during quarry extension vary significantly from that considered for the groundwater flow model the groundwater flow model will be re-evaluated. The model re-evaluation may include running the existing groundwater model for different stages of pit development and including transient analysis in the modelling to evaluate contributions from aquifer storage (which may require additional pumping tests and observations bore installation).

6.2.3 *Water Levels*

The groundwater monitoring program will include monitoring of water levels at the potentially affected groundwater bores. The results of the sensitivity scenario (showing higher drawdown than base case scenario) will be taken into account given the sensitivity scenario include reasonable variation in key input parameters for the model. In order to be able to identify over or under predictions by the modelling in a reasonable way, it is recommended that all bores showing a > 0.5 m of simulated drawdown be included in the monitoring program. This would include bores GW303436, GW303749 and GW306269.

As the predicted drawdown is based on steady state drawdown associated with the final stage of pit extension (the maximum drawdown expected over the life of the Project), initial monitoring of water levels can serve as a baseline against which to compare future water level measurements. Monitoring frequency of should be adaptable (depending on trends observed and stages of the quarry development) with twice annual monitoring recommended for the first year of monitoring. Water level data will be reported on an annual basis along with the reporting of the water take estimates.

6.2.4 Water Quality

Water quality monitoring is recommended at the in-pit sump(s) and existing monitoring bores while they remain accessible. Parameters monitored would include standard field parameters (pH, EC, temperature, ORP and DO) and laboratory analysis of TDS. Monitoring frequency of these sampling locations should be adaptable (depending on trends observed) with twice annual monitoring recommended for the first year of monitoring. Water quality results will be reported on an annual basis along with the reporting of the water take estimates.

Monitoring water quality of water discharges from the site would continue as per the conditions specified in the site Environmental Protection Licence (EPL). In addition to the current suite of parameters, it is recommended that consideration be given to including EC and TDS in the EPL related compliance monitoring.

6.3 FURTHER RECOMMENDATIONS

Following eventual cessation of quarrying activities (and pumping from pit sumps stopping) the final pit void would be expected to fill with water to some degree. The annual rainfall exceeded evaporation in the region coupled with the relatively low hydraulic conductivity of the host rock would likely result in water levels in the pit rising above pre-quarrying groundwater levels.

The magnitude of water level rise in the pit (and potential for overtopping) and long-term evolution of water quality will depend largely on the interplay between groundwater inflow to and outflow from the pit, rainfall and evaporative processes. If assessment of potential groundwater impact post-closure is required, pit lake modelling will be undertaken.

7 *REFERENCES*

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Annex A

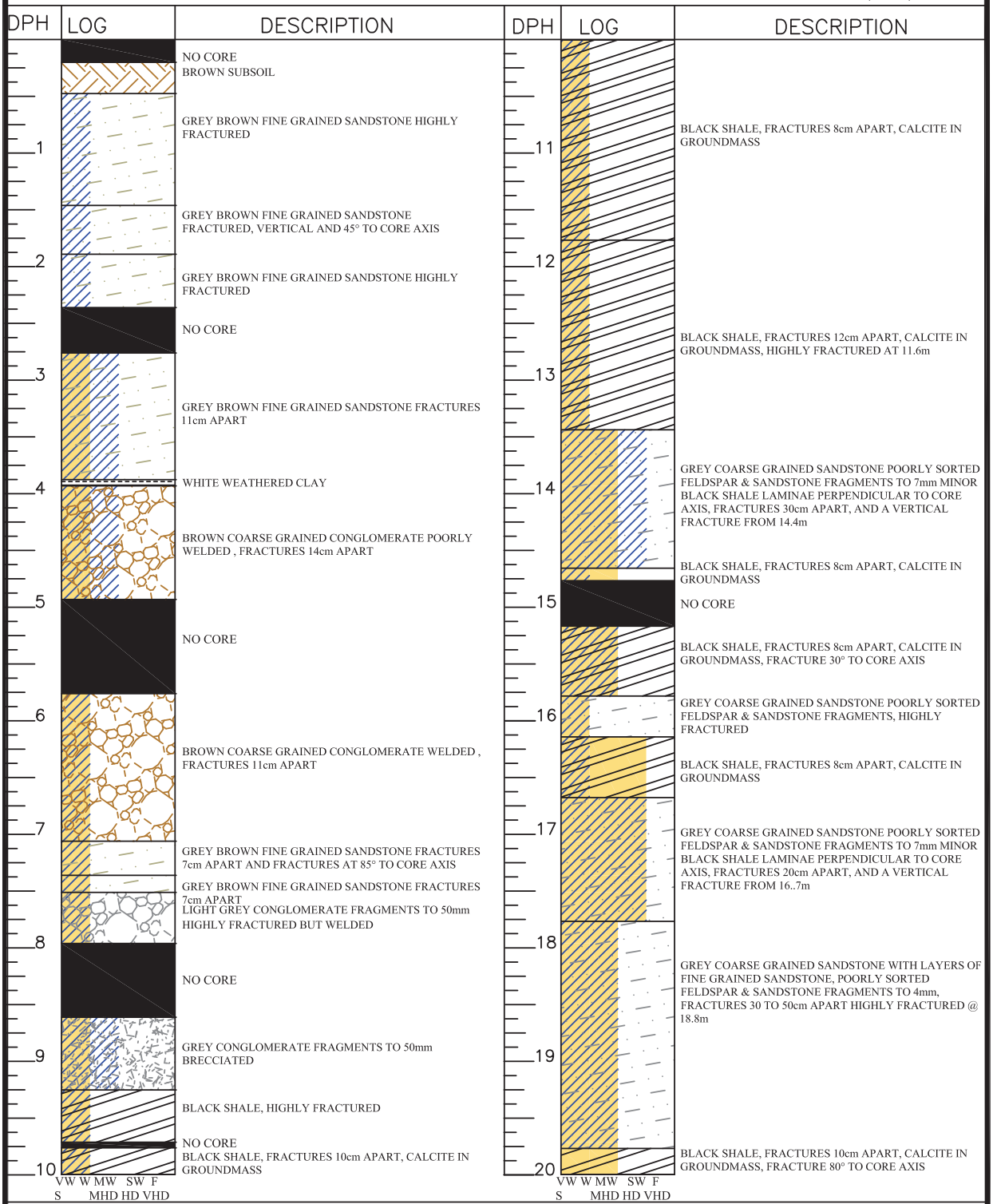
Borelogs

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1501–DH
PROJECT: SANCROX EXTENSION, ZONE 56
PAGE 1 OF 6

LOCATION: 481984,6521978 GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 19/5/15



COMMENTS:

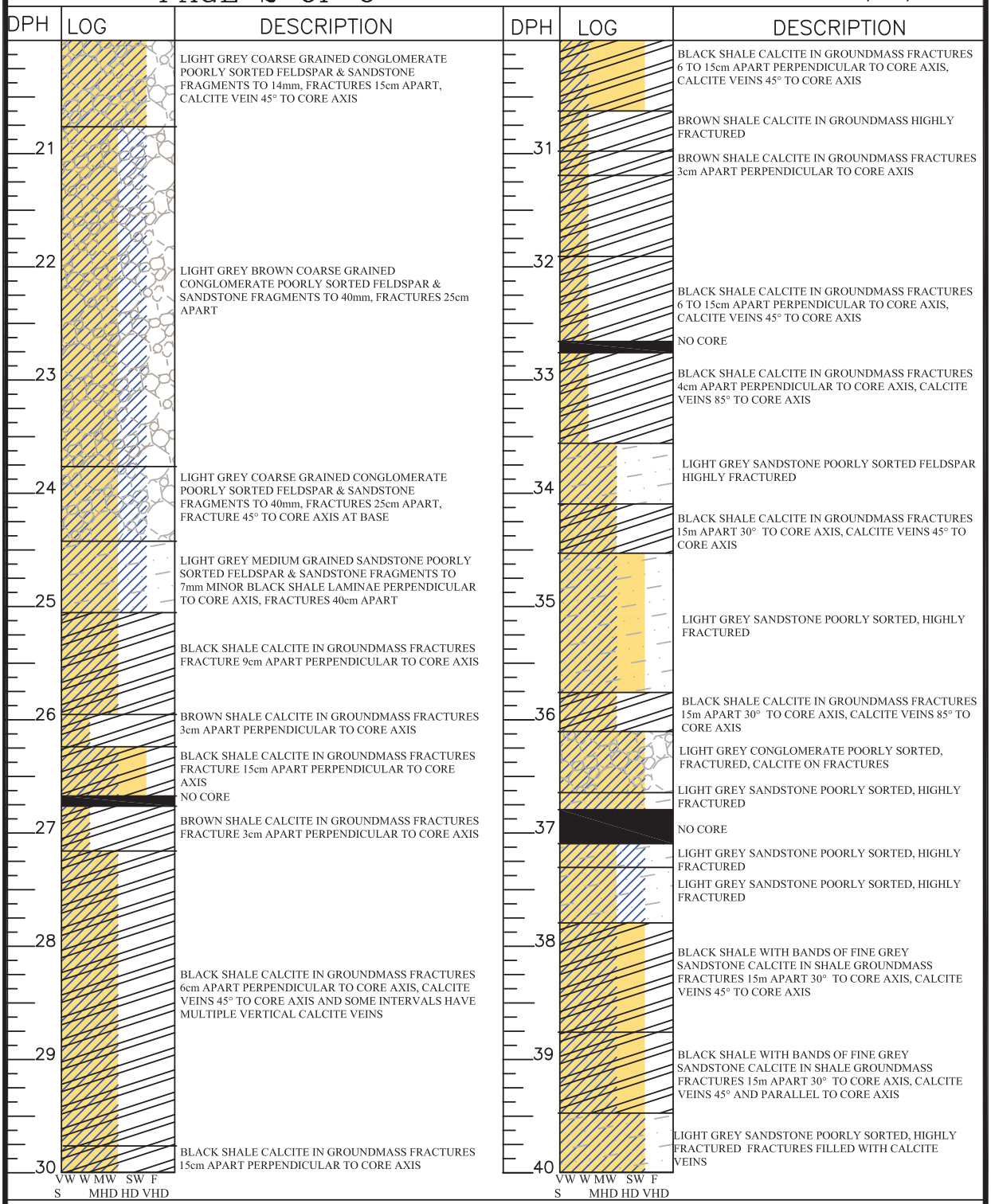
LEGEND: VW VERY WEATHERED, W WEATHERED, MW MODERATELY WEATHERED, SW SLIGHTLY WEATHERED, F FRESH
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1501–DH
PROJECT: SANCROX EXTENSION, ZONE 56
PAGE 2 OF 6

LOCATION: 481984,6521978 GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 19/5/15



COMMENTS:

LIGHT BROWN CONGLOMERATE POORLY SORTED FELDSPAR & SANDSTONE FRAGMENTS TO 40mm, FRACTURES 30 TO 100cm APART

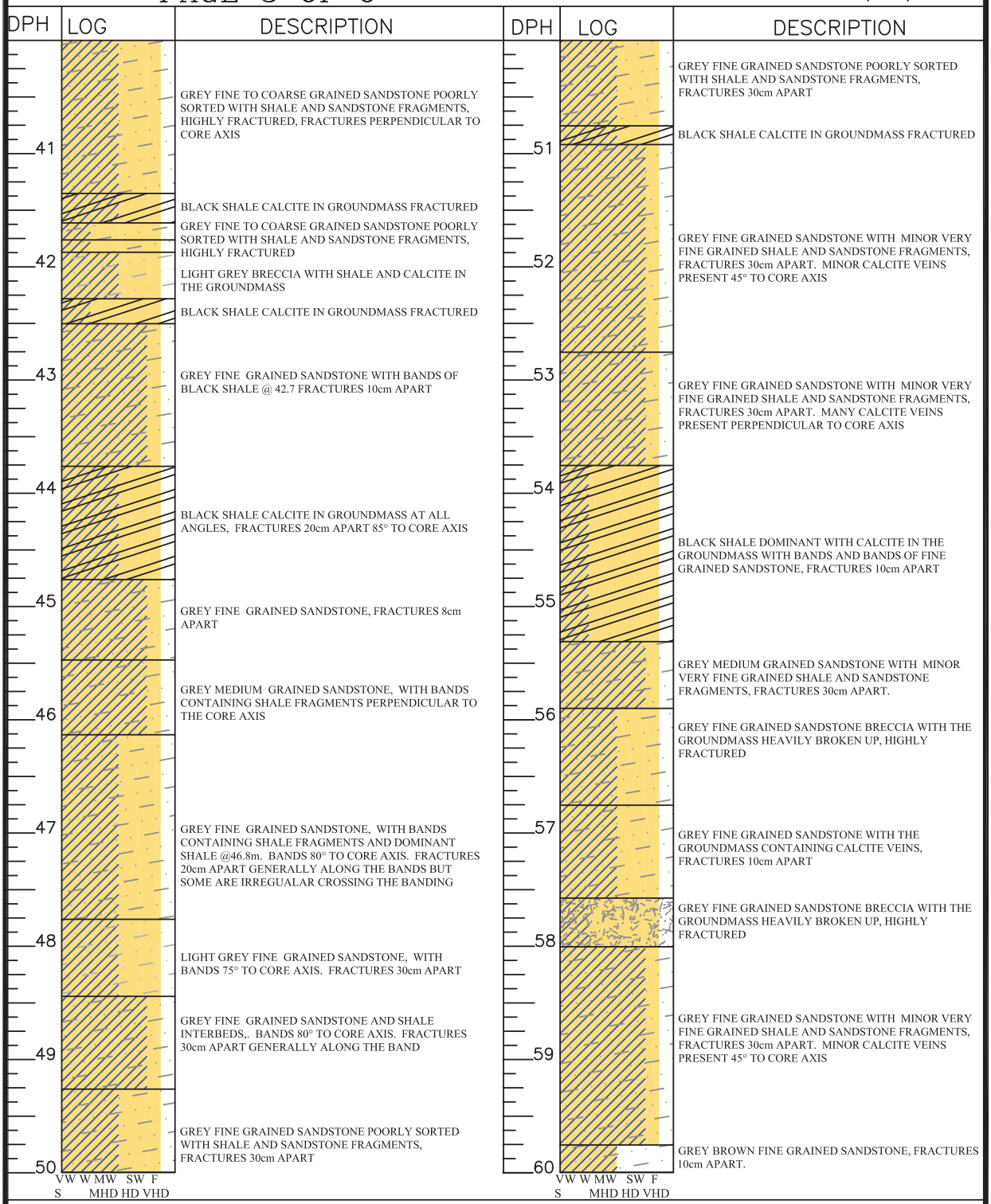
LEGEND: VW VERY WEATHERED, W WEATHERED, MW MODERATELY WEATHERED, SW SLIGHTLY WEATHERED, F FRESH
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1501–DH
PROJECT: SANCROX EXTENSION, ZONE 56
PAGE 3 OF 6

LOCATION: 481984,6521978 GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 19/5/15



COMMENTS:

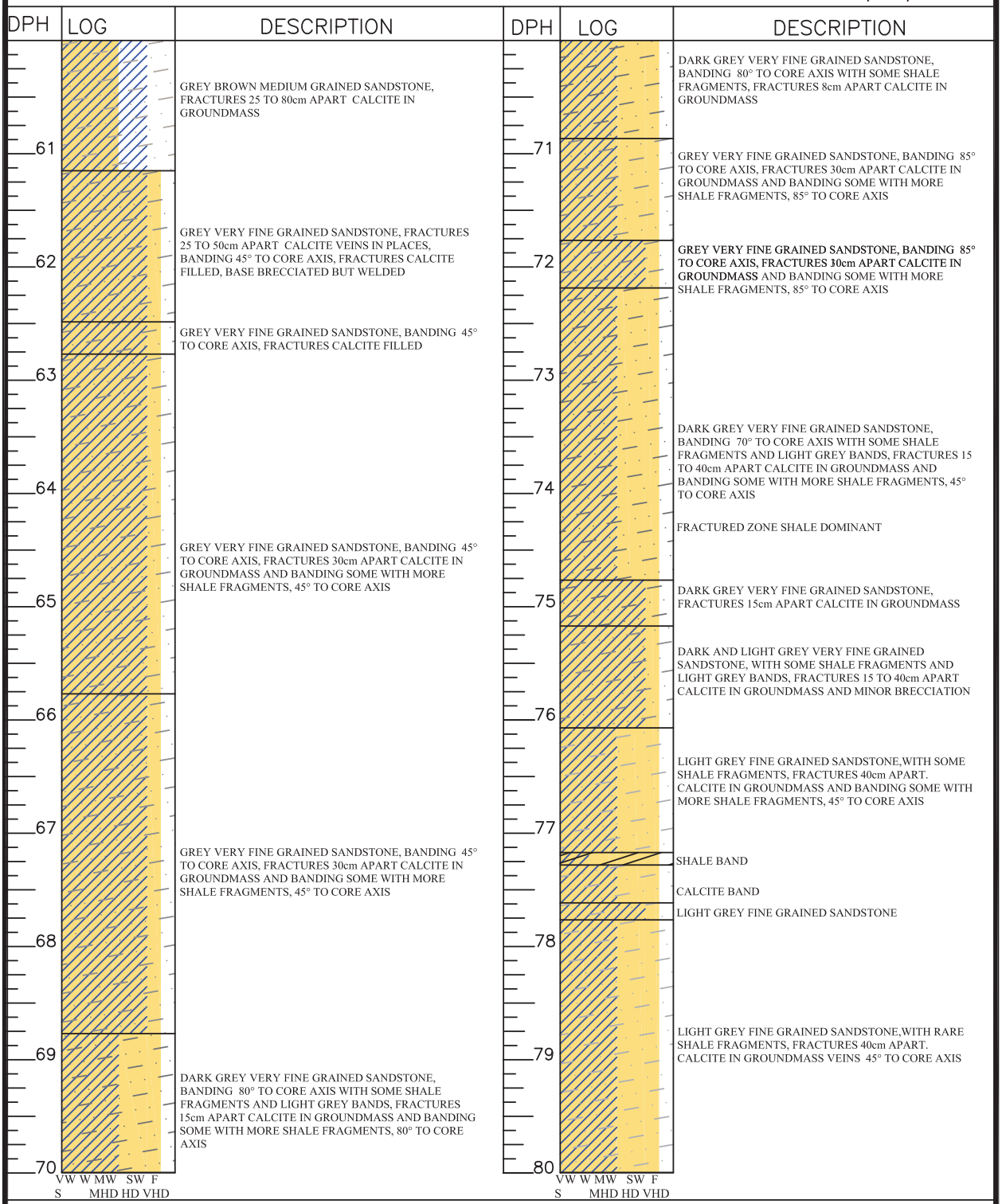
LEGEND: VW VERY WEATHERED, W WEATHERED, MW MODERATELY WEATHERED, SW SLIGHTLY WEATHERED, F FRESH
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1501–DH
PROJECT: SANCROX EXTENSION, ZONE 56
PAGE 4 OF 6

LOCATION: 481984,6521978 GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 19/5/15



COMMENTS:

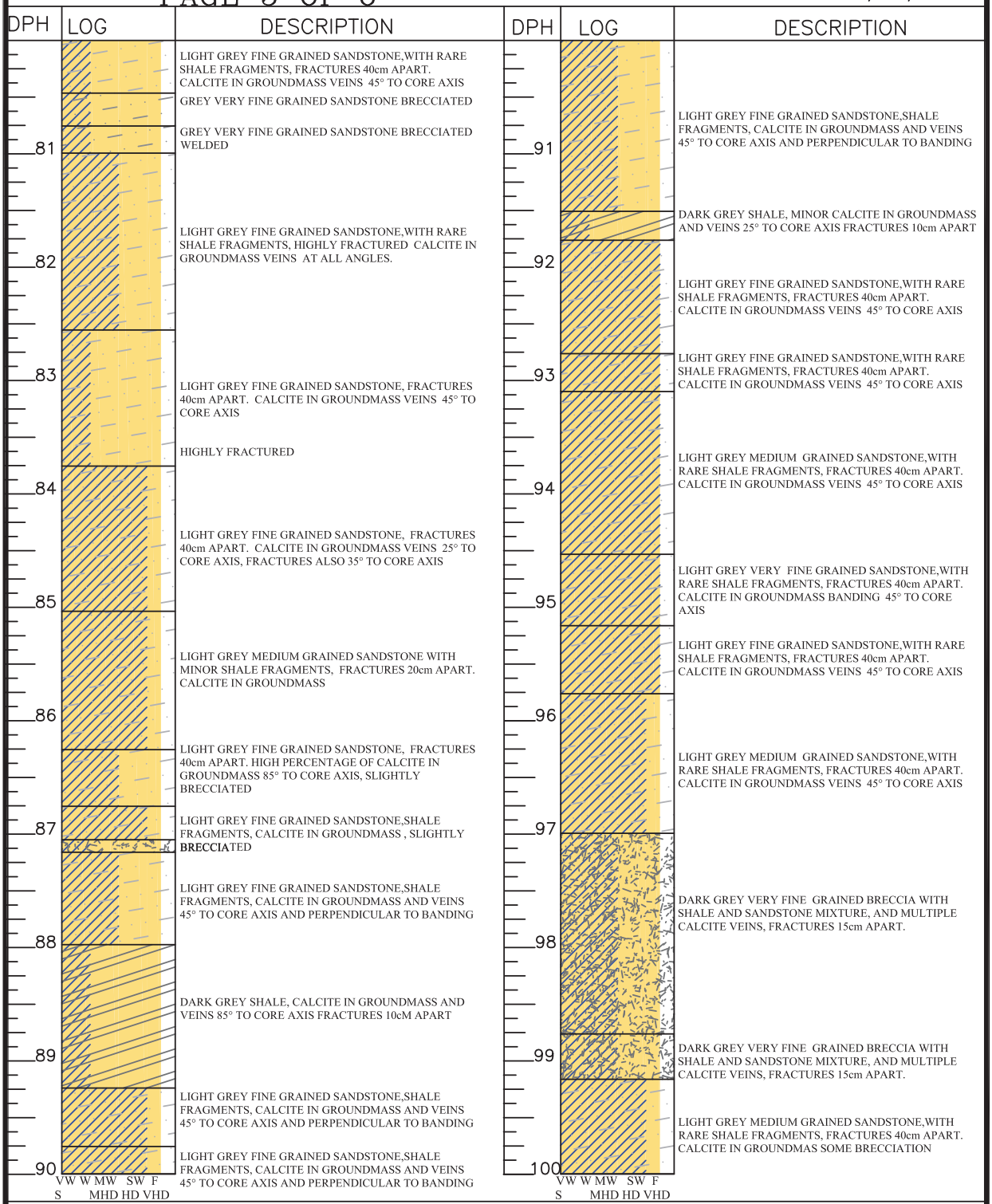
LEGEND: VW VERY WEATHERED, W WEATHERED, MW MODERATELY WEATHERED, SW SLIGHTLY WEATHERED, F FRESH
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1501–DH
PROJECT: SANCROX EXTENSION, ZONE 56
PAGE 5 OF 6

LOCATION: 481984,6521978 GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 19/5/15



COMMENTS:

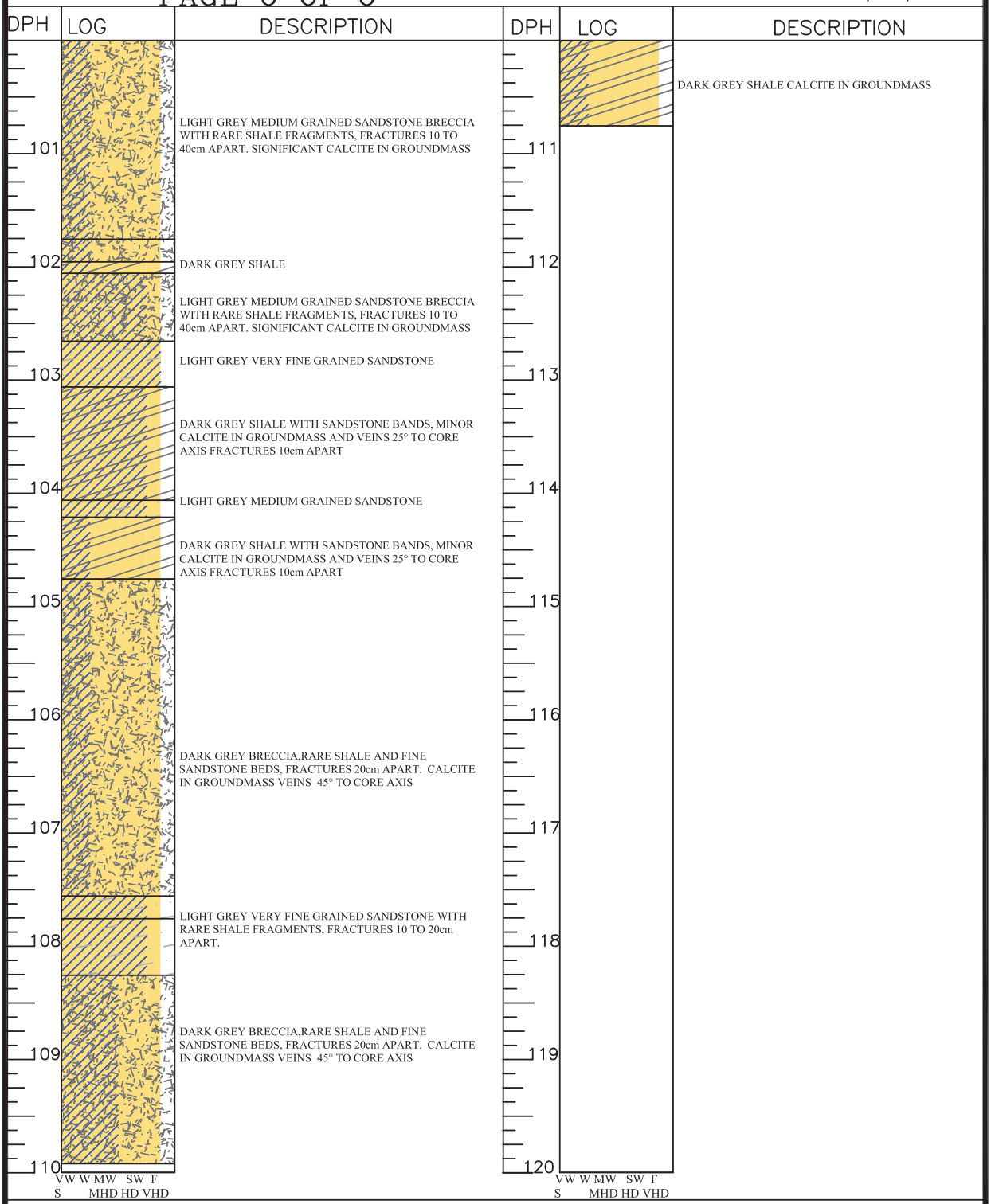
LEGEND: VW VERY WEATHERED, W WEATHERED, MW MODERATELY WEATHERED, SW SLIGHTLY WEATHERED, F FRESH
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1501–DH
PROJECT: SANCROX EXTENSION, ZONE 56

LOCATION: 481984,6521978 GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 19/5/15



COMMENTS:

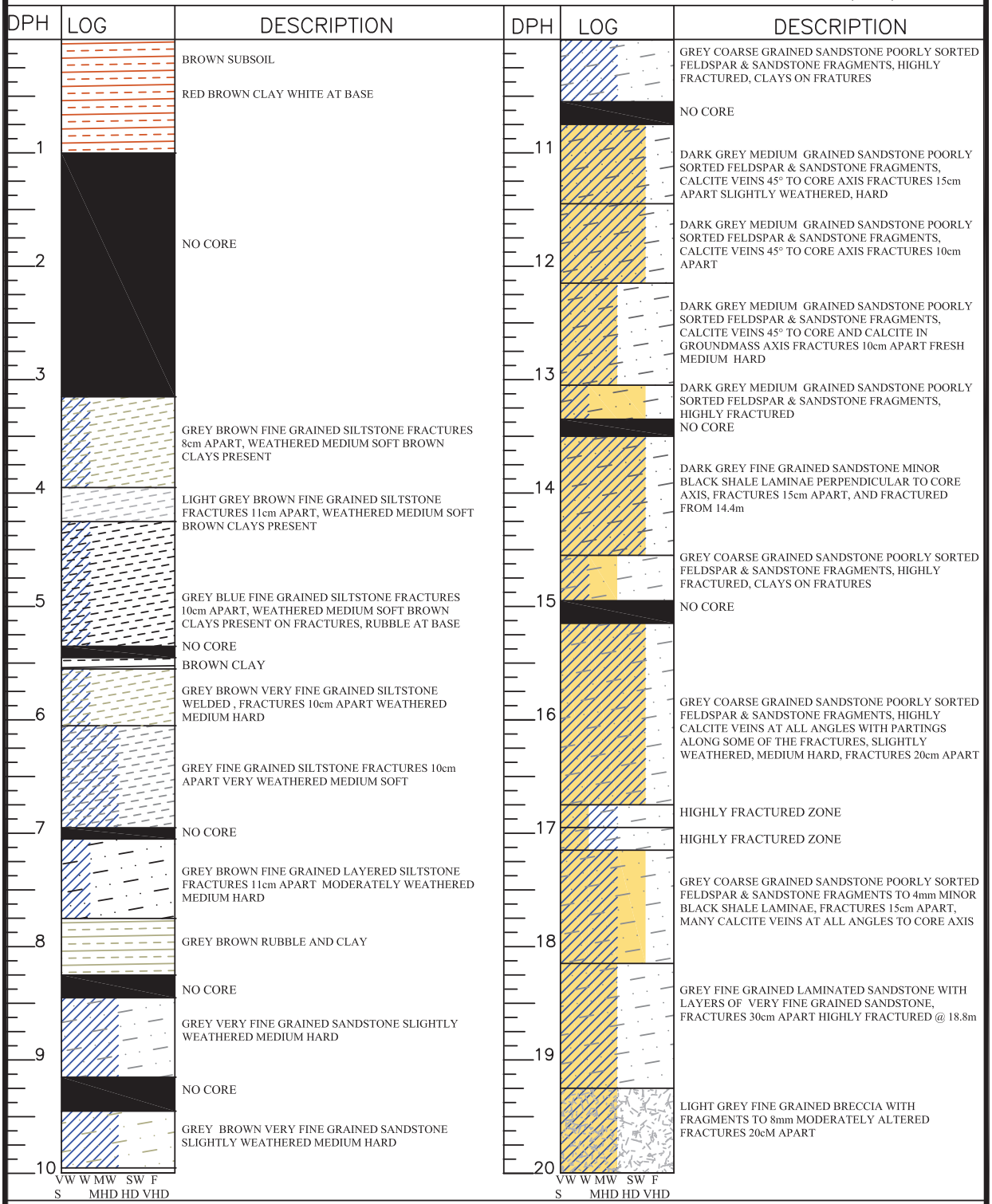
LEGEND: VW VERY WEATHERED, W WEATHERED, MW MODERATELY WEATHERED, SW SLIGHTLY WEATHERED, F FRESH
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1502–DH
PROJECT: SANCROX EXTENSION, ZONE 56

LOCATION: 4821703,6522320GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 2/7/15



COMMENTS:

LEGEND: VW VERY WEATHERED, W WEATHERED, MW MODERATELY WEATHERED, SW SLIGHTLY WEATHERED, F FRESH
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1502–DH
PROJECT: SANCROX EXTENSION, ZONE 56

LOCATION: 4821703,6522320GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 2/7/15

DPH	LOG	DESCRIPTION
21		LIGHT GREY BRECCIA , FRACTURES 20cm APART, SLIGHTLY WEATHERED MEDIUM HARD
		LIGHT GREY BRECCIA , HIGHLY FRACTURED, SLIGHTLY WEATHERED MEDIUM HARD
22		BLACK SHALE CALCITE IN GROUNDMASS FRACTURES 15cm APART PERPENDICULAR TO CORE AXIS. MINOR BANDS OF WEATHERED SANDSTONE
23		BLACK SHALE CALCITE IN GROUNDMASS AND IN VEINS AT ALL ANGLES, FRACTURES 15cm APART PERPENDICULAR TO CORE AXIS, MODERATELY FRESH MEDIUM SOFT
24		
25		BLACK SHALE CALCITE IN GROUNDMASS AND IN VEINS AT ALL ANGLES, FRACTURES 15cm APART PERPENDICULAR TO CORE AXIS, MODERATELY FRESH MEDIUM SOFT, VERY FRACTURES @ 26.9m
26		
27		BLACK SHALE CALCITE IN GROUNDMASS AND IN VEINS AT ALL ANGLES, FRACTURES 15cm APART PERPENDICULAR TO CORE AXIS, MODERATELY FRESH MEDIUM SOFT
		BLACK SHALE CALCITE IN GROUNDMASS FRACTURES 10cm APART PERPENDICULAR TO CORE AXIS
28		LIGHT GREY MEDIUM TO FINE GRAINED SANDSTONE MINOR BLACK SHALE LAMINAE PERPENDICULAR TO CORE AXIS, FRACTURES 20cm APART
		BLACK SHALE CALCITE IN GROUNDMASS FRACTURES 10cm APART PERPENDICULAR TO CORE AXIS
29		LIGHT GREY MEDIUM TO FINE GRAINED SANDSTONE MINOR BLACK SHALE FRAGMENTS, FRACTURES 30cm APART, SLIGHTLY WEATHERED, HARD
		LIGHT GREY MEDIUM GRAINED SANDSTONE POORLY SORTED FELDSPAR & SANDSTONE FRAGMENTS TO 7mm MINOR VERTICAL FRACTURE CALCITE FILLED, FRACTURES 30cm APART, HARD SLIGHTLY WEATHERED
30		
31		LIGHT GREY COARSE SANDSTONE TO CONGLOMERATE WITH EQUANT SUB ANGULAR FINE GRAINED SANDSTONE FRAGMENTS, FRESH HARD WITH SOME FRACTURES 10° TO CORE AXIS, MINOR CALCITE VEINS
32		
33		
34		BRECCIA WITH BLACK SHALE IN VERTICAL FRACTURE FRACTURES 15cm APART 30° TO CORE AXIS, CALCITE VEINS AT ALL ANGLES TO CORE AXIS, FRESH MODERATELY HARD
35		LIGHT GREY BRECCIA, FRACTURES 15cm APART 30° TO CORE AXIS, CALCITE VEINS AT ALL ANGLES TO CORE AXIS, FRESH, MODERATELY HARD
36		BLACK SHALE CALCITE IN GROUNDMASS FRACTURES 15cm APART 30° TO CORE AXIS, CALCITE VEINS 65° TO CORE AXIS, SLIGHTLY WEATHERED, MEDIUM HARD
37		BLACK SHALE WITH BANDS OF FINE GREY SANDSTONE CALCITE IN SHALE GROUNDMASS FRACTURES 15cm APART 30° TO CORE AXIS, CALCITE VEINS 45° TO CORE AXIS
38		LIGHT GREY CONGLOMERATE POORLY SORTED, FRACTURED, CALCITE VEINS COMMON AND ON FRACTURES, FRESH MODERATELY HARD
39		LIGHT GREY CONGLOMERATE POORLY SORTED, FRACTURED, CALCITE VEINS COMMON AND ON FRACTURES, FRESH MODERATELY HARD
40		LIGHT GREY BRECCIA, FRACTURES 15cm APART 30° TO CORE AXIS, CALCITE VEINS AT ALL ANGLES TO CORE AXIS, FRESH, MODERATELY HARD

VW W MW SW F
S MHD HD VHD

COMMENTS:

LIGHT BROWN CONGLOMERATE POORLY SORTED FELDSPAR & SANDSTONE FRAGMENTS TO 40mm, FRACTURES 30 TO 100cm APART

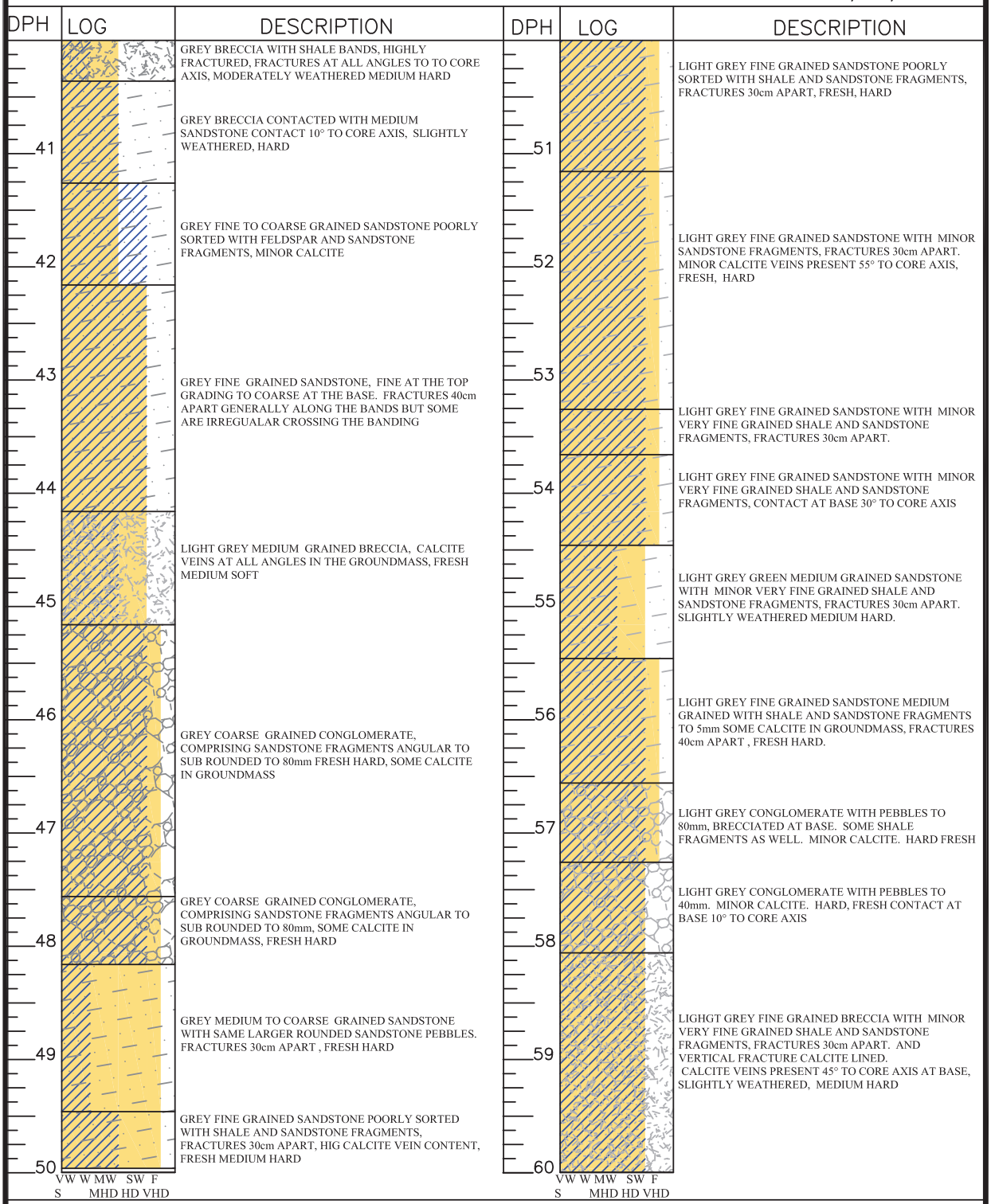
LEGEND: VW VERY WEATHERED, W WEATHERED, MW MODERATELY WEATHERED, SW SLIGHTLY WEATHERED, F FRESH
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1502–DH
PROJECT: SANCROX EXTENSION, ZONE 56

LOCATION: 4821703,6522320GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 2/7/15



COMMENTS:

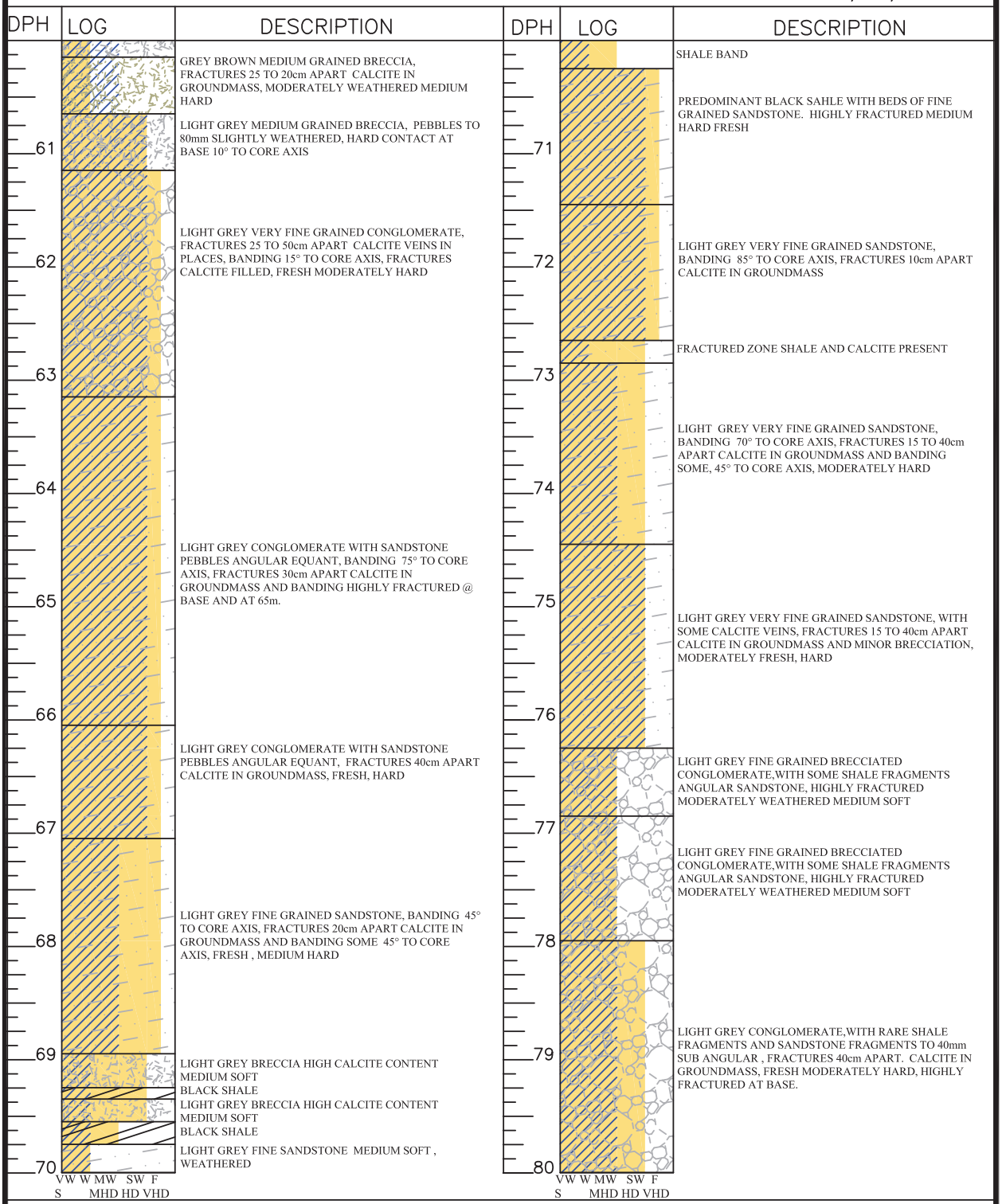
LEGEND: VW VERY WEATHERED, W WEATHERED, MW MODERATELY WEATHERED, SW SLIGHTLY WEATHERED, F FRESH
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1502–DH
PROJECT: SANCROX EXTENSION, ZONE 56

LOCATION: 4821703,6522320GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 2/7/15



COMMENTS:

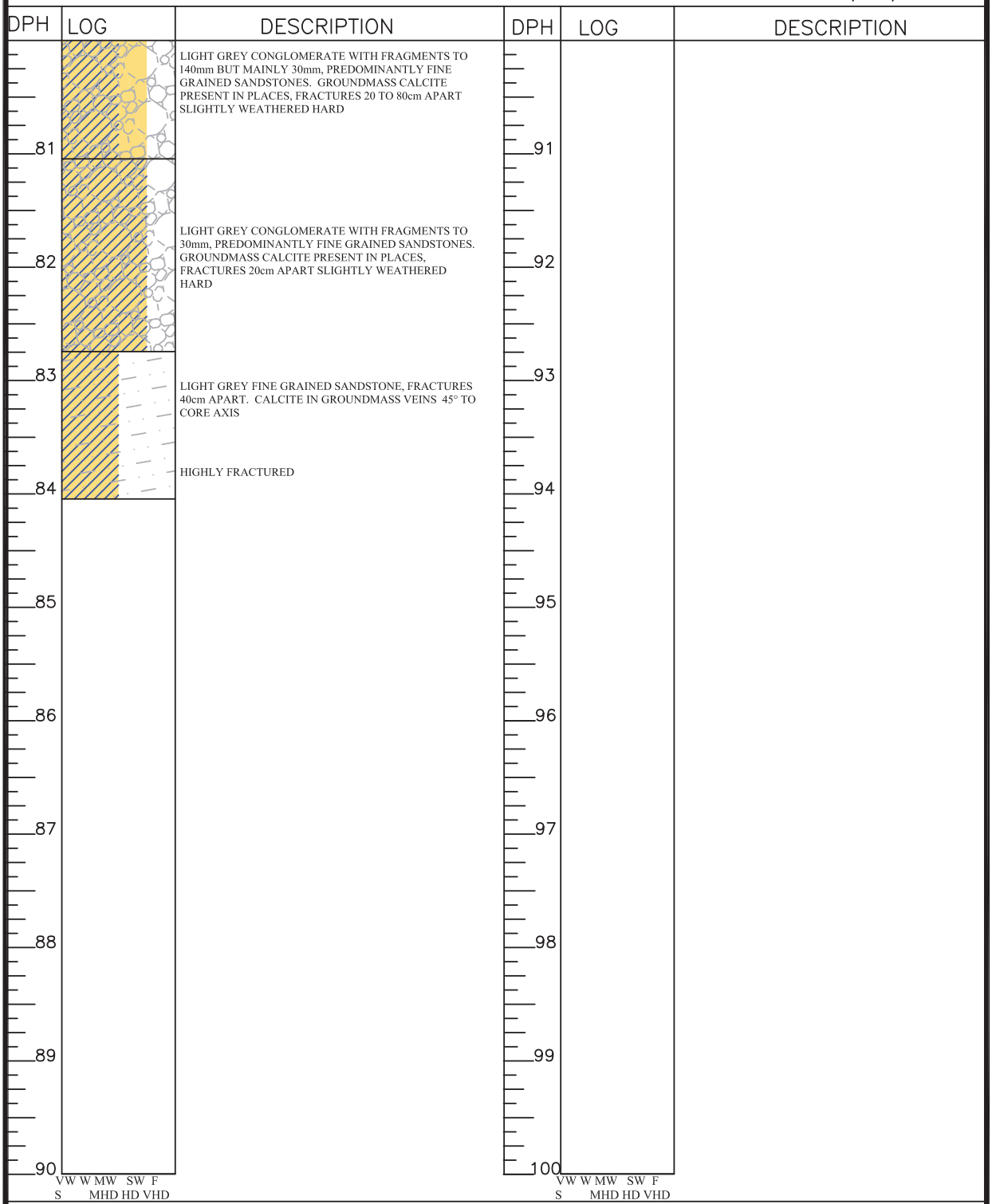
LEGEND: VW VERY WEATHERED, W WEATHERED, MW MODERATELY WEATHERED, SW SLIGHTLY WEATHERED, F FRESH
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1502–DH
PROJECT: SANCROX EXTENSION, ZONE 56
PAGE 5 OF 5

LOCATION: 4821703,6522320GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 2/7/15



COMMENTS:

LEGEND: VW VERY WEATHERED, W WEATHERED, MW MODERATELY WEATHERED, SW SLIGHTLY WEATHERED, F FRESH
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1503–DH
PROJECT: SANCROX EXTENSION, ZONE 56

LOCATION: 482127,6521775 GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 2/6/15

DPH	LOG	DESCRIPTION
0		BROWN SUBSOIL
		LIGHT GREY CLAY
1		
		NO CORE
2		
		GREY BROWN FINE GRAINED GRAVELLY SANDSTONE
3		
		NO CORE
4		BROWN GREY COARSE GRAINED CONGLOMERATE POORLY WELDED , FRACTURED
		NO CORE
5		
		BROWN GREY COARSE GRAINED CONGLOMERATE POORLY WELDED , FRACTURED
6		
		GREY BROWN FINE GRAINED SANDSTONE FRACTURES 7cm APART AND VERTICAL FRACTURE AT 85° TO CORE AXIS
7		
		NO CORE
8		LIGHT GREY SANDSTONE VERY FINE GRAINED
		GREY SANDSTONE VERY FINE GRAINED, FRACTURES 15cm APART
		GREY SANDSTONE RUBBLE
9		NO CORE
		BROWN GREY SANDSTONE RUBBLE
		GREY SANDSTONE RUBBLE
10		BLACK SHALE, FRACTURES 10cm APART, CALCITE IN GROUNDMASS
		VW W MW SW F
		S MHD HD VHD

DPH	LOG	DESCRIPTION
10		BLACK SHALE, FRACTURES 10cm APART, CALCITE IN GROUNDMASS, FRACTURE 80° TO CORE AXIS
		LIGHT GREY SANDSTONE RUBBLE
11		NO CORE
		GREY SANDSTONE VERY FINE GRAINED BRECCIATED
12		
		GREY FINE GRAINED SANDSTONE POORLY, FRACTURES 10cm APART
13		
		GREY BROWN COARSE GRAINED CONGLOMERATE POORLY SORTED FELDSPAR & SANDSTONE FRAGMENTS TO 10mm, FRACTURES 10cm APART
14		LIGHT GREY MEDIUM GRAINED SANDSTONE POORLY SORTED FELDSPAR & SANDSTONE FRAGMENTS, HIGHLY FRACTURED
		GREY BROWN COARSE GRAINED CONGLOMERATE POORLY SORTED FELDSPAR & SANDSTONE FRAGMENTS TO 10mm, FRACTURES 20cm APART
15		
		GREY COARSE GRAINED SANDSTONE POORLY SORTED FELDSPAR & SANDSTONE FRAGMENTS TO 7mm, FRACTURES 20cm APART, CALCITE IN THE GROUNDMASS GENERALLY 45° TO CORE AXIS
16		
17		
18		
		GREY COARSE GRAINED SANDSTONE POORLY SORTED FELDSPAR & SANDSTONE FRAGMENTS TO 7mm, FRACTURES 20cm APART, CALCITE IN THE GROUNDMASS GENERALLY 45° TO CORE AXIS
19		
		BLACK SHALE, FRACTURED RUBBLE
20		
		VW W MW SW F
		S MHD HD VHD

COMMENTS:

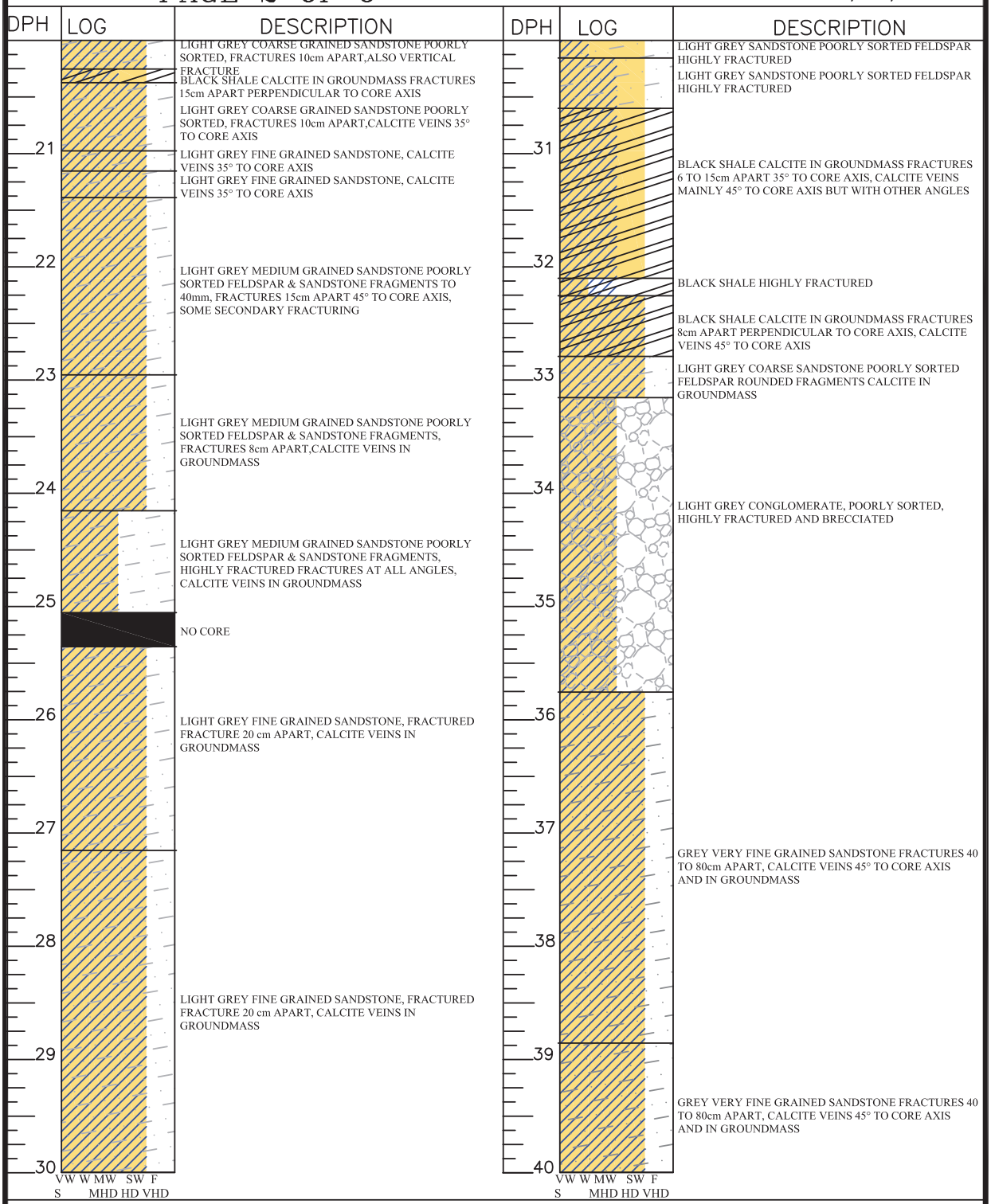
LEGEND: VW VERY WEATHERED, W WEATHERED, MW MODERATELY WEATHERED, SW SLIGHTLY WEATHERED, F FRESH
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1503–DH
PROJECT: SANCROX EXTENSION, ZONE 56
PAGE 2 OF 6

LOCATION: 482127,6521775 GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 2/6/15



COMMENTS:

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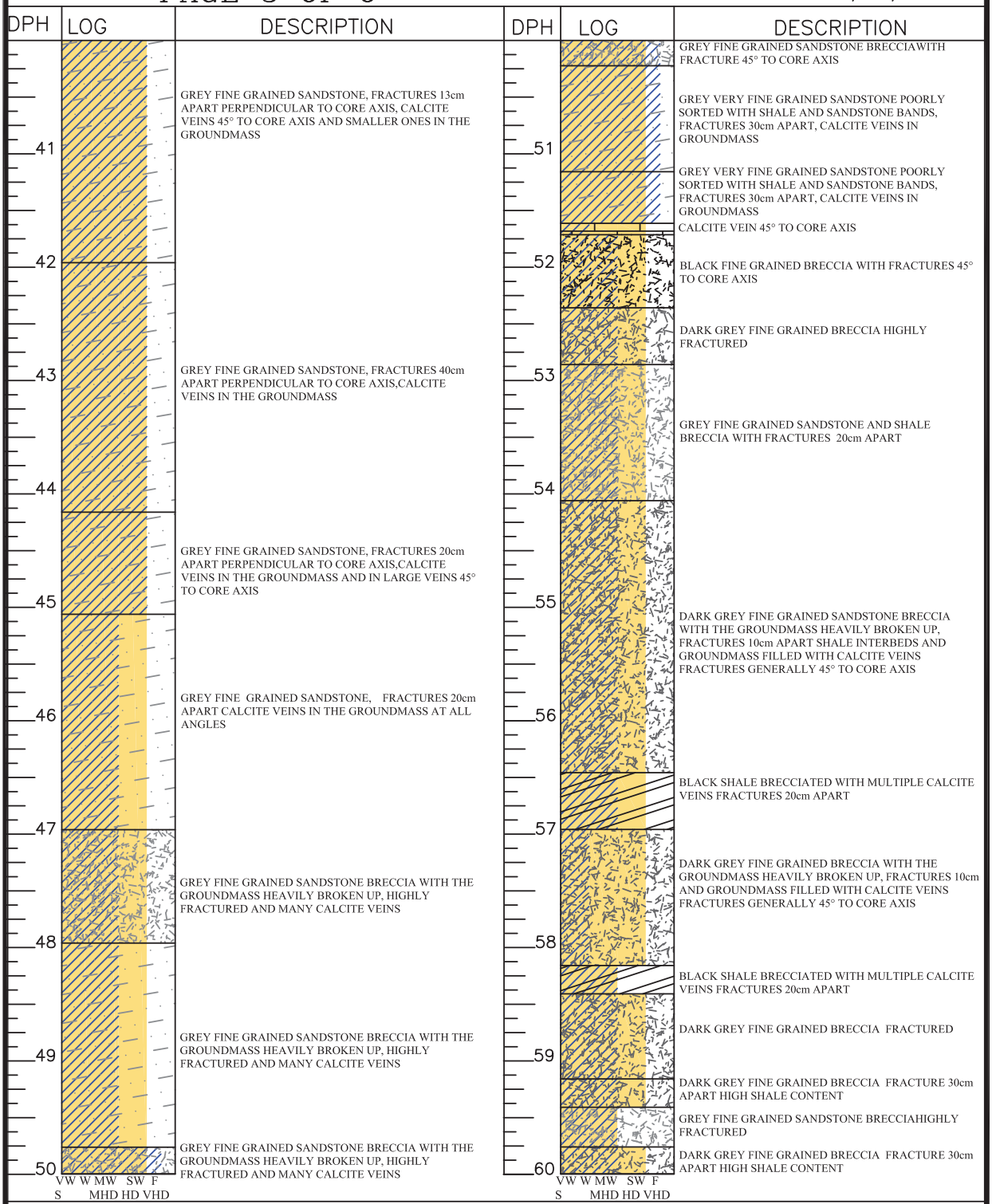
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1503–DH
PROJECT: SANCROX EXTENSION, ZONE 56
PAGE 3 OF 6

LOCATION: 482127,6521775 GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 2/6/15



COMMENTS:

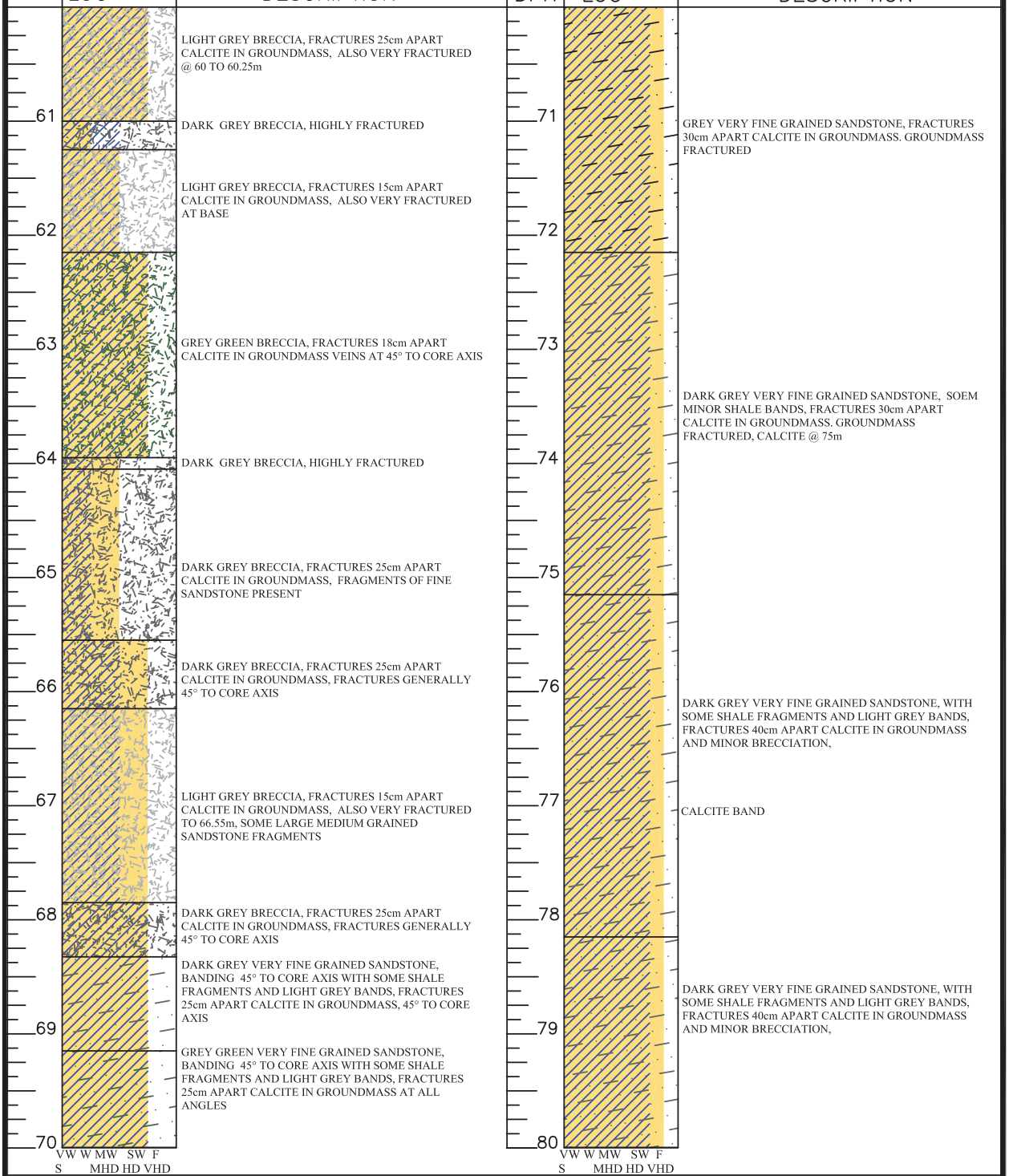
LEGEND: VW VERY WEATHERED, W WEATHERED, MW MODERATELY WEATHERED, SW SLIGHTLY WEATHERED, F FRESH
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1503–DH
PROJECT: SANCROX EXTENSION, ZONE 56

LOCATION: 482127,6521775 GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 3/6/15



COMMENTS:

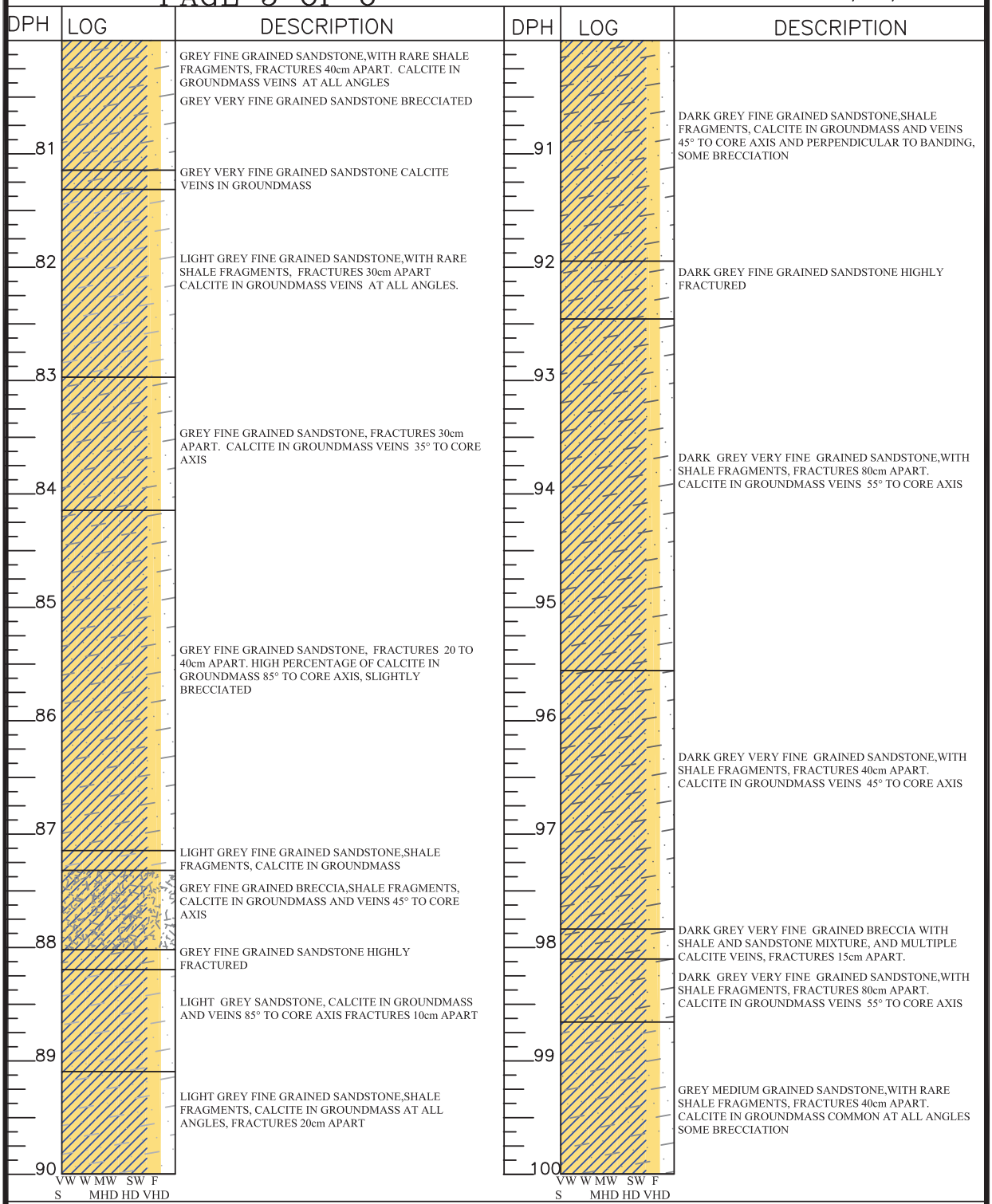
LEGEND: VW VERY WEATHERED, W WEATHERED, MW MODERATELY WEATHERED, SW SLIGHTLY WEATHERED, F FRESH
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1503–DH
PROJECT: SANCROX EXTENSION, ZONE 56
PAGE 5 OF 6

LOCATION: 482127,6521775 GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 3/6/15



COMMENTS:

LEGEND: VW VERY WEATHERED, W WEATHERED, MW MODERATELY WEATHERED, SW SLIGHTLY WEATHERED, F FRESH
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1503–DH
PROJECT: SANCROX EXTENSION, ZONE 56

LOCATION: 482127,6521775 GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 3/6/15

DPH	LOG	DESCRIPTION
101		DARK GREY VERY FINE GRAINED SANDSTONE, SHALE AND FINE SANDSTONE BEDS, FRACTURES 50cm APART. CALCITE IN GROUNDMASS ALL ANGLES
102		
103		
104		
105		
106		
107		
108		
109		
110		

VW W MW SW F
S MHD HD VHD

DPH	LOG	DESCRIPTION
111		
112		
113		
114		
115		
116		
117		
118		
119		
120		

VW W MW SW F
S MHD HD VHD

COMMENTS:

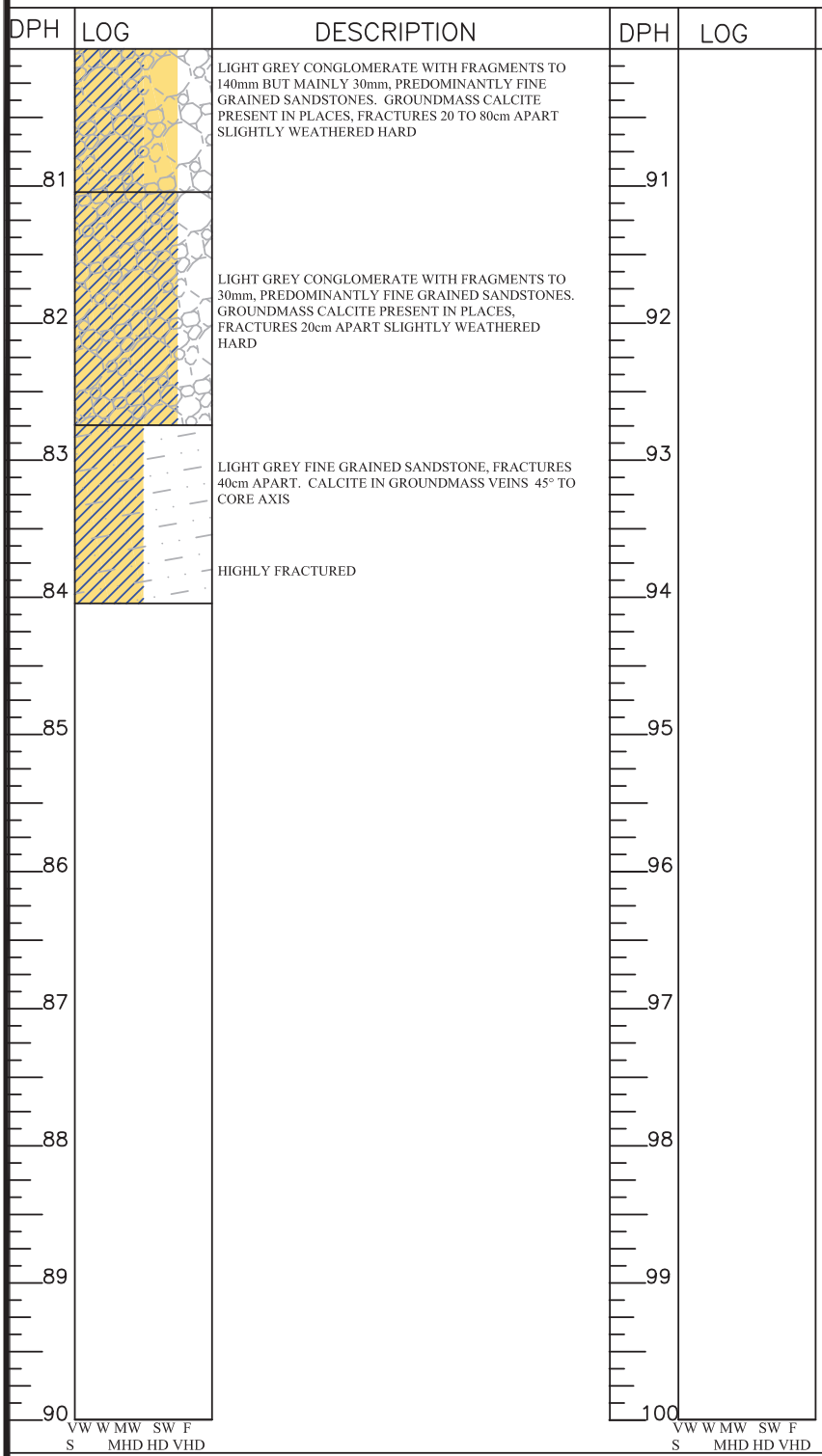
LEGEND: VW VERY WEATHERED, W WEATHERED, MW MODERATELY WEATHERED, SW SLIGHTLY WEATHERED, F FRESH
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

HANSON CONSTRUCTION MATERIALS

GRAPHIC DRILL LOG

HOLE: SA–1502–DH
PROJECT: SANCROX EXTENSION, ZONE 56
PAGE 1 OF 5

LOCATION: 4821703,6522320GDA
DRILLED: MACQUARIE DRILLING
LOGGED: P BROWNE 2/7/15



COMMENTS:

LEGEND: VW VERY WEATHERED, W WEATHERED, MW MODERATELY WEATHERED, SW SLIGHTLY WEATHERED, F FRESH
S SOFT, MHD MEDIUM HARD, HD HARD, VHD VERY HARD

Annex B

Form A Documents

(Showing Bore Construction Details)

Department of Primary Industries
Office of Water

Form A Particulars of completed work

Page 1

Driller's Licence No:	DL 2266	1
Class of Licence:	4	
Driller's Name:	Steven Baker	
Assistant Driller:	Darran marko	
Contractor:	LCR contractors	
New bore	X	
Deepened		
Reconditioned		
Replacement bore		
Enlarged		
Other (specify)		
Final Depth	110 m	SA 1501

Work Licence No:	20BL173794	2
Name of Licensee:	Handson	
Intended Use:	water monitoring	
Completion Date:	19.10.2015	

DRILLING DETAILS 3

From (m)	To (m)	Hole Diameter (mm)	Drilling Method See Code 3
0	11.40	165.1	9
114	110	120	9

WATER BEARING ZONES 4

From (m)	To (m)	Thickness (m)	S W L (m)	Estimated Yield (L/s) Individual Aquifer	Estimated Yield (L/s) Cumulative	Test method See Code 4		D D L at end of test (m)	Duration Hrs	Duration min	Salinity (Conductivity or TDS) Cond (µS/cm)	Salinity (Conductivity or TDS) TDS (mg/L)
20	50	30	-	—	Damp	—	—	—	—	—	—	—
70	110	40	6		0.10		11	—	—	30	1080	—

CASING / LINER DETAILS 5

Material Code 5	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Method Fixing Code 5
4	125	5.5	0	11.4	1
6	50		71	50	5
6	50		20	0	5

Casing support method — See Code 5: 2

Type of casing bottom — See Code 5: 2

Centralisers installed {Yes/No}: no (indicate on sketch)

Sump installed {Yes/No}: no From m To m

Pressure cemented {Yes/No}: no From m To m

Casing Protector cemented in place: yes

WATER ENTRY DESIGN 6

General Material Code 5	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Opening type See Code 6	Fixing See Code 5	Screen Aperture (mm)	Slot Details Length (mm)	Width (mm)	Alignment See Code 6
6	50		116	71	5	5	1	2600	3	H
6	50		50	20	5	5	1	2600	3	H

GRAVEL PACK 7

Type		Grade		Grain size (mm) From	Grain size (mm) To	Depth (m) From	Depth (m) To	Quantity Litres	Quantity m^3
Rounded		Graded	X	5	7	110	70	338.4	0.33
Crushed		Ungraded		5	7	50	19	262.4	0.26
Bentonite/Grout seal (Yes/No)	yes					70	50	169.3	0.17
Method of placement of Gravel Pack	See Code 7	1				19	0	160.8	0.16

For Departmental use only: GW

Department of Primary Industries
Office of Water

Form A Particulars of completed work

Work Licence No:

BORE DEVELOPMENT 8

Chemical used for breaking down drilling mud (Yes/No) Yes Name:

Method	Bailing/Surging		Jetting		Airlifting		Backwashing		Pumping		Other:	
Duration		hrs		hrs	1	hrs		hrs		hrs		hrs

DISINFECTION ON COMPLETION 9

Chemical(s) used	Quantity applied (Litres)	Method of application
chloriae	200 Lts	Flushed

PUMPING TESTS ON COMPLETION 10

Test type		Date	Pump intake depth (m)	Initial Water Level (SWL) (m)	Pumping rate (L/s)	Water Level at end of pumping (DDL) (m)	Duration of Test (hrs)	Recovery: Water level (m)	Recovery: Time taken (hrs)	Recovery: Time taken (mins)
Multi stage (stepped drawdown)	Stage 1									
	Stage 2									
	Stage 3									
	Stage 4									
Single stage (constant rate)										

Height of measuring point above ground level m Test Method See Code 4

WORK PARTLY BACKFILLED OR ABANDONED 11

Original depth of work: m Is work partly backfilled: (Yes/No)

Is work abandoned: (Yes/No) Method of abandonment: Backfilled Plugged Capped

Has any casing been left in the work (Yes/No) From m To m

Sealing / fill type (See Code 11)	From depth (m)	To depth (m)	Sealing / fill type (See Code 11)	From depth (m)	To depth (m)

Site chosen by: Hydrogeologist Geologist Driller Diviner Client X Other 12

13

Lot No 2 DP No 574308

Work Location Co ordinates Easting 481984 Northing 6521978 Zone

GPS: (Yes/No) Yes >> AMG/AGD or MGA/GDA (See explanation)

Longitude Latitude

Please mark the work site with "X" on the CLID provided map.

Indicate also the distances in metres from two (2) adjacent boundaries, and attach the map to this Form A package.

Signatures:

Driller: _____ **Licensee:** _____

Date: 20-10-2015 **Date:** _____

Department of Primary Industries
Office of Water

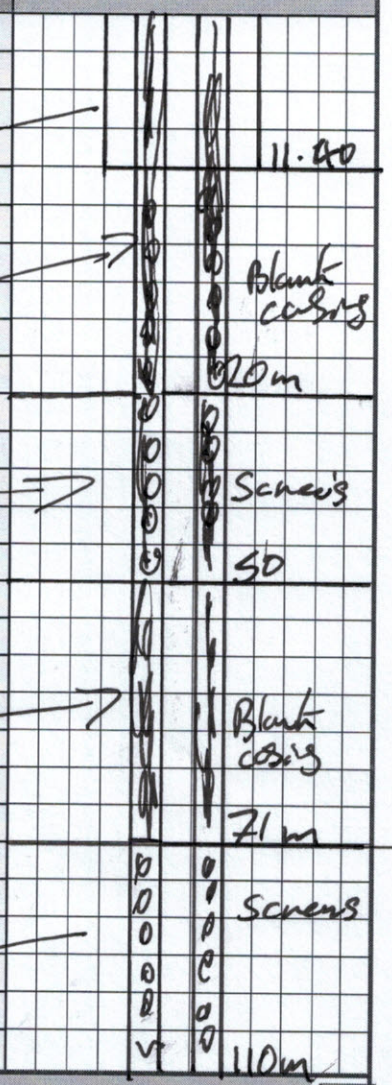
Form A Particulars of completed work

Work Licence No:

DRILLER'S ROCK/STRATA DESCRIPTION (LITHOLOGY) — 15

Depth From (m)	Depth To (m)	Description (See Code 15)
0		See Attached Geologist Log

WORK CONSTRUCTION SKETCH



WORK NOT CONSTRUCTED BY DRILLING RIG — 16

Method of excavation: Hand dug ☐ Back hoe ☐ Dragline ☐ Dozer ☐ Other

Depth (m)	Length (m)	Width (m)	Diameter (m)	Lining material	Dimentions of liner (m)	From Depth (m)	To Depth (m)

Please attach copies of the following if available — 17

Geologist log	(Yes/No) YES	Laboratory analysis of water Sample	(Yes/No) no	Pumping test(s)	(Yes/No) no
Geophysical log	(Yes/No) no	Sieve analysis of aquifer material	(Yes/No) no	Installed Pump details	(Yes/No) no

SA 1502

Department of Primary Industries
Office of Water

Form A Particulars of completed work

Driller's Licence No:	DL2266	1
Class of Licence:	4	
Driller's Name:	S Baker	
Assistant Driller:	J Dodds J Willcockson	
Contractor:	LRC contracting	
New bore	X	
Deepened		
Reconditioned		
Replacement bore		
Enlarged		
Other (specify)		
Final Depth	84.05 m	SA1502

Work Licence No:	20BL173794	2
Name of Licensee:	HAndSon	
Intended Use:	water monitoring	
Completion Date:	20/08/2015	

DRILLING DETAILS 3

From (m)	To (m)	Hole Diameter (mm)	Drilling Method See Code 3
0	9	123	7
9	84.05	96	13

WATER BEARING ZONES 4

From (m)	To (m)	Thickness (m)	S W L (m)	Estimated Yield (L/s) Individual Aquifer	Estimated Yield (L/s) Cumulative	Test method See Code 4		D D L at end of test (m)	Duration Hrs	Duration min	Salinity (Conductivity or TDS) Cond (µS/cm)	Salinity (Conductivity or TDS) TDS (mg/L)
45	81	36	15		0.16		1	16	2	30		

CASING / LINER DETAILS 5

Material Code 5	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Method Fixing Code 5
6	50	8	81	84	5
6	50	8	0	45	5

Casing support method — See Code 5: 2

Type of casing bottom — See Code 5: 2

Centralisers installed {Yes/No}: no (indicate on sketch)

Sump installed {Yes/No}: no — From ____ m To ____ m

Pressure cemented {Yes/No}: no — From ____ m To ____ m

Casing Protector cemented in place

WATER ENTRY DESIGN 6

General Material Code 5	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Opening type See Code 6	Fixing See Code 5	Screen Aperture (mm)	Slot Details Length (mm)	Width (mm)	Alignment See Code 6
6	50	8	45	81	5	5	1			H

GRAVEL PACK 7

Type		Grade		Grain size (mm) From	Grain size (mm) To	Depth (m) From	Depth (m) To	Quantity Litres	Quantity m^3
Rounded		Graded	X	5	7	30	84	284	0.28
Crushed		Ungraded							
Bentonite/Grout seal (Yes/No)	Yes					0	30	158	0.16
Method of placement of Gravel Pack	See Code 7	1							

For Departmental use only: G W

SA 1502

Department of Primary Industries
Office of Water

Form A Particulars of completed work

Work Licence No:

BORE DEVELOPMENT 8

Chemical used for breaking down drilling mud (Yes/No) Yes Name: chlorine

Method	Bailing/Surging	Jetting	Airlifting	Backwashing	Pumping	Other:
	[ ]	[ ]	[X]	[ ]	[X]	
Duration	hrs	hrs	2-5 hrs	hrs	1 hrs	hrs

DISINFECTION ON COMPLETION 9

Chemical(s) used	Quantity applied (Litres)	Method of application

PUMPING TESTS ON COMPLETION 10

Test type		Date	Pump intake depth (m)	Initial Water Level (SWL) (m)	Pumping rate (L/s)	Water Level at end of pumping (DDL) (m)	Duration of Test (hrs)	Recovery: Water level (m)	Recovery: Time taken (hrs)	Recovery: Time taken (mins)
Multi stage (stepped drawdown)	Stage 1									
	Stage 2									
	Stage 3									
	Stage 4									
Single stage (constant rate)										

Height of measuring point above ground level [ ] m Test Method [ ] See Code 4

WORK PARTLY BACKFILLED OR ABANDONED 11

Original depth of work: 84.05 m Is work partly backfilled: (Yes/No) [ ]

Is work abandoned: (Yes/No) [ ] Method of abandonment: Backfilled [ ] Plugged [ ] Capped [ ]

Has any casing been left in the work (Yes/No) [ ] From [ ] m To [ ] m

Sealing / fill type (See Code 11)	From depth (m)	To depth (m)	Sealing / fill type (See Code 11)	From depth (m)	To depth (m)

Site chosen by: Hydrogeologist [ ] Geologist [ ] Driller [ ] Diviner [ ] Client [X] Other [ ] 12

13

Lot No 2 DP No 574308

Work Location Co ordinates Easting [ ] Northing [ ] Zone [ ]

GPS: (Yes/No) [ ] >> AMG/AGD [ ] or MGA/GDA [ ] (See explanation)

Longitude [ ] [ ] [ ] Latitude [ ] [ ] [ ]

Please mark the work site with "X" on the CLID provided map.

Indicate also the distances in metres from two (2) adjacent boundaries, and attach the map to this Form A package.

Signatures:

Driller: [signature] **Licensee:** .....

Date: 24/8/2015 **Date:** .....

SA 1502

Department of Primary Industries
Office of Water

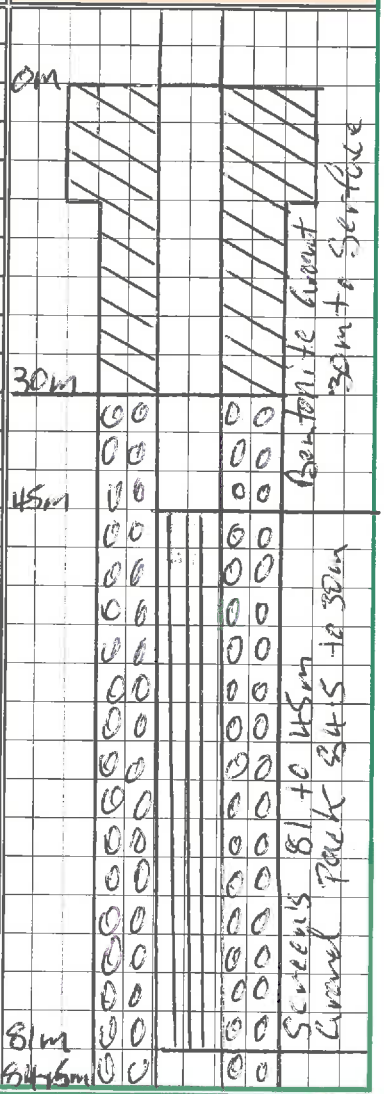
Form A Particulars of completed work

Work Licence No:

DRILLER'S ROCK/STRATA DESCRIPTION (LITHOLOGY)

Depth From (m)	Depth To (m)	Description (See Code 15)
0		See Attached Geologist Log

15 WORK CONSTRUCTION SKETCH



WORK NOT CONSTRUCTED BY DRILLING RIG — 16

Method of excavation: Hand dug ☐ Back hoe ☐ Dragline ☐ Dozer ☐ Other ☐

Depth (m)	Length (m)	Width (m)	Diameter (m)	Lining material	Dimentions of liner (m)	From Depth (m)	To Depth (m)

Please attach copies of the following if available — 17

Geologist log	(Yes/No) YES	Laboratory analysis of water Sample	(Yes/No) NO	Pumping test(s)	(Yes/No) NO
Geophysical log	(Yes/No) NO	Sieve analysis of aquifer material	(Yes/No) NO	Installed Pump details	(Yes/No) NO

SA1503

Department of Primary Industries
Office of Water

Form A Particulars of completed work

Driller's Licence No:	DL 2266	1
Class of Licence:	4	
Driller's Name:	S Baker	
Assistant Driller:	J cox T willcockson	
Contractor:	LCR contracting	
New bore	X	
Deepened		
Reconditioned		
Replacement bore		
Enlarged		
Other (specify)		
Final Depth	101.75 m	SA1503

Work Licence No:	20BL173794	2
Name of Licensee:	Hawdson	
Intended Use:	water monitoring	
Completion Date:	22/08/2015	

DRILLING DETAILS 3

From (m)	To (m)	Hole Diameter (mm)	Drilling Method See Code 3
0	9	123	7
9	101.75	96	13

WATER BEARING ZONES 4

From (m)	To (m)	Thickness (m)	S W L (m)	Estimated Yield (L/s) Individual Aquifer	Estimated Yield (L/s) Cumulative	Test method See Code 4		D D L at end of test (m)	Duration Hrs	Duration min	Salinity (Conductivity or TDS) Cond (µS/cm)	Salinity (Conductivity or TDS) TDS (mg/L)
30	101.75	71.75	15		0.2		1	16	2	30		

CASING / LINER DETAILS 5

Material Code 5	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Method Fixing Code 5
6	50	8	0	30	5

Casing support method — See Code 5: 2

Type of casing bottom — See Code 5: 2

Centralisers installed (Yes/No): no (indicate on sketch)

Sump installed (Yes/No): no From m To m

Pressure cemented (Yes/No): no From m To m

Casing Protector cemented in place

WATER ENTRY DESIGN 6

General Material Code 5	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Opening type See Code 6	Fixing See Code 5	Screen Aperture (mm)	Slot Details Length (mm)	Width (mm)	Alignment See Code 6
6	50	8	30	101.75	5	5	1			H

GRAVEL PACK 7

Type		Grade		Grain size (mm) From	Grain size (mm) To	Depth (m) From	Depth (m) To	Quantity Litres	Quantity m^3
Rounded		Graded	X	5	7	29	101.75	374	0.37
Crushed		Ungraded							
Bentonite/Grout seal (Yes/No)	yes					0	29	163	0.16
Method of placement of Gravel Pack		See Code 7	1						

For Departmental use only: GW

SA 1503

Department of Primary Industries
Office of Water

Form A Particulars of completed work

Work Licence No:

BORE DEVELOPMENT 8

Chemical used for breaking down drilling mud (Yes/No)	YES	Name:	CHLORINE								
Method	Bailing/Surging		Jetting		Airlifting	X	Backwashing		Pumping	X	Other:
Duration		hrs		hrs	1-3	hrs		hrs	1	hrs	hrs

DISINFECTION ON COMPLETION 9

Chemical(s) used	Quantity applied (Litres)	Method of application

PUMPING TESTS ON COMPLETION 10

Test type		Date	Pump intake depth (m)	Initial Water Level (SWL) (m)	Pumping rate (L/s)	Water Level at end of pumping (DDL) (m)	Duration of Test (hrs)	Recovery: Water level (m)	Recovery: Time taken (hrs)	Recovery: Time taken (mins)
Multi stage (stepped drawdown)	Stage 1									
	Stage 2									
	Stage 3									
	Stage 4									
Single stage (constant rate)										

Height of measuring point above ground level ____ m Test Method ____ See Code 4

WORK PARTLY BACKFILLED OR ABANDONED 11

Original depth of work: ____ m Is work partly backfilled: (Yes/No) ____

Is work abandoned: (Yes/No) ____ Method of abandonment: Backfilled ____ Plugged ____ Capped ____

Has any casing been left in the work (Yes/No) ____ From ____ m To ____ m

Sealing / fill type (See Code 11)	From depth (m)	To depth (m)	Sealing / fill type (See Code 11)	From depth (m)	To depth (m)

Site chosen by: Hydrogeologist ____ Geologist ____ Driller ____ Diviner ____ Client X Other ____ 12

13

Lot No 2 DP No 574308

Work Location Co ordinates Easting 482127 Northing 6521775 Zone ____

GPS: (Yes/No) ____ >> AMG/AGD ____ or MGA/GDA ____ (See explanation)

Longitude ____ Latitude ____

Please mark the work site with "X" on the CLID provided map.

Indicate also the distances in metres from two (2) adjacent boundaries, and attach the map to this Form A package.

Signatures:

Driller: _____ **Licensee:** _____

Date: 24/08/2015 **Date:** _____

Please submit forms to water.gds@dpi.nsw.gov.au or to the local NSW Office of Water agency

SA 1503

Department of Primary Industries
Office of Water

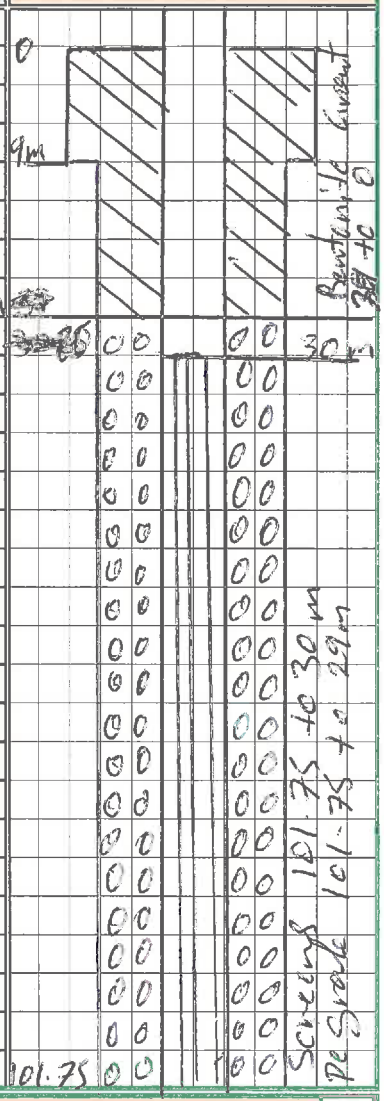
Form A Particulars of completed work

Work Licence No:

DRILLER'S ROCK/STRATA DESCRIPTION (LITHOLOGY)

Depth From (m)	Depth To (m)	Description (See Code 15)
0		See Attached Geologist Log

15 WORK CONSTRUCTION SKETCH



WORK NOT CONSTRUCTED BY DRILLING RIG — 16

Method of excavation: Hand dug ☐ Back hoe ☐ Dragline ☐ Dozer ☐ Other ☐

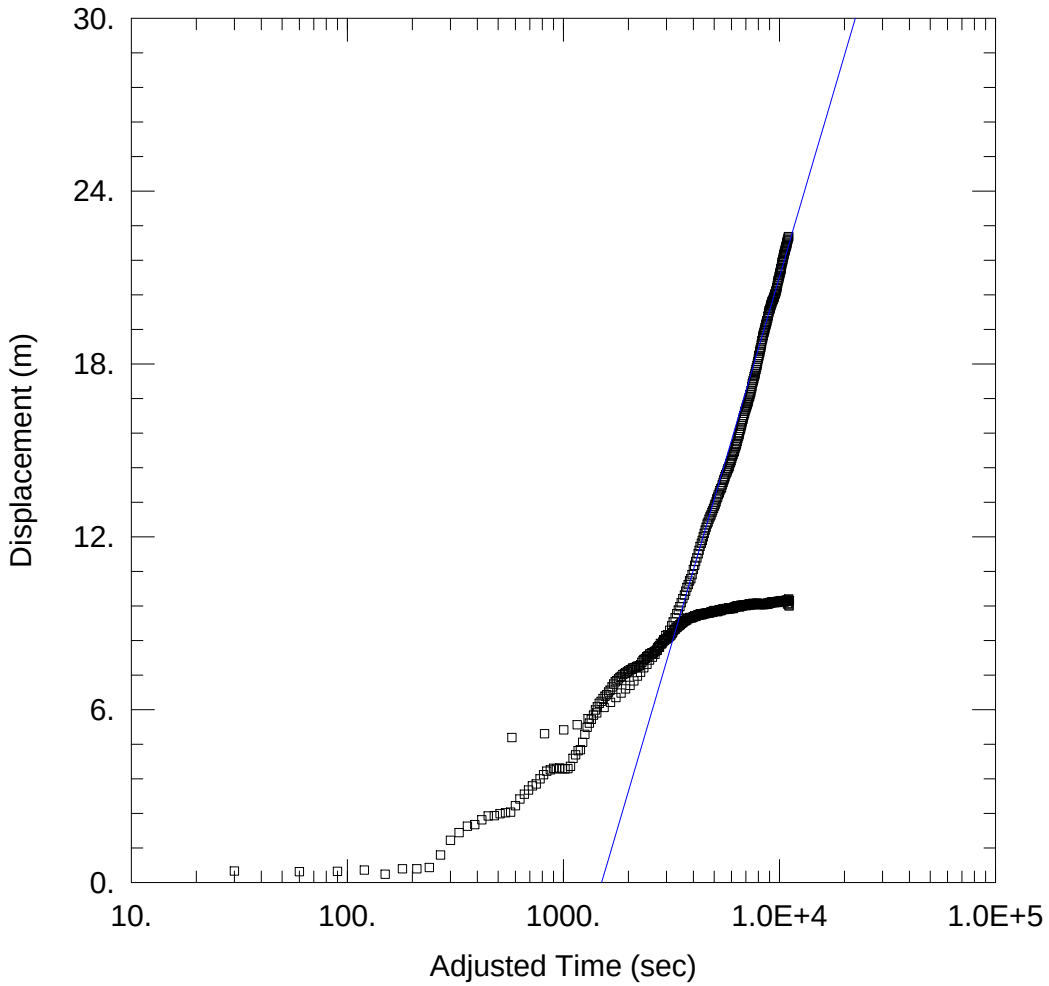
Depth (m)	Length (m)	Width (m)	Diameter (m)	Lining material	Dimentions of liner (m)	From Depth (m)	To Depth (m)

Please attach copies of the following if available — 17

Geologist log	(Yes/No) YES	Laboratory analysis of water Sample	(Yes/No) no	Pumping test(s)	(Yes/No) no
Geophysical log	(Yes/No) no	Sieve analysis of aquifer material	(Yes/No) no	Installed Pump details	(Yes/No) no

Annex C

AQTESOLV Outputs



WELL TEST ANALYSIS

Data Set: P:\...\SA1501 - Both Pumping Stages - Cooper Jacob.aqt
Date: 02/01/18 Time: 10:42:42

PROJECT INFORMATION

Company: ERM
Client: Hanson
Project: 0418291
Location: Sancrox
Test Well: SA1501
Test Date: 29 November 2017

AQUIFER DATA

Saturated Thickness: 70. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SA1501	0	0

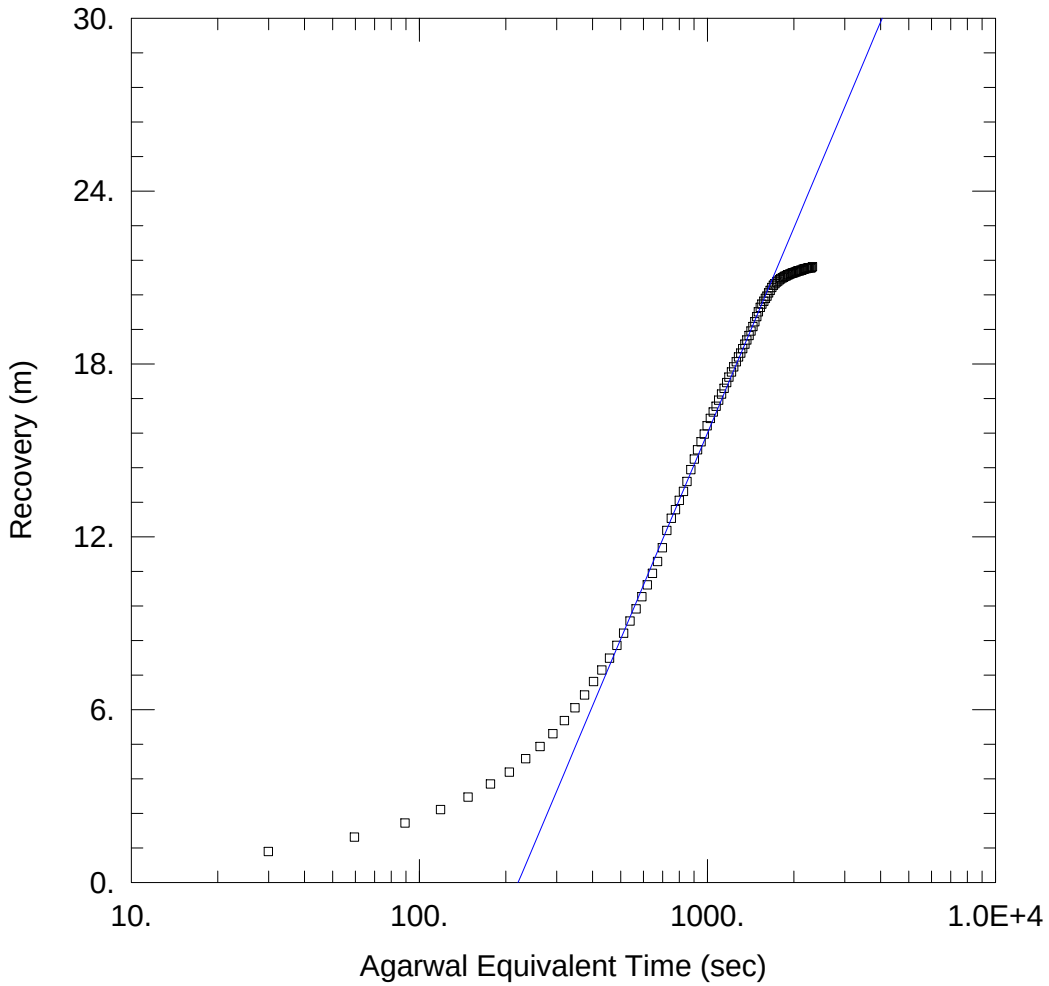
Observation Wells

Well Name	X (m)	Y (m)
SA1501	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 0.062 m^2/day S = 3.878



WELL TEST ANALYSIS

Data Set: P:\...\SA1501 - Recovery Stage - Cooper Jacob.aqt
Date: 02/01/18 Time: 10:44:47

PROJECT INFORMATION

Company: ERM
Client: Hanson
Project: 0418291
Location: Sancrox
Test Well: SA1501
Test Date: 29 November 2017

AQUIFER DATA

Saturated Thickness: 70. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SA1501	0	0

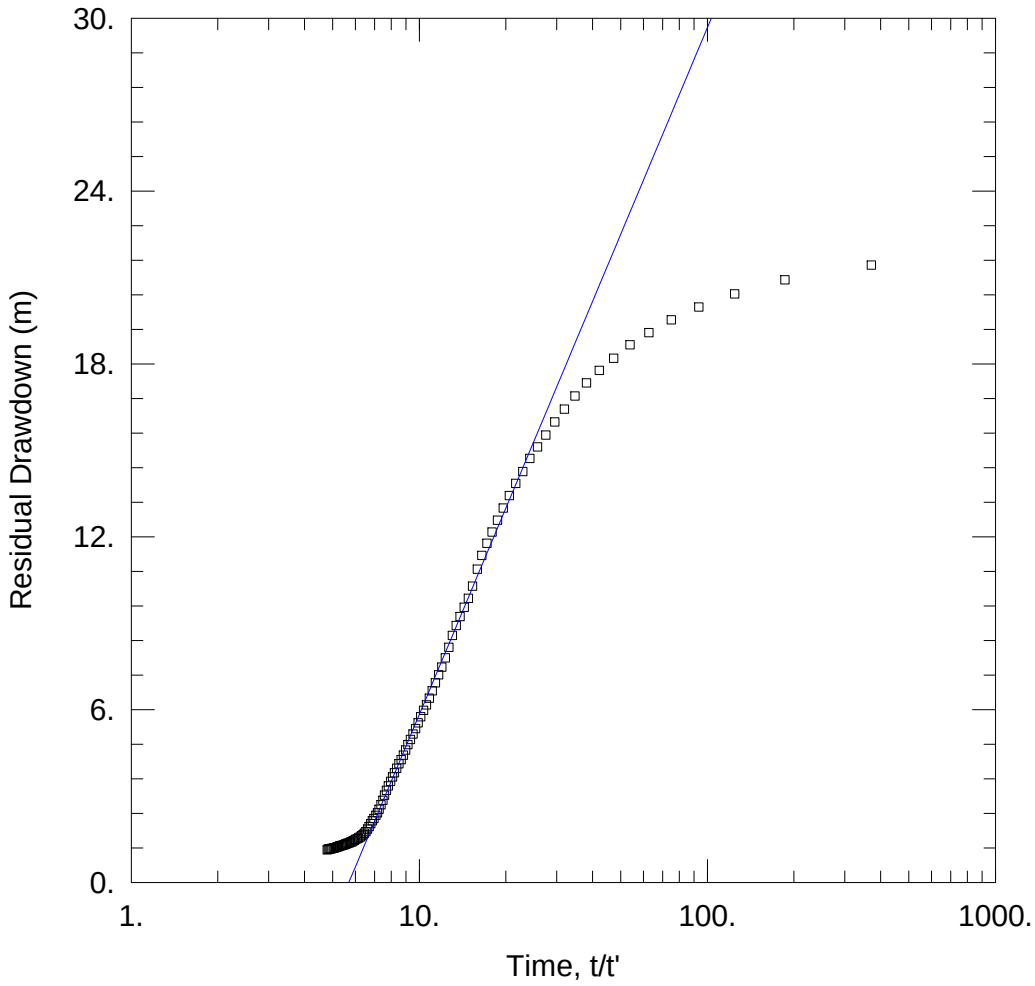
Observation Wells

Well Name	X (m)	Y (m)
▫ SA1501	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 0.06667 m^2/day S = 0.6113



WELL TEST ANALYSIS

Data Set: P:\...\SA1501 - Recovery Stage - Theis Recovery.aqt
Date: 02/01/18 Time: 10:46:02

PROJECT INFORMATION

Company: ERM
Client: Hanson
Project: 0418291
Location: Sancrox
Test Well: SA1501
Test Date: 29 November 2017

AQUIFER DATA

Saturated Thickness: 70. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SA1501	0	0

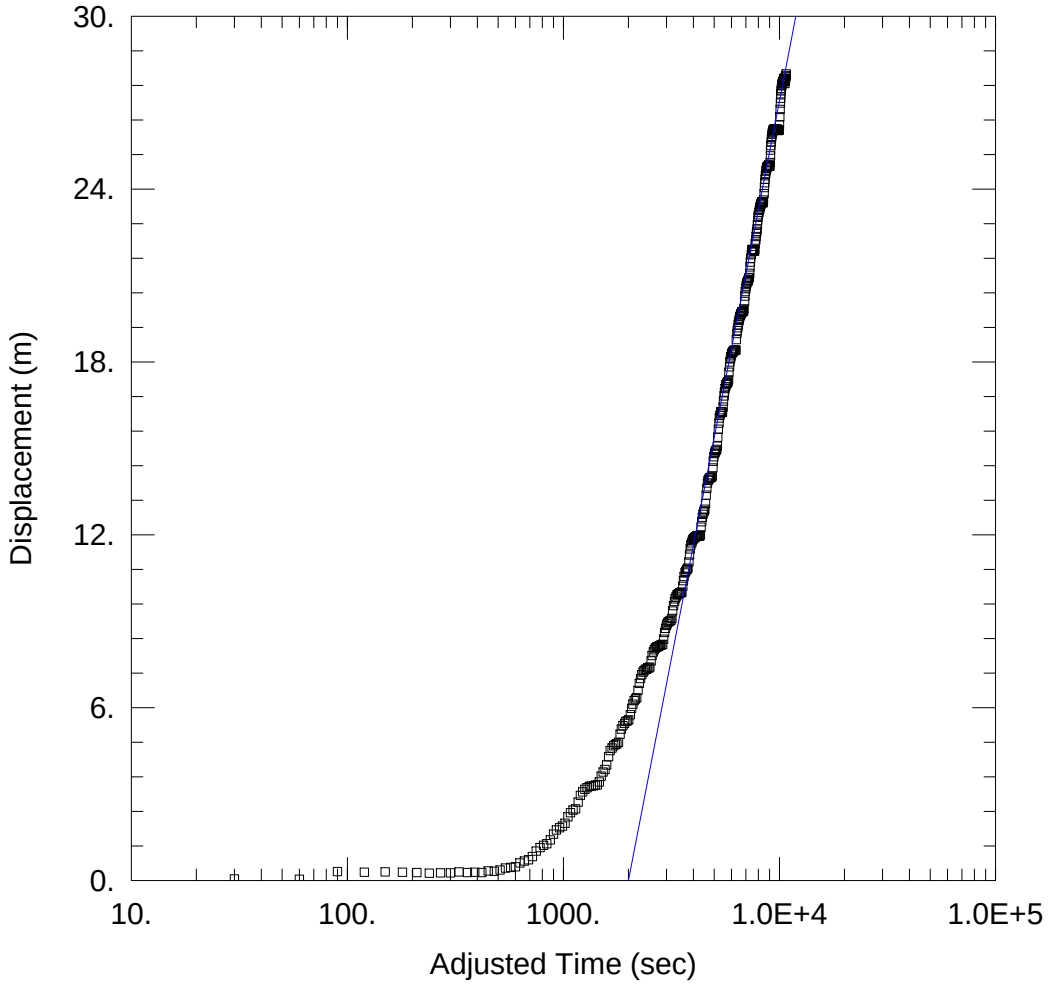
Observation Wells

Well Name	X (m)	Y (m)
▫ SA1501	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 0.06643 m^2/day S/S' = 5.693



WELL TEST ANALYSIS

Data Set: P:\...\SA1502 - 1st Pumping Stage - Cooper Jacob.aqt
Date: 02/01/18 Time: 10:47:13

PROJECT INFORMATION

Company: ERM
Client: Hanson
Project: 0418291
Location: Sancrox
Test Well: SA1502
Test Date: 28 November 2017

AQUIFER DATA

Saturated Thickness: 36. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SA1502	0	0

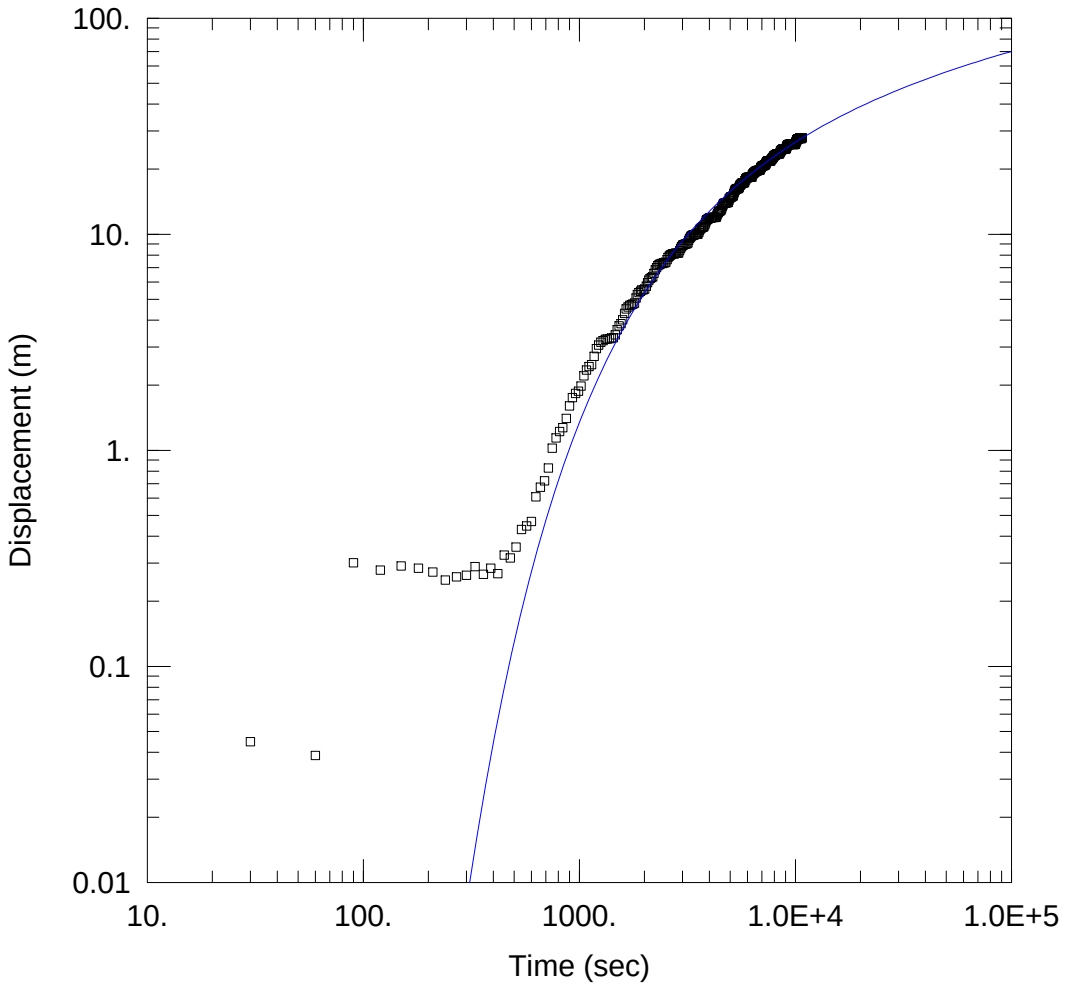
Observation Wells

Well Name	X (m)	Y (m)
▫ SA1502	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 0.006819 m^2/day S = 0.5673



WELL TEST ANALYSIS

Data Set: P:\...\SA1502 - 1st Pumping Stage - Theis Hantush.aqt
Date: 02/01/18 Time: 10:48:07

PROJECT INFORMATION

Company: ERM
Client: Hanson
Project: 0418291
Location: Sancrox
Test Well: SA1502
Test Date: 28 November 2017

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SA1502	0	0

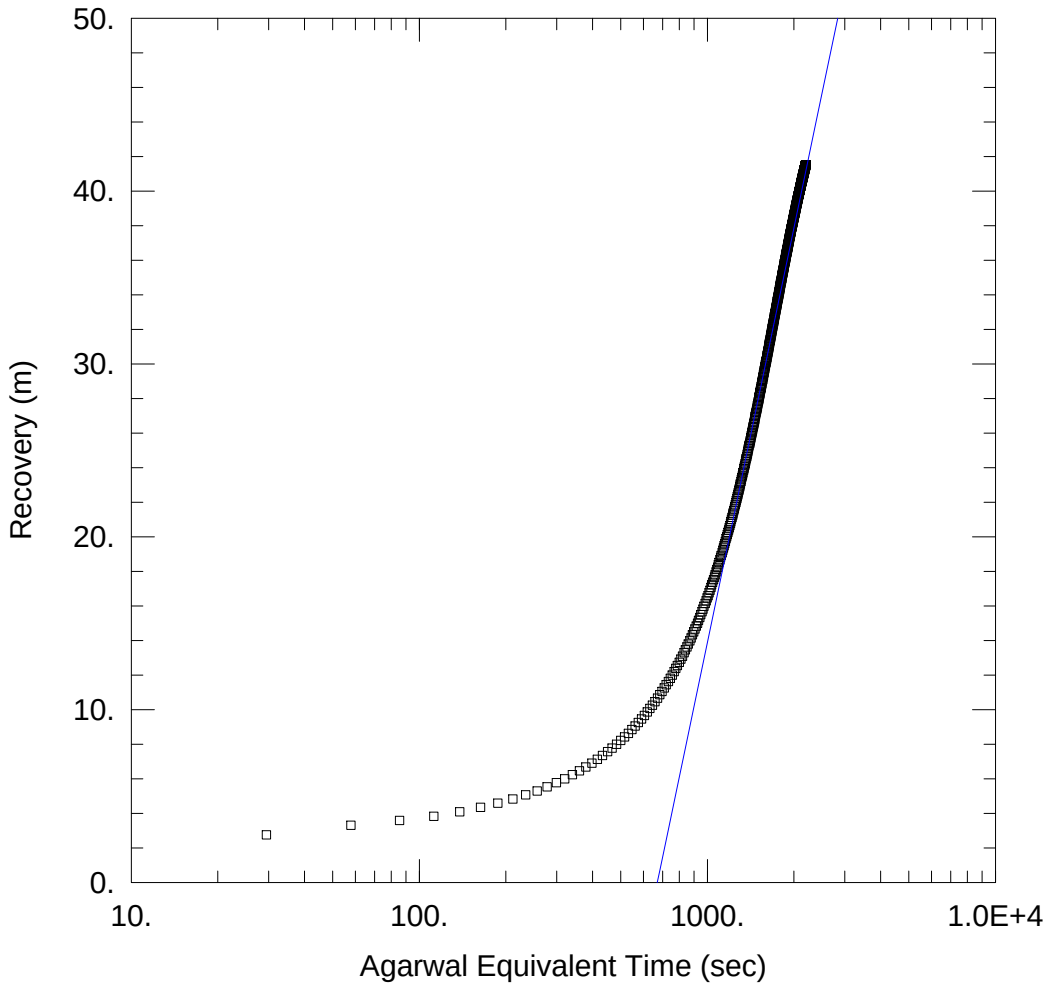
Observation Wells

Well Name	X (m)	Y (m)
□ SA1502	0	0

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 0.005671 m^2/day
S = 0.7479
Kz/Kr = 1.
b = 36. m



WELL TEST ANALYSIS

Data Set: P:\...\SA1502 - Recovery Stage - Cooper Jacob.aqt
Date: 02/01/18 Time: 10:49:01

PROJECT INFORMATION

Company: ERM
Client: Hanson
Project: 0418291
Location: Sancrox
Test Well: SA1502
Test Date: 28 November 2017

AQUIFER DATA

Saturated Thickness: 36. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SA1502	0	0

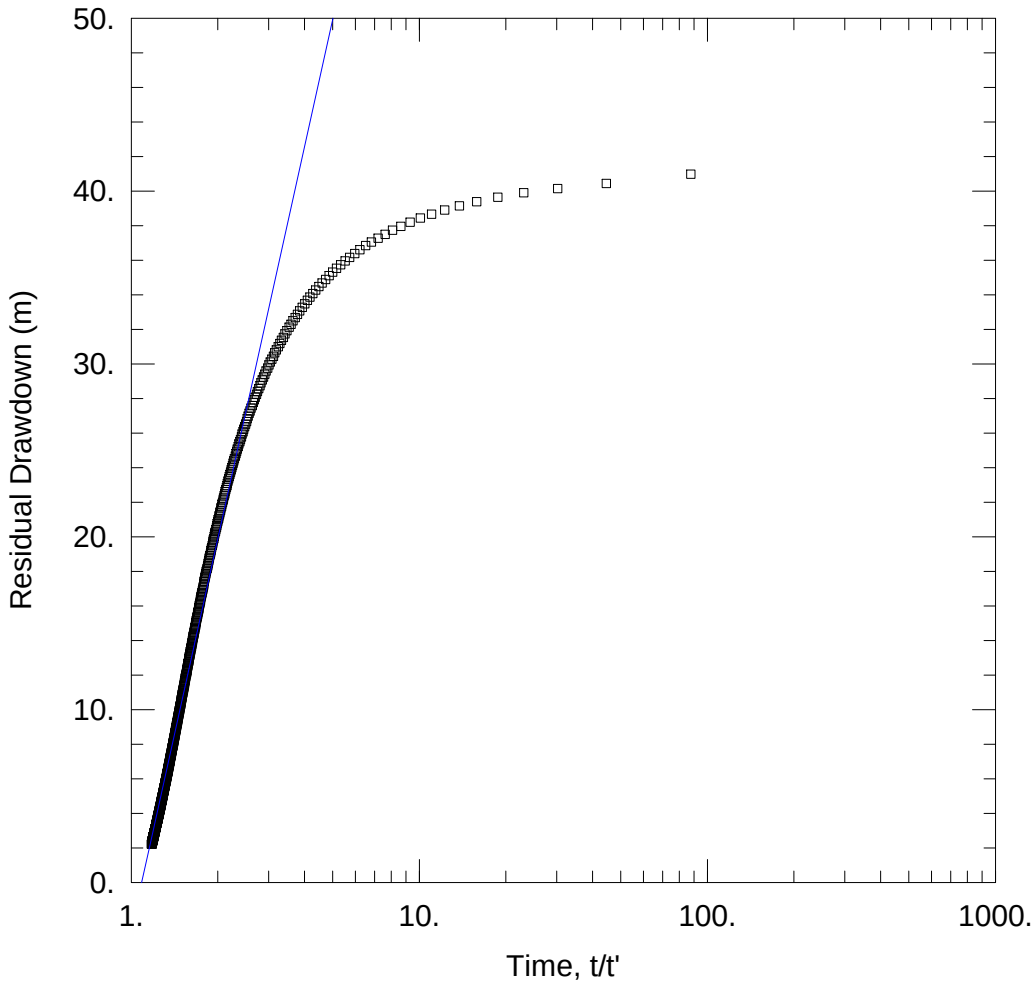
Observation Wells

Well Name	X (m)	Y (m)
▫ SA1502	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 0.009913 m^2/day S = 0.2763



WELL TEST ANALYSIS

Data Set: P:\...\SA1502 - Recovery Stage - Theis Recovery.aqt
Date: 02/01/18 Time: 10:50:14

PROJECT INFORMATION

Company: ERM
Client: Hanson
Project: 0418291
Location: Sancrox
Test Well: SA1502
Test Date: 28 November 2017

AQUIFER DATA

Saturated Thickness: 36. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SA1502	0	0

Observation Wells

Well Name	X (m)	Y (m)
▫ SA1502	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 0.01051 m^2/day S/S' = 1.087

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New Zealand
Peru
Poland
Portugal
Puerto Rico
Singapore
Spain
Sri Lanka
Sweden
Taiwan
Thailand
UK
USA
Venezuela
Vietnam

Environmental Resources Management

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Newcastle NSW 2300
Watt Street Commercial Centre
45 Watt Street
Newcastle NSW2300

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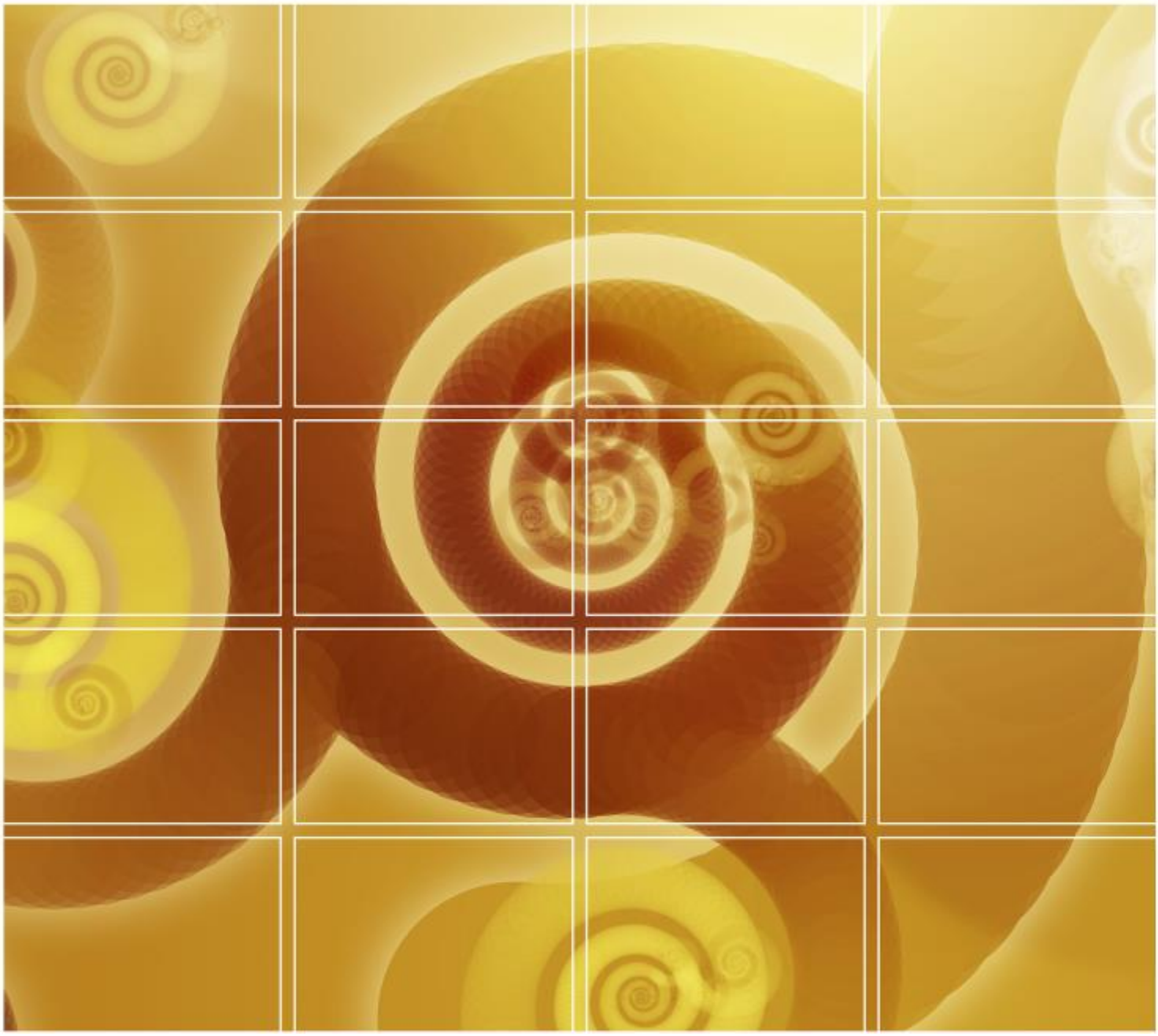
Annex G

Noise And Vibration Impact Assessment



Sancrox Quarry Expansion

Noise and Vibration Impact Assessment

Hanson Construction Materials Pty Ltd

August 2019

0418291_Final

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Sancrox Quarry Expansion

Noise and Vibration Impact Assessment

Hanson Construction Materials Pty Ltd (Hanson)

August 2019

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Approved by:	*Thomas Buchan*
Position:	Project Manager
Signed:	
Date:	*28 August, 2019*
Approved by:	*Murray Curtis*
Position:	Partner Director
Signed:	
Date:	*28 August 2019*

Environmental Resources Management Australia Pty Ltd

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1 INTRODUCTION

1.1 BACKGROUND

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Hanson Construction Materials Pty Ltd (Hanson) to conduct a Noise and Vibration Impact Assessment to inform the Environmental Impact Assessment (EIA) for the proposed Sancrox Quarry Expansion Project (the Project).

The Project is a State Significant Development (SSD #7293) and therefore the planning approvals process is regulated under Part 4.1 of the *Environmental Planning and Assessment Act 1979* (the EP&A Act), which requires Department of Planning and Environment (DP&E) approval for development consent, supported by an Environmental Impact Statement (EIS).

This report presents the methodology, results and findings of the assessment and considers the following environmental factors:

- Construction noise and vibration.
- Operational noise and vibration.
- Road traffic noise during construction and operation.
- Blasting overpressure and ground-borne vibration.

This report has been prepared to document the assessment of the environmental factors listed above and meet the requirements of the Secretary's Environmental Assessment Requirements (SEARs).

1.2 PROJECT DESCRIPTION

Hanson proposes to extend the life of the quarry by expanding the approved extraction boundary to facilitate the extraction and distribution of high quality construction materials for use in civil infrastructure and road construction projects. The Project will provide vital construction resources to service and accommodate further regional development in the Port Macquarie Hastings region.

The proposed expansion of the Sancrox Quarry will increase operations to 24 hours per day, seven days a week, increasing extraction from 455,000 tonnes per annum (tpa) to 750,000 tpa. The expansion of the quarry will progress westward and southward to excavate new resource.

The quarrying will be undertaken in five stages, with the first two extending the footprint of the quarry, the third stage deepening within the footprint, and the final two stages extending the footprint and extracting to the approved depth of 40 metres (m) Australian Height Datum (AHD).

In addition to the expansion of the quarry, the site will establish new ancillary facilities, including:

- a concrete batching plant (50,000 tpa);
- a concrete recycling facility (20,000 tpa); and
- an asphalt production plant (50,000 tpa).

Chapter 2 of the EIS provides further details of the Project.

1.3 PROJECT LOCALITY

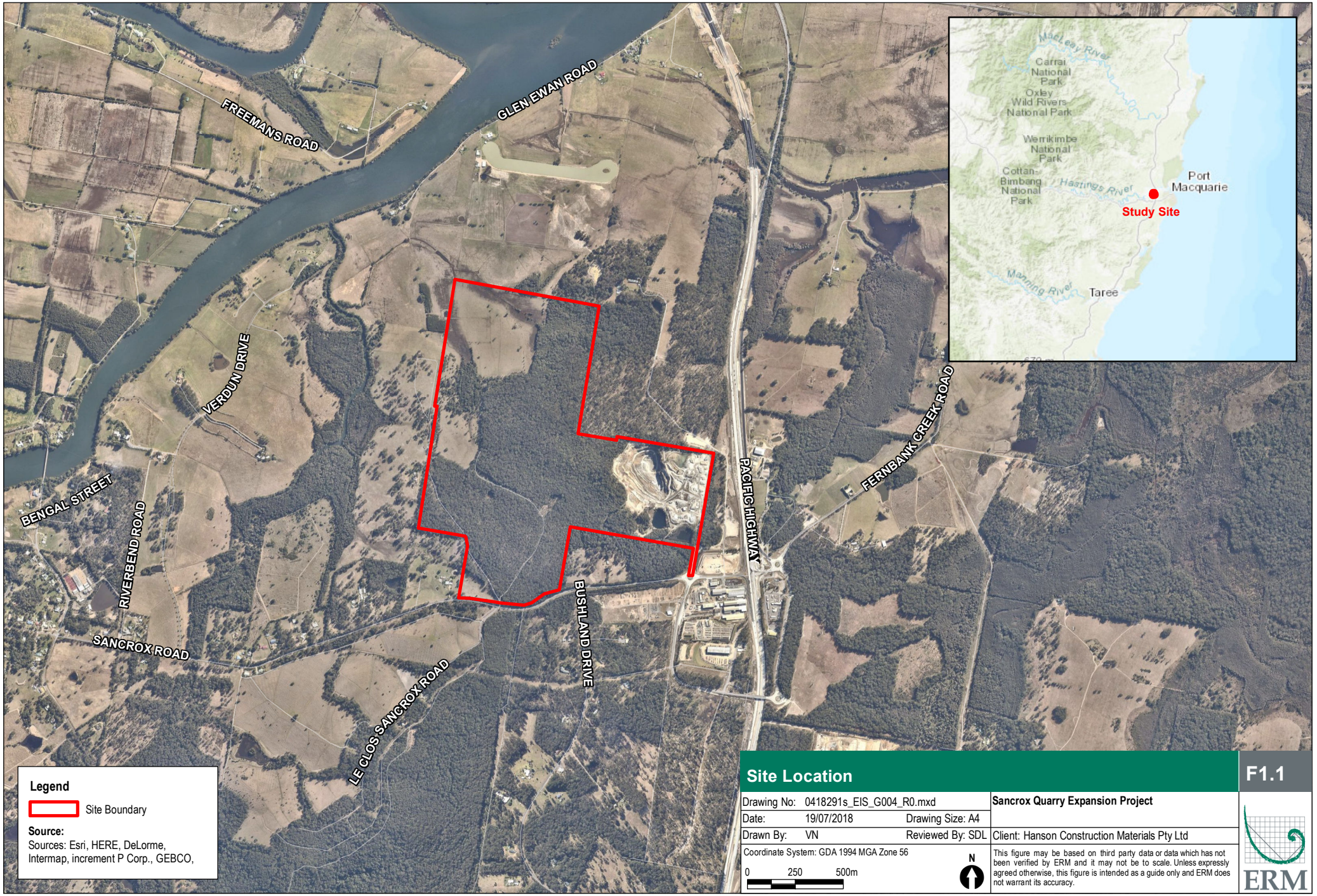
The Sancrox Quarry is located off Sancrox Road, in Sancrox NSW, approximately six kilometres (km) west of Port Macquarie. Hanson owned land includes the existing operational quarry area, as well as surrounding non-operational land.

The Project site is zoned RU1 (Primary Production) within the Port Macquarie – Hastings Local Environment Plan 2011. The environment surrounding the site includes remnant woodland vegetation immediately adjacent to the north, west and south. A narrow strip of vegetation is present along the eastern boundary, with partially cleared land located 100m to the east. The Pacific Highway and Cassegrain Winery are located approximately 175 m and 210 m to the east, respectively. Sancrox Road is located approximately 230 m to the south of the site, with a suite of industrial facilities beyond.

The closest residence to the site is located approximately 150 m to the south, along Sancrox Road. A number of rural residential residences are also located along Bushland Drive to the south-west of the site, the closest being approximately 650 m to the south-west. Another rural residential residence is located approximately 1 km to the west.

The location of the Sancrox Quarry, surrounding area and other items of importance to this assessment are identified in *Figure 1.1* to *Figure 1.3*. *Figure 1.3* includes the dwelling (receptor) locations adopted for assessing the potential noise and vibration impacts from the Project. The original proposed Project staging and layout of the ancillary facilities is presented in *Annex A.*

It should be noted that during the preparation of this report the pit layout of stage 4 and the final stage was modified in north-western corner. This was a due to the risk of flooding identified in the hydrology assessment. The updated staging layout is presented in Chapter 2 of this EIS. Based on these minor changes to the pit layout, it is not anticipated that noise impacts will alter significantly. Therefore the original noise modelling results have been retained for this report.



Site Location

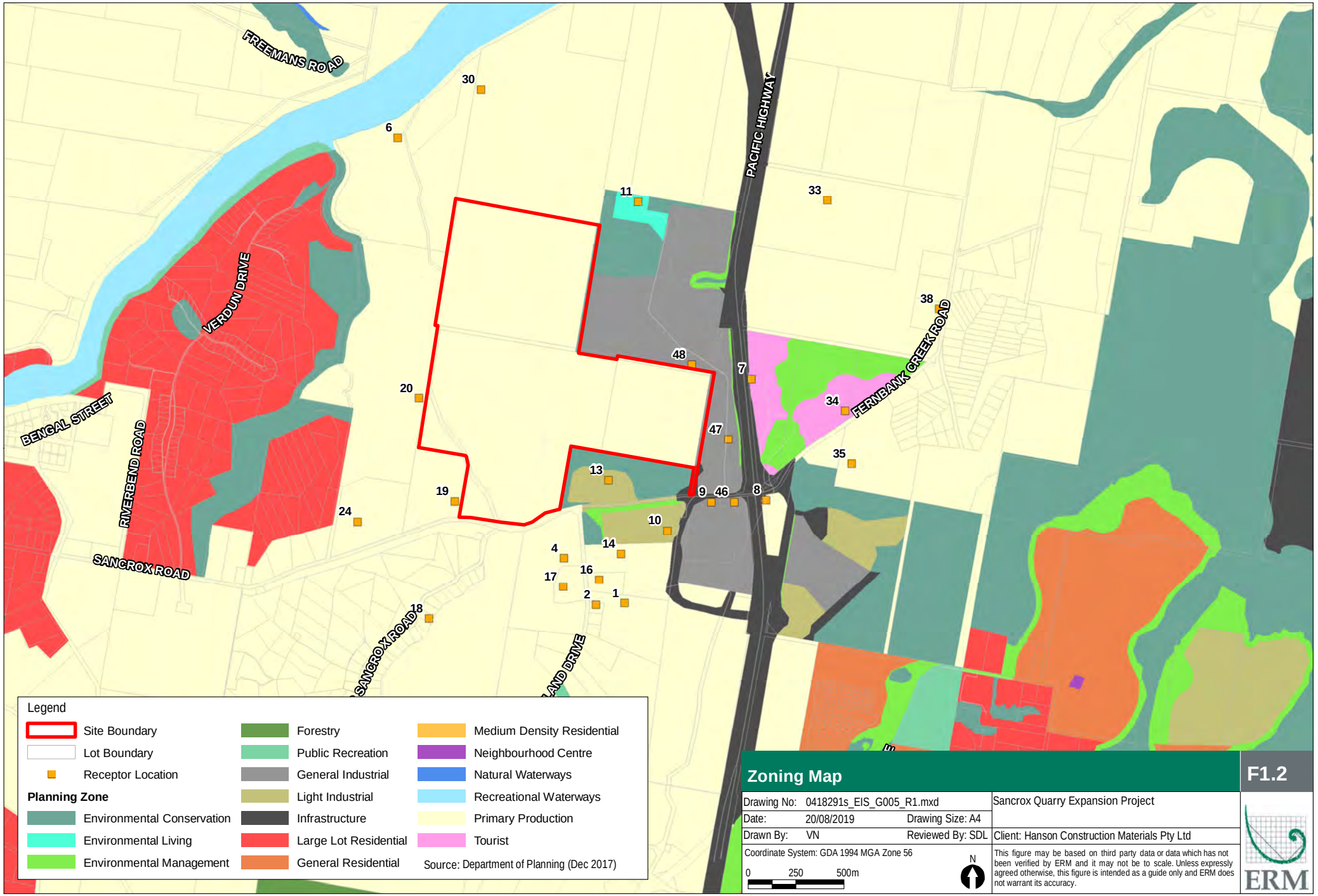
F1.1

Drawing No:	0418291s_EIS_G004_R0.mxd		Sancrox Quarry Expansion Project
Date:	19/07/2018	Drawing Size: A4	
Drawn By:	VN	Reviewed By: SDL	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM


FREEMANS ROAD
PACIFIC HIGHWAY
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANGROX ROAD
FERNBANK CREEK ROAD
SANGROX ROAD
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35
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19
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46
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24
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14
4
16
17
2
1
18
Legend
Site Boundary
Lot Boundary
Receptor Location
Planning Zone
Environmental Conservation
Environmental Living
Environmental Management
Forestry
Public Recreation
General Industrial
Light Industrial
Infrastructure
Large Lot Residential
General Residential
Medium Density Residential
Neighbourhood Centre
Natural Waterways
Recreational Waterways
Primary Production
Tourist
Source: Department of Planning (Dec 2017)
Zoning Map
F1.2
Drawing No: 0418291s_EIS_G005_R1.mxd
Date: 20/08/2019
Drawing Size: A4
Drawn By: VN
Reviewed By: SDL
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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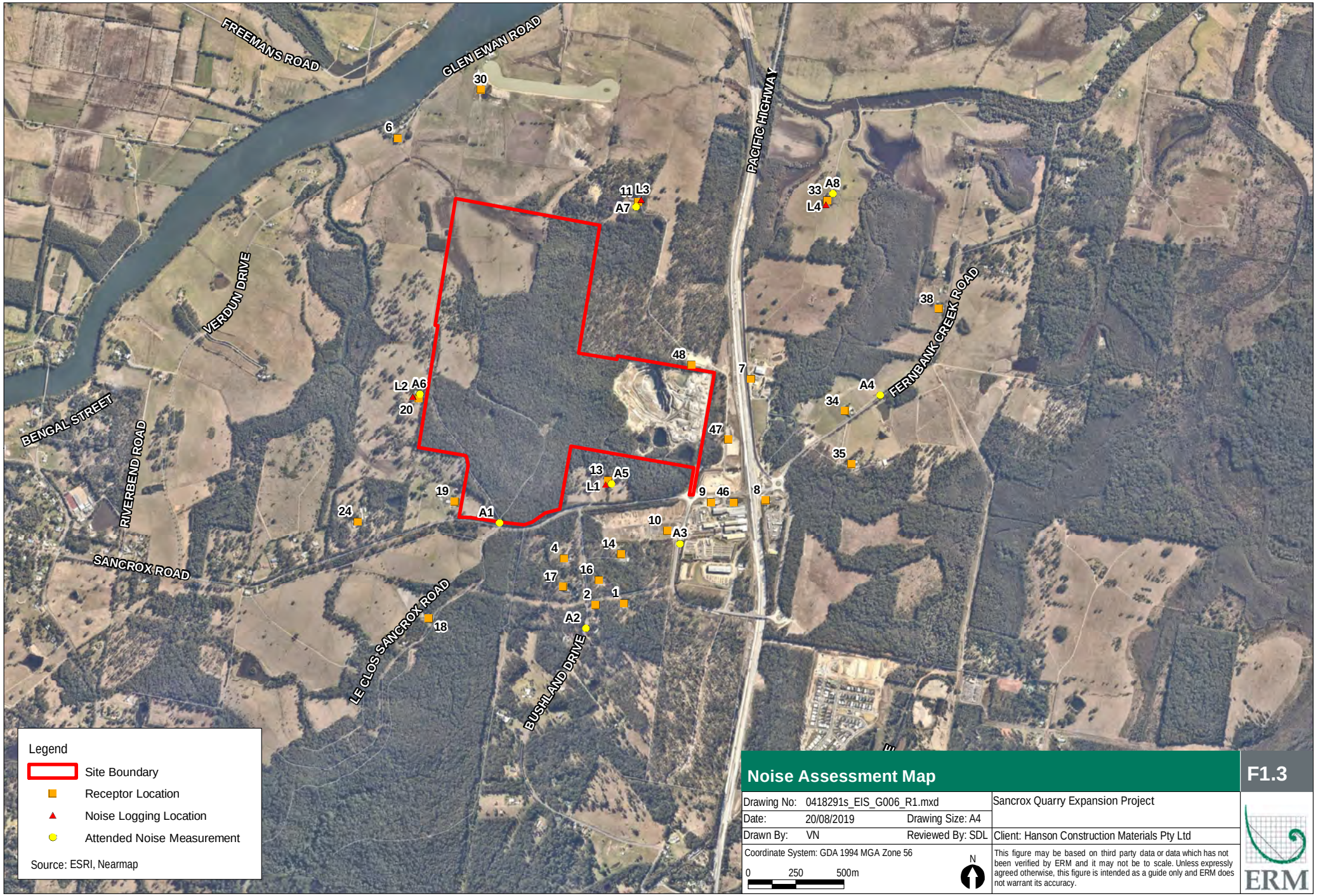
FREEMANS ROAD
GLEN EWAN ROAD
PACIFIC HIGHWAY
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
FERNBANK CREEK ROAD
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A1
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A3
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14
16
17
2
1
A2
18
Legend
Site Boundary
Receptor Location
Noise Logging Location
Attended Noise Measurement
Source: ESRI, Nearmap
Noise Assessment Map
F1.3
Drawing No: 0418291s_EIS_G006_R1.mxd
Sancrox Quarry Expansion Project
Date: 20/08/2019
Drawing Size: A4
Drawn By: VN
Reviewed By: SDL
Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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2 ASSESSMENT METHODOLOGY

This chapter describes the assessment methodology adopted for potential quarry construction and operational noise impact at nearby receptors. It also presents the methodology adopted for evaluating potential blasting overpressure and vibration impacts at nearby receptors. It should be noted that the noise modelling assessment includes conceptual mitigation (described in *Section 2.10.2*) based on reasonable and feasible mitigation measures determined through consultation with Hanson. In summary this includes boundary mitigation, plant/equipment procurement and at source mitigation.

An acoustics glossary of relevant acoustical concepts and terminology is provided in *Annex B*. All sound pressure levels presented in this report (e.g. noise levels predicted at a receptor) are in decibels referenced to 2×10^{-5} Pa. All sound power levels presented in this report (e.g. noise levels assigned to specific sources) are decibels referenced to 10^{-12}W.

A baseline noise monitoring campaign to quantify the existing noise environment (ambient and background noise levels) at the closest and/or potentially most affected residential receptors situated in the vicinity of the Project has been completed, as described in *Chapter 3*.

2.1 OBJECTIVES AND SCOPE OF WORK

The objective of this Noise and Vibration Impact Assessment is to meet the requirements of the Secretary's Environmental Assessment Requirements (SEARs). Noise and blasting related SEARs are outlined in *Table 2.1* below.

Table 2.1 Secretary's Environmental Assessment Requirements (SEARs)

SEARs	Where it's addressed
A detailed assessment of the likely construction, operational and off-site transport noise impacts of the development in accordance with the Interim Construction Noise Guideline, NSW Industrial Noise Policy and the NSW Road Noise Policy respectively, and having regard to the Voluntary Land Acquisition and Mitigation Policy.	Chapter 2 Chapter 6 Chapter 7
If a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the Interim Construction Noise Guideline.	Chapter 4 Chapter 6
Proposed blasting hours, frequency and methods.	Section 4.3.2
A detailed assessment of the likely blasting impacts of the development (including noise, vibrations, overpressure, visual and odour) on people, animals, buildings, infrastructure and significant natural features, having regard to the relevant ANZEC guidelines.	Section 7.5
Reasonable and feasible mitigation measures to minimise noise emissions.	Chapter 8
Monitoring and management measures, in particular real-time and attended noise monitoring.	Section 8.4

To assess Project construction and operational noise and vibration (including road traffic), the following scope of work has been completed:

- Review and validate the available Project and third party data and information as considered relevant to the assessment.
- Review aerial photography, zoning data, cadastre data and third party assessments conducted in the area to identify potential residential and other sensitive receptors situated within the potential area of influence of the quarry.
- Identify significant noise and vibration generating plant, equipment and machinery that may be in use or activities that will be undertaken as part of the Project and their likely/known emissions to develop applicable assessment scenarios.
- Review unattended noise measurement data to establish representative baseline noise levels for the area and then develop Project-specific noise and vibration criteria in accordance with recognised NSW policy and guidelines as applicable to Project activities.
- Complete a qualitative assessment of low risk acoustical factors (road traffic noise, vibration and ground-borne noise). Complete a quantitative assessment of key acoustical factors, including potential noise impacts associated with construction and operational aspects. The quantitative assessment was completed by predicting Project noise levels (via modelling) for the scenarios developed.
- Provide a comparison of predicted levels to the Project-specific develop noise and vibration criteria at receptors, identify any noise levels that exceed criteria and determine the magnitude and extent of any impacts.
- Recommend mitigation, management measures and/or monitoring options suitable to the predicted levels and designed to minimise impacts as far as is feasible, reasonable and practicable to implement.

2.2 *POLICY SETTING*

In NSW, noise pollution is regulated through the *Protection of the Environment Operations Act 1997* (POEO Act) as the key piece of environment protection legislation. Noise pollution is defined under the POEO Act as:

'*the emission of offensive noise, which means noise that by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances, is harmful (or is likely to be harmful) to or interferes unreasonably (or is likely to interfere unreasonably) with the comfort or repose of a person outside the premises from which the noise is emitted*'.

Under the POEO Act, the *POEO (Noise Control) Regulation 2008* addresses common noisy activities that occur in residential situations; it limits the time of day that noisy articles (such as lawn mowers, stereos and leaf blowers) are permitted to be heard in neighbouring residences, however it does not specify noise limits and an applicable approach for the assessment of existing sites.

Various noise and vibration assessment guidelines endorsed by NSW regulators (refer to *Section 2.3*) provide a guidance framework and methodology for deriving acceptable levels and standard methods for assessing and measuring construction and operational impacts with due regard to the POEO Act. The guidelines and standards are discussed below.

2.3 RELEVANT POLICY, GUIDELINES AND STANDARDS

This assessment has been conducted with due regard to and in accordance with the following key policy, guidelines and standards:

- Australian and New Zealand Environment Council (ANZEC) – *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*, 1990.
- Department of Planning and Environment (DP&E) - *Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments*, September 2018.
- International Organisation for Standardisation (ISO) 9613-2:1996 (ISO9613:2) - *Acoustics - Attenuation of Sound during Propagation Outdoors - Part 2: General Method of Calculation*.
- German Institute for Standardisation – DIN 4150 (1999-02) Part 3 (DIN4150-3) – *Structural Vibration - Effects of Vibration on Structures*.
- NSW Environment Protection Authority (EPA) – NSW *Environmental Noise Management – Industrial Noise Policy* (INP), January 2000 and relevant application notes.
- NSW Department of Environment and Climate Change (DECC) – NSW *Interim Construction Noise Guideline* (ICNG), July 2009.
- NSW Department of Environment, Climate Change and Water (DECCW) – NSW *Road Noise Policy* (RNP), March 2011.
- NSW Department of Environment and Conservation – NSW *Environmental Noise Management – Assessing Vibration: A Technical Guideline* (the NSW Vibration Guideline), February 2006.
- NSW Government – Transport for NSW (TfNSW) *Construction Noise Strategy* (7TP-ST-157/2.0), dated April 2013.
- Standards Australia AS1055–1997™ (AS1055) – *Description and Measurement of Environmental Noise*, Parts 1, 2 and 3.
- Standards Australia AS IEC 61672.1–2004™ (AS61672) – *Electro Acoustics - Sound Level Meters Specifications Monitoring* or Standards Australia AS1259.2-

1990™ (AS1259) – *Acoustics – Sound Level Meters – Integrating Averaging* as relevant to the device.

- Standards Australia AS/IEC 60942:2004/IEC 60942:2003 (IEC60942) – Australian Standard™ – *Electroacoustics – Sound Calibrators*.
- Standards Australia AS2187.2-2006™ (AS2187.2) – *Explosives – Storage and Use Part 2: Use of Explosives*.
- Standards Australia AS 2436–2010™ (AS2436) – *Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites*.
- United Kingdom (UK) – *Calculation of Road Traffic Noise* (CoRTN) calculative methods, adapted to Australia conditions.

Further information regarding the application of the key policy and guidelines is provided below.

2.4 NSW INDUSTRIAL NOISE POLICY

Responsibility for the control of noise emissions in NSW is typically vested in Local Government and the NSW Environment Protection Authority (EPA). The INP and relevant application notes provide a framework and methodology for deriving limit conditions for consent and licence conditions.

The INP is designed for large and complex industrial sources and outlines processes designed to strike a feasible and reasonable balance between the operations of industrial activities and the protection of the community from noise levels that are intrusive or unpleasant.

In this case, the INP is considered the suitable document to establish baseline noise levels and to quantifiably assess potential noise emissions and impacts associated with the operation of the quarry.

The INP assessment methodology is outlined in more detail in *Annex C*. Baseline noise values are presented in *Chapter 3* and operational noise criteria presented in *Chapter 4*.

The INP (released in 2000) was withdrawn and replaced by the NSW Environment Protection Authority – *Noise Policy for Industry* (NPI) in October 2017. The implementation of the NPI as relevant to this Project is described below.

The INP does however remain the applicable policy and was implemented for the purposes of this assessment as per the requirements stated in the EPA document, *Implementation and Transitional Arrangements for the Noise Policy for Industry (2017).*

Item 2 of *Implementation and Transitional Arrangements for the Noise Policy for Industry (2017)* states that, "*The NPI (2017) will take effect immediately upon its release and should be referenced in relevant Secretary's Environmental Assessment*

Requirements (SEARs) for new industrial development issued after the policy release date. Where SEARs were issued before the release of the new NPI policy, and have not been modified, the assessment requirements referenced in the SEARs will apply for a period of two (2) years from the date of issue of the SEARs consistent with the provisions in the Environmental Planning and Assessment Regulation 2000, Schedule 2, Part 2, 3 (7)".

Item 3 of the *Implementation and Transitional Arrangements for the Noise Policy for Industry (2017)* then states, "*In situations where SEARs are not issued (that is, development consent that is not State Significant Development or Infrastructure), however, a proponent can demonstrate that environmental assessment substantially commenced before release of the new policy, planning and regulatory authorities may choose to determine the application based on the NSW Industrial Noise Policy (2000) for a period of up to one (1) year from the date of release of the Noise Policy for Industry (2017)*".

In this circumstance the SEARs were issued first in 2015 and then re-issued in September 2017 both prior to the NPI, 2017 being released for use. Furthermore, the EIS including this NVIA where well progressed by September 2017. On this basis the NPI, 2017 does not apply to this project, which has been assessed on the basis of the INP as identified in the September 2017 SEAR's.

2.5 NSW INTERIM CONSTRUCTION NOISE GUIDELINE

The ICNG presents an accepted method by which construction noise and vibration impacts may be assessed for a range of receptor types for works completed in NSW.

It provides as set of recommended standard hours of construction:

- Monday to Friday: 7 am to 6 pm;
- Saturday: 8 am to 1pm; and
- No work on Sundays or public holidays.

The ICNG encourages works to occur within the recommended standard hours of construction unless justification is provided. It focuses on minimising construction noise impacts, rather than just achieving numeric noise levels, and recognises that some noise from construction sites is inevitable.

The ICNG encourages organisations involved with construction, maintenance or upgrading works (e.g. large-scale contractors or Government agencies) to develop their own best-practice techniques for managing construction noise and vibration, and implementing feasible and reasonable mitigation measures.

In this case, the ICNG is considered the suitable document to quantifiably assess potential noise emissions and impacts associated with Project construction activities.

The ICNG assessment methodology is outlined in more detail in *Annex D* of this report. Baseline noise values are presented in *Chapter 3* and construction noise management levels are presented in *Chapter 4*.

2.6 *BLASTING*

AS2187.2 presents methods for the preliminary estimation of air-blast overpressure and ground-borne vibration levels. These methods have been adopted here to consider potential Project emissions for a range of charge values and receptor distances.

The AS2187.2 equations offer a highly conservative method to estimate levels in the absence of measured site laws. Typically, for example at a quarry where a long-term blasting program is proposed with many blast events, the AS2187.2 equations are further refined via a series of test blasts, completed to more accurately determine site constants and exponents relevant to the equation.

2.6.1 *Air-Blast Overpressure*

Preliminary estimations for overpressure have been completed using the following AS2187.2 equation:

$$\mathrm{P} = K_a \left(\frac{R}{(Q^{1/3})} \right)^a$$

Where:

- **P** = Pressure, in kilopascals;
- **Q** = Maximum Instantaneous Charge (effective charge mass per delay), in kg. Explosive loading/detonation sequence/effective charge mass per delay. The maximum charge, in kilograms, initiated at any instant of time.
- **R** = Distance from charge, in metres;
- **Ka** = Site constant, a value of 14.56 was adopted; and
- **a** = Site exponent, a value of -1.45 was adopted.

The conversion of the 'P' pressure unit to linear decibels (dBZ) is completed using the following formula:

$$\mathrm{SPL} = 10\ x \log \left(\frac{P}{P_0} \right)^2$$

2.6.2 *Ground-Borne Vibration*

Preliminary estimations for vibration have been completed using the following AS2187.2 equation:

$$\mathrm{V} = K_g \left(\frac{R}{(Q^{1/2})} \right)^{-B}$$

Where:

- **V** = ground vibration as vector peak particle velocity, in mm/s;
- **R** = distance between charge and point of measurement, in m;
- **Q** = Maximum Instantaneous Charge (effective charge mass per delay), in kg. Explosive loading/detonation sequence/effective charge mass per delay. The maximum charge, in kilograms, initiated at any instant of time.
- **Kg** = a constant related to site and rock properties for estimation purposes, a value of 1140 was adopted; and
- **B** = a constant related to site and rock properties for estimation purposes, a value of 1.6 was adopted.

2.6.3 Estimated Charge Values

Each of the equations presented above are reliant on a charge value being applied to predict the overpressure and ground-borne vibration levels due to blasting.

Historical blasting data provided by Hanson for November 2016 to June 2017 indicated that the average MIC (maximum instantaneous charge) value was 148 kg and the maximum MIC was 215 kg.

2.7 NSW ROAD NOISE POLICY

The RNP was approved to replace the Environmental Criteria for Road Traffic Noise (ECRTN) with effect from 1 July 2011. The RNP outlines the range of measures needed to minimise road traffic noise and its impacts. It is intended for use by acoustics specialists as well as:

- Road project proponents.
- Determining authorities and regulators involved in the approval and construction of road projects and land use developments that generate additional traffic on existing roads.
- City and transport planners and policymakers dealing with issues such as route corridors, heavy vehicle transport and building codes.

The RNP aims to identify the strategies that address the issue of road traffic noise from existing roads, new road projects, road redevelopment projects and new traffic-generating developments. In this case, the RNP is considered the suitable document to qualitatively assess potential noise emissions and impacts associated with construction and operational road traffic.

The RNP vary based on road type and are dependent on the development being assessed. The RNP criteria adopted for this assessment are presented in *Chapter 4* of this report.

2.8 VIBRATION GUIDELINES AND STANDARDS

The effects of vibration in buildings can be divided into three main categories: human comfort (annoyance), cosmetic damage and structural damage. An overview of the applicable standards and guidelines is provided below.

- **Human Comfort (annoyance)**: The NSW Vibration Guideline provides guidance for assessing human exposure (comfort or annoyance issues) to vibration. The publication is based on British Standard (BS 6472–1992) – *Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz*).

- **Cosmetic and Structural Damage**: There is currently no Australian policy or guideline for assessing the potential for building damage (cosmetic and structural**)** from vibration. It is common practice to derive safe limit values for assessment purposes from international standards, such as German Standard DIN4150 Part 3-1999 (DIN4150-3) – *Structural Vibration - Effects of Vibration on Structures*. DIN4150-3 presents a set of safe limit values that below which cosmetic or structural damage is unlikely to occur.

The NSW Vibration Guideline and DIN 4150-3 criteria vary based on vibration type and receptor type and are dependent on the component frequency of the vibration event. To avoid presenting an exhaustive list of criterion values and since vibration impacts are not expected (refer to *Chapter 5*), the criteria values from the NSW Vibration Guideline and DIN 4150-3 were considered in the assessment of potential impacts but are not reproduced here.

2.9 REQUIREMENTS FOR LAND ACQUISITION

The *Voluntary Land Acquisition and Mitigation Policy For State Significant Mining, Petroleum And Extractive Industry Developments* (VLAMP) is to be applied by consent authorities when assessing and determining development applications and modification applications for mining, petroleum and extractive industry developments subject to the State significant development provisions of the Environmental Planning and Assessment Act 1979 (EP&A Act). The VLAMP (released in 2018) refers to the NPI (released in 2017) for a number of industrial noise related features. For the purposes of this assessment, these references to the NPI and its applicable noise features were applied with regard to the INP, the policy applicable to the Project for the assessment of industrial noise, as outlined in *Section 2.4*.

The policy recognises that:

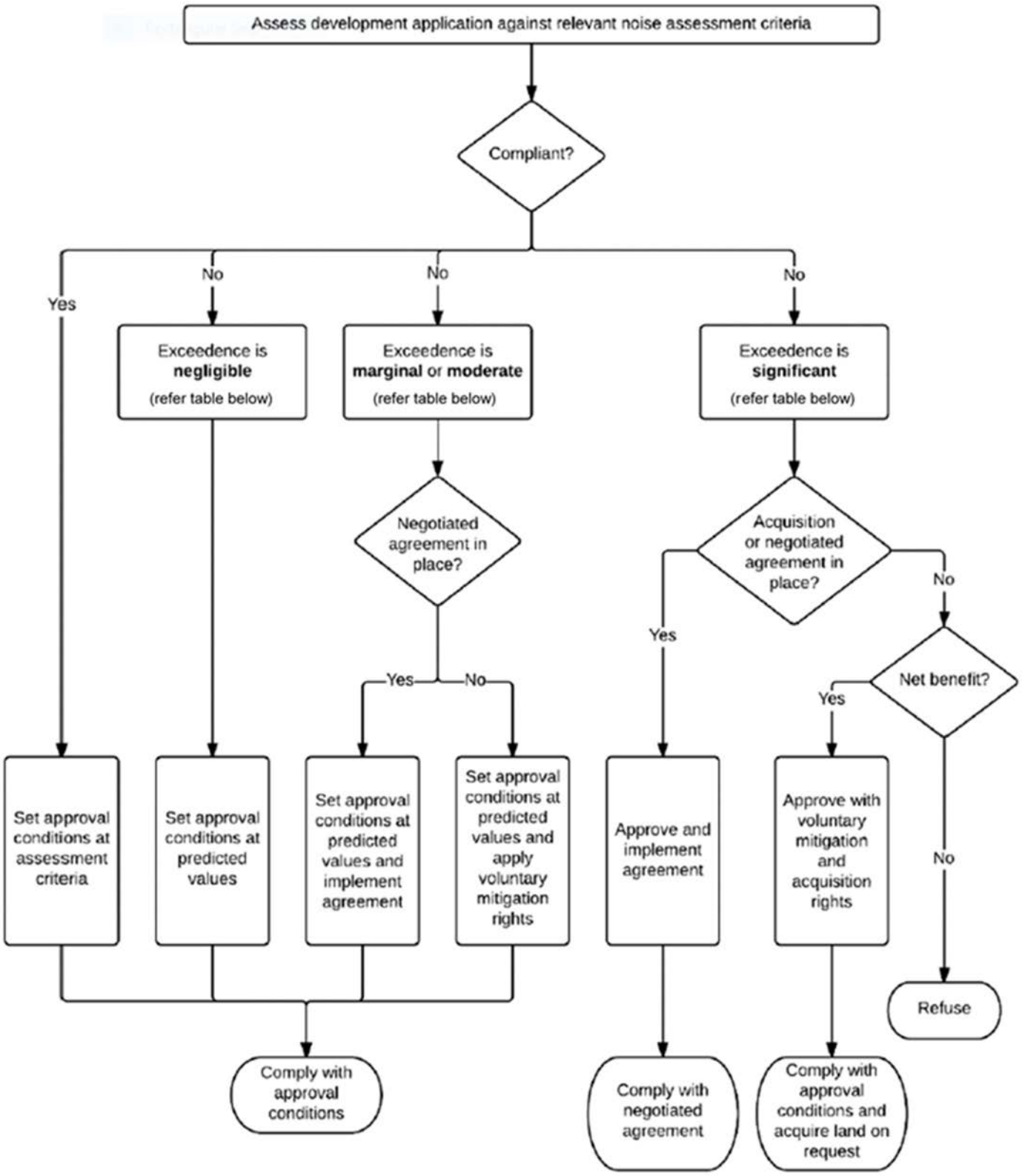
- Not all exceedances of the relevant assessment criteria equate to unacceptable impacts.

- Consent authorities may decide that it is in the public interest to allow the development to proceed, even though there would be exceedances of the relevant assessment criteria, because of the broader social and economic benefits of the development.

- Some landowners may be prepared to accept higher impacts on their land, subject to entering into suitable negotiated agreements with applicants, which may include the payment of compensation.

Table 2.2 below outlines the policy's interpretation of the significance of any potential exceedances of the relevant noise assessment criteria, and identifies potential treatments for these exceedances.

The decision-making process, which should be applied by a consent authority under this policy, is summarised in *Figure 2.1* below.



Process for Decision-Making on Noise Impacts (VLAMP) — **F2.1**

Drawing No: 0418291s_NVIA_C001_R0.cdr		Noise and Vibration Impact Assessment Sancrox Quarry Expansion
Date: 25/02/2019	Drawing size: A4	
Drawn by: GC	Reviewed by: SD	Client: Hanson Construction Materials Pty Ltd
		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

Table 2.2 Characterisation of Noise Impacts & Potential Treatments

Predicted Noise Exceeds Project Criteria by	And the total cumulative industrial noise level is	Characterisation of Impacts	Potential Treatment
All time periods 0-2dBA above the project specific noise level (PSNL)	Not applicable	Impacts are considered to be negligible	The exceedances would not be discernible by the average listener and therefore would not warrant receiver based treatments or controls
All time periods 3-5dBA above the PSNL	• < recommended amenity noise levels; or • > recommended amenity noise level, but increase in total cumulative industrial noise level resulting from the development is <1 dBA	Impacts are considered to be marginal	Provide mechanical ventilation/comfort condition systems to enable windows to be closed without compromising internal air quality/amenity.
All time periods 3-5dBA above the PSNL	> recommended amenity noise level, and the increase in total cumulative industrial noise level resulting from the development is >1 dBA	Impacts are considered to be moderate	As for marginal impacts but also upgraded façade elements like windows, doors, roof insulation etc. to further increase the ability of the building façade to reduce noise levels.
Day and evening >5dBA above the PSNL	< recommended amenity noise levels	Impacts are considered to be moderate	As for marginal impacts but also upgraded façade elements like windows, doors, roof insulation etc. to further increase the ability of the building façade to reduce noise levels.
Day and evening >5dBA above the PSNL	> recommended amenity noise levels	Impacts are considered to be significant	Provide mitigation as for moderate impacts and see voluntary land acquisition provisions below.
Night >5dBA above the PSNL	Not applicable	Impacts are considered to be significant	Provide mitigation as for moderate impacts and see voluntary land acquisition provisions below.

Source: DP&E, 2018

Voluntary Mitigation Rights

A consent authority should only apply voluntary mitigation rights where, even with the implementation of best practice management:

- The noise generated by the development would meet the requirements in *Table 2.2* above, such that impacts would be characterised as marginal, moderate or significant, at any residence on privately owned land; or

- The development would increase the total industrial noise level at any residence on privately owned land by more than 1 dBA and noise levels at the residence are already above the recommended amenity criteria in Table 2.1 of the INP; or

- The development includes a private rail line and the use of that private rail line would cause exceedances of the recommended acceptable levels in Table 6 of Appendix 3 of the Rail Infrastructure Noise Guideline (RING) by greater than or equal to 3 dBA at any residence on privately owned land.

All noise levels must be calculated in accordance with the INP or RING (as applicable). The selection of mitigation measures should be guided by the potential treatments identified in *Table 2.2* above.

Voluntary Land Acquisition Rights

A consent authority should only apply voluntary land acquisition rights where, even with the implementation of best practice management:

- The noise generated by the development would be characterised as significant, according to *Table 2.2* above, at any residence on privately owned land; or

- The noise generated by the development would contribute to exceedances of the recommended maximum noise levels in Table 2.1 of the INP on more than 25% of any privately owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls; or

- The development includes a private rail line and the use of that private rail line would cause exceedances of the recommended maximum criteria in Table 6 of Appendix 3 of the RING at any residence on privately owned land.

All noise levels must be calculated in accordance with the INP or RING (as applicable).

In accordance with the SEARs, this assessment has considered the characterisation of impacts and potential treatment as per the INP and with due regard to the principles presented in the Voluntary Land Acquisition and Mitigation Policy.

2.10 NOISE MODELLING

The methodology, inputs and assumptions that have informed the construction and operational noise modelling are outlined below:

- Brüel and Kjær's Predictor 7810 (Version 11.2) noise modelling software package was utilised to calculate noise levels using the International Organisation for Standardisation (ISO) 9613-2:1996 (ISO9613:2) - *Acoustics - Attenuation of Sound during Propagation Outdoors - Part 2: General Method of Calculation* noise propagation algorithms (international method for general purpose, 1/1 octaves). For sound calculated using ISO9613:2, the indicated accuracy is ±3dBA at source to receiver distances of up to 1000 m and unknown at distances above 1000 m.

- The ISO9613:2 calculative algorithms are widely accepted for the use of construction and operational (industrial) noise modelling regardless of the software package that simply implements these standardised calculative methods.

- The Predictor software package allows 3D elevation data to be combined with ground regions, water, foliage, significant building structures and receptor locations, to create a detailed and accurate representation of the site and surrounding area. The noise model allowed for the quantification of noise levels from multiple sources, based on sound power or pressure levels emitted from each source. The model computed the noise propagation in the assessment area of influence to specifically quantify A-weighted decibels ($L_{eq,\ 15\ minute}$ and L_{max} in dBA) at identified receptors.
- Sound Power Level (L_W, dBA) data incorporated into the Project-specific noise models was provided by Hanson, obtained from relevant Australian Standards or adapted from a proprietary source term database available at the time of the assessment.
  - L_W is a measure of the total power radiated by a source; it is a fundamental property of the source and is independent of the surrounding environment.
  - L_W differs from a Sound Pressure Level (L_P), which is the level of sound pressure as measured at a distance by a standard sound level meter with a microphone. L_P is the received sound (e.g. $L_{eq,\ 15\ minute}$ in dBA) as opposed to L_W, which is the sound 'intensity' at the source.
- 3D elevation data, zoning data and cadastre (spatial data) was obtained from the NSW Land and Property Information (LPI).
  - Buildings on and near the quarry were included in the noise model based on this spatial data or manually digitised from aerial photography.
  - Only large industrial buildings in close proximity to the site have been included into the model as buildings.
- Noise levels were calculated at 1.5m above ground level for all receptors, in accordance with the INP and ICNG. It is noted that ambient, background and project noise levels may be higher at receptor heights above 1.5 m.
- In all cases noise has been assessed at the most-affected point at or within the residential property boundary or, if that is more than 30 m from the residence, at the most-affected point within 30 m of the residence.
- The model included a temperature of 12.8°C and humidity of 74%, representative of conservative noise enhancing conditions derived from annual historical data from the NSW Bureau of Meteorology (BOM). Further information is provided below regarding prevailing meteorological conditions. A ground factor of 0.8 was adopted for the modelling area (0.0 is hard, 1.0 is soft).

- Amongst other features, noise modelling software offer a range of emission source types to be used to predict levels at receptors, these include but are not limited to "area sources", "point sources", "line sources" and "moving point sources". These source types were adopted as follows:
  - To accurately represent general construction emissions, capturing the size, layout and number of noise generating plant / equipment, "area sources" were utilised to predict $L_{eq,\ 15\ minute}$ noise levels. A separate area source was placed in the model for each phase of works to accurately represent the distribution of noise across the site during each work phase.
  - For operational noise emissions, a combination of "point sources", "line sources" and "moving point sources", were used to predict $L_{eq,\ 15\ minute}$ noise levels and accurately represent emissions based on the actual positions of known plant, equipment and machinery included in the current Project design.
  - For operational scenarios, "moving point sources" extended south of the site to Sancrox Road to represent emissions from Project vehicle movements leaving the quarry.
  - "Point sources" were utilised to predict all Lmax noise levels for the purpose of the sleep disturbance assessment.
- A number of other modelling features have been adopted for noise modelling and are listed below, these features are outlined in the assessment scenarios summarised in *Chapter 6* and *Chapter 7*:
  - **Quantity** is the number of equipment operating per 15 minute assessment period.
  - **Duty Factor** is the percentage of time the equipment operates per 15 minute assessment period, or represents a reduced emission for part of the period.
  - **Base LW Value** is source emission or 'Sound Power Level' (LW) directly allocated to the equipment, unadjusted.
  - **INP Penalty** considers any annoying characteristic such as tonality, low frequency noise or impulsiveness.
  - **Total LW Value** is the overall equipment source emission (LW) adjusted for the quality, duty factor and INP penalty. INP penalties were not included for operational stages of the noise assessment as plant/equipment can be procured/mitigated to avoid offensive noise characteristics.
- The noise assessment scenarios and modelling data are summarised in *Chapter 6* and *Chapter 7*, however all LW, dBA values have considered and applied the relevant INP modifying factors (penalties) for offensive noise characteristics, prior to modelling.

- Construction noise level predictions have been conducted to identify results for representative worst-case scenarios, as the predicted values consider the cumulative emission (and potential impact) of all equipment sources working concurrently.
- It is not possible or warranted to reflect potential impacts, to model every plausible activity, task or usage for each noise generating source and location, hence the conservative approach adopted here has been applied to ensure that representative worst-case noise predictions were conducted. Furthermore, area sources were utilised were possible to reflect the potential distribution of noise across the site, and the potential emissions from activities undertaken at various locations within and around the site.

2.10.1 Prevailing Meteorological Conditions

Prevailing meteorological conditions have the potential to increase noise levels at receptors influenced by the effects of wind and temperature inversions. Winds blowing between the source and the receptor, and temperature inversions can increase noise levels by between 1 dBA and approximately 7 dBA depending on the distance of the receptor from the source and condition.

These noise level increases are normally detectable (or quantifiable via modelling) for receptor distances greater than 100 m from the source, which is the case for this Project with most receptors more than 500 m from the site.

Prevailing meteorological conditions for the area were established for this assessment based on the EPA's noise enhancing wind analysis (NEWA) method. The NEWA analysis was based on Bureau of Meteorology (BOM) meteorological data from the nearest Automated Weather Station (AWS) (i.e. Port Macquarie Airport, Station ID: 060139) for a 12 month period (2017).

The NEWA method differs to a wind rose method, that is prescribed by guidelines for use in the Air Quality Assessment. Therefore wind roses should not be applied for the assessment of noise in NSW, where the NEWA method is used.

The key difference is that NEWA calculates the percentage occurrence of wind directions during the INP daytime, evening and night time assessment periods. NEWA results will differ when compared to wind roses due to the different time periods e.g. wind roses commonly apply before 9AM, before 3PM.

The NEWA analysis identified that north-westerly and westerly winds prevailed. The north-westerly and westerly directions represent source to receiver (noise enhancing) winds. Therefore, the following conditions were included in the operational noise model for each period:

- **Daytime**: Calm wind conditions and a Class-D temperature inversion, representing a stable condition.

- **Evening**: 3 m/s wind condition for the westerly prevailing direction and a Class-F temperature inversion.
- **Night time (and morning shoulder)**: 3 m/s wind condition for the two prevailing directions and a Class-G temperature inversion.

For the construction noise model a Class-D temperature inversion was adopted (representing a stable condition) for all scenarios.

Although other receptors are situated at distances further from the site that could be influenced by the effects of other wind and inversion conditions, compliance at the closest receptors and further attenuation provided by intervening topography will ensure compliance at other receptors.

2.10.2 Conceptual Mitigation Measures

Based on preliminary noise modelling results, it was evident that operational noise levels have the potential to exceed the PSNL during daytime, evening, night time and morning shoulder periods at residential receptors to the south of the Project site across all stages of the proposed quarry expansion.

Following preliminary noise modelling Hanson was consulted to determine suitable mitigation that could be incorporated into the project design to assist in reducing noise impacts. Based on the consultation with Hanson, reasonable and feasible mitigation measures have been discussed and conceptual mitigation was modelled to achieve compliance with the PSNL for all operational assessment scenarios.

Hanson has considered and then confirmed that all recommended measures presented in this noise assessment report are feasible and reasonable. Specifically, the noise reducing mitigation and/or required source emission values (presented in *Table 2.3* below) are achievable by using a combination of acoustic enclosures, barriers/walls/mounds and suitable equipment selection/procurement i.e. with lower source emission values.

This mitigation involves the following measures:

Boundary Mitigation:

- Earth Bunding (approximately 25 m in height, 450 m in length and 75 m in width) is required along the southern boundary of the site to provide additional shielding from the processing plant and asphalt production plant.
- Earth Bunding (approximately 20 m in height, 250 m in length and 60 m in width) is also required at the western boundary of the pit to provide shielding from in pit activities from Stage 2 of the quarry expansion when in pit activities progress closer to Receptor 20 to the west.

Plant / Equipment Procurement:

- During the operational design, choose appropriate machines for each task and adopt efficient work practices to minimise the total number of noise sources on the site. Select the quietest item of plant available where options that suit the design permit, with consideration to offensive noise characteristics such as tonality, low frequency noise or impulsiveness.
- The key items of plant/equipment are presented in *Table 2.3*. The required LW deductions for these specific items of equipment/plant and the LW required to meet most stringent night time PSNL are presented in *Table 2.3*.
- Operational LW emissions should be at or below those presented in *Table 2.3* and *Table 7.1* of this report. Where items of procured plant generate offensive noise characteristics, INP penalties will be applied prior to meeting the LW values presented above.

At Source Mitigation:

- Where LW values for plant/equipment outlined in *Table 2.3* are not reasonable or feasible, the operational design will incorporate acoustic enclosures / barriers to assist in reducing the noise emission of identified plant/equipment. Design of acoustic enclosures / barriers will also consider offensive noise characteristics as tonality, low frequency noise or impulsiveness.

Table 2.3 below details the required LW deductions for specific items of equipment/plant and the LW required to meet most stringent night time PSNL. These LW values can be met by a combination of at source mitigation and equipment procurement.

INP penalties for offensive noise characteristics such as tonality, low frequency noise or impulsiveness were not included for conceptual mitigation noise modelling, as plant/equipment can be procured/mitigated to avoid offensive noise characteristics.

Table 2.3 LW mitigation required to meet most stringent PSNL

Equipment / Plant	Reduction of LW (dBA)	Required/Mitigated LW
Cone Crusher	10	108
Jaw Crusher	10	105
Barmac Crusher	10	97
Screens	10	105
Asphalt Stack	10	102
Asphalt Plant	10	100
Pug mill	10	101
Feeder	5	108
Conveyors	10	81 (LW/m)

1. LW in dBA, rounded to nearest whole number.

2.11 CUMULATIVE IMPACTS

Noise impact assessments are generally based on predicting project-specific levels at the closest and/or most affected receptors and then comparing these to criteria or management levels that apply to the type of emission being considered.

In the case of construction and operational emissions, the noise criteria are derived based on existing noise levels for the area, for road traffic and vibration fixed values apply. To assess potential cumulative impacts a varied approach has therefore been adopted, as described below.

2.11.1 *Noise*

The operational noise criteria (INP) are based on existing noise levels measured at locations surrounding the Project site, such that existing conditions and industrial noise contributions are considered as part of the assessment approach. The criteria are designed to prevent any long-term increase in cumulative industrial noise. Therefore, the INP criteria address potential cumulative impacts without further discussion required.

The construction noise criteria (ICNG) and management levels are based on existing noise levels measured at locations surrounding the Project site, but focus on the direct impacts from the site under assessment. Cumulative construction noise impacts are beyond the control of Hanson, are temporary in most circumstances and are best managed by local or state consent authorities for significant projects. Therefore, a qualitative assessment of potential cumulative impacts has been conducted but limited discussion regarding cumulative impacts is required.

Road Traffic Noise

The road traffic noise criteria (RNP) are fixed values but are derived to assess the Project's noise level contribution (i.e. project vehicles on public roads) and the effects of cumulative road traffic noise impacts. Therefore, the RNP criteria address potential cumulative impacts without further discussion required.

2.11.2 *Vibration*

The vibration criteria (the NSW vibration guideline and DIN4150-3) are again fixed values derived to assess the Project site vibration level contribution. Cumulative impacts are unlikely to occur in most circumstances due to the lack of existing influential sources. Therefore, a qualitative assessment of potential cumulative impacts has been conducted but limited discussion regarding cumulative impacts is required.

In light the above, the focus of any discussion regarding cumulative impacts is associated with operational noise, as presented in *Chapter 7*.

2.12 CONSULTATION

The SEARs require consultation with relevant local, State and Commonwealth Government authorities. These agencies as relevant to the noise and vibration assessment are outlined in *Table 2.4*, along with the response received.

Table 2.4 Stakeholder Consultation

Relevant Stakeholder	Consultation Method	Response
Environment Protection Agency	Letter advising that the EIS process is underway and the assessment will address the SEARs. Request for additional comments made.	The EPA understands that the crusher plant on the premises is dated and is potentially a significant source of noise and dust impacts to sensitive receivers surrounding the premises. The influence of this plant whilst operating on noise and dust levels received at neighbouring properties must be included in any assessment of impacts from this proposal. If the assessment indicates that the plant is a significant noise or dust source, then consideration will be given to feasible mitigation measures and / or plant upgrade.

3 EXISTING CONDITIONS

This chapter describes the sensitive receptors in proximity to the site, the measurement approach adopted to quantify existing levels representative of their location and results; and the results of environmental noise measurements and logging.

3.1 EXISTING NOISE ENVIRONMENT

A key element in assessing environmental noise impacts is an understanding of the existing ambient and background noise levels in the vicinity of the closest and/or potentially most affected receptors situated in proximity to the site. The noise environment in the vicinity of the Project receptors is best described as 'rural' - defined by the INP as '*an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic. Such areas may include:*

- *an agricultural area, except those used for intensive agricultural activities;*
- *a rural recreational area such as resort areas;*
- *a wilderness area or national park; and*
- *an area generally characterised by low background noise levels (except in the immediate vicinity of industrial noise sources).*

This area may be located in either a rural, rural-residential, environment protection zone or scenic protection zone, as defined on a council zoning map (i.e. Local Environmental Plan (LEP) or other planning instrument)'.

Despite the predominantly rural setting of the Project site, the existing noise environment of the surrounding area is under the influence of traffic noise from the nearby Pacific Highway. The existing background noise levels considered in this assessment are therefore much higher than would typically be experienced in a rural environment.

3.2 POTENTIALLY SENSITIVE RECEPTORS

The potentially sensitive receptors where compliance has been assessed are presented below in *Table 3.1* and identified in *Figure 1.3*.

Table 3.1 Potentially Sensitive Receptors

ID[1]	Description	GPS Co-ordinates (UTM, Zone 55H)		Ground Height (AHD), m	Approximate Distance from Quarry (m)	Direction from Quarry
		Easting	Northing			
13[3]	Unoccupied Residential (Dwelling) Receptor	482489	6521606	17	185	South
14	Residential (Dwelling) Receptor	482557	6521227	19	540	South
1	Residential (Dwelling) Receptor	482564	6520983	30	785	South
16	Residential (Dwelling) Receptor	482434	6521102	24	720	South
2	Residential (Dwelling) Receptor	482404	6520969	35	845	South
17	Residential (Dwelling) Receptor	482264	6521086	21	750	South
4	Residential (Dwelling) Receptor	482251	6521225	14	620	South
18	Residential (Dwelling) Receptor	481534	6520898	35	950	South West
19	Residential (Dwelling) Receptor	481673	6521507	14	300	South West
24	Residential (Dwelling) Receptor	481162	6521402	12	780	South West
20	Residential (Dwelling) Receptor	481482	6522044	23	340	West
6	Residential (Dwelling) Receptor	481371	6523402	6	1,200	North West
30	Residential (Dwelling) Receptor	481804	6523653	4	1,380	North West
11	Residential (Dwelling) Receptor	482612	6523043	19	820	North
48	Potential Future Industrial Receptor	482902	6522221	19	50	North East
33	Residential (Dwelling) Receptor	483599	6523052	10	1,100	North East
38	Residential (Dwelling) Receptor	484170	6522500	10	1,250	East
7	Cassegrain Winery – Commercial	483212	6522146	13	240	East
47	Potential Future Industrial Receptor	483092	6521830	9	150	East
34	Residential (Dwelling) Receptor	483705	6521959	16	780	East
35	Residential (Dwelling) Receptor	483732	6521688	30	790	East
8	Industrial Receptor	483289	6521515	10	490	East
46	Expressway Spares - Commercial	483124	6521504	7	400	South East
9	Industrial Receptor	482977	6521492	7	330	South East
10	Industrial Receptor	482813	6521379	12	360	South

1. Receptor ID's have been derived from the Air Quality and Greenhouse Gas Assessment (Annex G) to ensure consistency across receptors throughout the EIS.
2. Australian Height Datum (AHD) in metres.
3. This location is assessed in full despite being unoccupied.

Guidance Note

Receptor locations were established based on observations made whilst on and near the site, review of land use zoning data and the results of preliminary noise modelling, where receptor positions were optimised to predict likely worst-case noise levels.

These locations do not represent all receptors located in the vicinity of the Project site but have been selected for the purposes of this assessment; they are considered to be representative of locations that will potentially experience the highest impacts associated with the quarry's construction and subsequent ongoing operation.

During the site survey and subsequent measurements, it was observed that the dwelling at R1 appeared unoccupied and uninhabited. The land or property owner was not contacted to confirm this, so the property and occupants actual status is unknown hence noise levels have been assessed at this location regardless of the properties status.

3.3 EXISTING BACKGROUND NOISE LEVELS

This section presents the measured noise levels from short-term operator attended noise measurements and long-term unattended noise logging completed adopting the methodology described below.

3.3.1 Monitoring Methodology

Ambient and background noise levels were quantified via monitoring, with due regard to the requirements described in INP, applicable parts of Standards Australia AS1055–1997™ (AS1055) – *Description and Measurement of Environmental Noise* and other relevant Australian and international standards for environmental noise monitoring.

To quantify existing noise levels in the absence of the site under assessment, unattended noise logging and operator attended noise measurements were completed at select locations considered representative of existing conditions experienced by the community near the project. The unattended logging and attended measurements and were conducted by a qualified acoustician and Member of the Australian Acoustical Society (MAAS). The equipment used and key features of the monitoring methodology is described below.

Measurement and Logging Equipment

The measurement and logging equipment used to complete the assessment complied with the requirements of AS61672 or AS1259 as relevant to the device. Each device had current National Association of Testing Authorities, Australia (NATA) calibration certificates, with certification at intervals not exceeding two years at the time of use. The equipment used for this assessment was as follows:

- 4 x Ngara (Type 1) Environmental Noise Loggers.
- 1 x Brüel & Kjær 2250 (Type 1) Sound Level Meter.
- 1 x Brüel & Kjær (Type 1) Sound Level Calibrator.

Instrument calibration was checked prior to monitoring and again at the conclusion with no difference noted between the two measurements. The sound level calibrator used complied with the requirements of IEC60942.

Unattended Noise Logging

Long-term unattended noise logging was completed at four locations at residential receptors situated in proximity to the quarry, identified as L1 to L4 in *Figure 1.3.*

These locations were selected for this assessment as they allowed the measurement of existing ambient and background noise levels that are considered representative of the most affected receptors situated in close proximity to the project.

The loggers were deployed on Monday, 6 November 2017 and collected on Wednesday 22 November 2017. The logging devices were set to record acoustical and statistical parameters at 15 minute intervals for the monitoring period. As a minimum L_{max}, L_{min}, L_{eq}, L_1, L_{10} and L_{90} values were captured.

At the conclusion of the logging period, the captured noise data was combined with meteorological data from the nearest Bureau of Meteorology (BOM) Automated Weather Station (AWS) to exclude any values that exceeded the rain and wind thresholds for noise logging analysis.

The nearest BOM AWS is situated at Port Macquarie Airport (AWS Site Number: 060139). Any extraneous or potentially spurious data was excluded during this process.

Any data recorded at the Port Macquarie Airport AWS during periods of rain or when wind speeds that exceeded 7 m/s (approximately equal to 5 m/s at microphone height, 1.5 m above ground level) has been excluded.

The residual noise data, not excluded when combined with the meteorological data noted above, was used to calculate the daily and overall ambient (L_{eq}) and background (L_{90}) noise levels as per the requirements of the INP.

Operator Attended Noise Measurements

Short-term operator attended noise measurements were conducted at eight locations around the site on Monday, 6 November; Tuesday, 7 November and Wednesday 22 November 2017, identified as R1 to R4 and A1 to A4 in *Figure 1.3*. These locations were selected whilst in the vicinity of the project site to better understand the broader acoustical environment.

Each measurement was of 15 minutes duration and time synchronised to the noise logging device to allow for comparison of measured values at a range of acoustically different locations.

The measurement device was set to show instantaneous noise levels throughout each measurement, with noise events noted by the operator. Overall 15 minute acoustical and statistical parameters were recorded by the device (in dBA) with L_{max}, L_{min}, L_{eq}, L_1, L_{10} and L_{90} values captured as a minimum.

3.3.2 Unattended Noise Logging Results

The measured daily and overall, ambient (L_{eq}) and background (L_{90}) noise levels, for each noise logging location (L1 to L4) are presented in *Table 3.*2 to *Table 3.5*. These daily and overall summary values were established as per the requirements of the INP.

The L_{eq} acoustical parameter corresponds to the level of noise equivalent to the energy average of ambient noise levels occurring over a measurement period. L_{90} represents the level exceeded for 90 percent of the measurement period and is referred to as the average minimum or background noise level.

In accordance with the INP the assessment periods are defined as follows:

- Daytime is the period from 7AM to 6PM, Monday to Saturday or 8AM to 6PM on Sundays and public holidays.
- Evening is the period from 6PM to 10PM, Monday to Sunday (seven days per week).
- Night time is all remaining periods.

Unattended noise logging charts which present the unattended noise logging data and weather conditions in 15 minute samples are provided in *Annex E* of this report.

Table 3.2 Unattended Environmental Noise Logging (L01)

	Measured Existing Noise Levels					
Date	**ABL Day**	**ABL Evening**	**ABL Night**	**Leq Day**	**Leq Evening**	**Leq Night**
Monday-6-Nov-17	-	37.9	36.2	*38.8*	52.2	44.2
Tuesday-7-Nov-17	*39.8*	36.5	*33.5*	*46.8*	44.0	*41.6*
Wednesday-8-Nov-17	*37.8*	36.3	33.1	*47.1*	44.9	44.2
Thursday-9-Nov-17	39.9	37.8	34.2	47.9	45.5	44.0
Friday-10-Nov-17	41.3	37.4	32.1	49.3	44.7	43.4
Saturday-11-Nov-17	38.9	34.2	*29.0*	47.3	44.3	*43.3*
Sunday-12-Nov-17	33.7	33.9	28.2	44.6	46.3	43.5
Monday-13-Nov-17	35.0	*37.1*	31.7	46.2	*44.2*	43.1
Tuesday-14-Nov-17	37.6	36.0	33.4	46.6	45.3	43.3
Wednesday-15-Nov-17	37.9	35.0	31.6	47.1	46.0	43.7
Thursday-16-Nov-17	*38.4*	35.2	32.1	*46.2*	53.5	42.8
Friday-17-Nov-17	38.2	*35.1*	30.1	47.5	*48.0*	42.7
Saturday-18-Nov-17	*35.1*	36.1	32.5	*45.9*	49.4	51.9
Sunday-19-Nov-17	37.6	36.8	*35.2*	46.6	49.8	*44.2*
Summary RBL Values	**38**	**36**	**32**	**47**	**48**	**45**

1. All noise levels are dBA re 2 x 10-5 Pa.
2. '-' indicates periods with too few valid samples due to weather or logger operation.
3. Grey italicised text indicated that some samples were excluded from the ABL due to inclement weather experienced on the day.
4. Summary RBL parameters are rounded to the nearest whole decibel (dB).

Table 3.3 Unattended Environmental Noise Logging (L02)

	Measured Existing Noise Levels					
Date	**ABL Day**	**ABL Evening**	**ABL Night**	**Leq Day**	**Leq Evening**	**Leq Night**
Monday-6-Nov-17	-	37.6	*31.7*	*41.5*	53.9	*42.2*
Tuesday-7-Nov-17	*33.8*	37.7	31.4	*43.8*	51.1	41.4
Wednesday-8-Nov-17	36.4	39.3	30.1	44.6	49.5	41.5
Thursday-9-Nov-17	36.7	35.4	29.9	51.4	50.9	39.9
Friday-10-Nov-17	36.2	34.8	*30.0*	51.7	48.7	*42.5*
Saturday-11-Nov-17	34.6	33.3	30.2	53.5	49.9	42.1
Sunday-12-Nov-17	32.4	*41.9*	33.1	47.8	*53.4*	44.8
Monday-13-Nov-17	34.8	39.9	34.2	44.1	50.2	43.9
Tuesday-14-Nov-17	37.8	36.8	34.7	45.7	51.4	43.8
Wednesday-15-Nov-17	*40.0*	37.9	34.6	*47.7*	51.8	45.6
Thursday-16-Nov-17	38.5	*42.0*	32.5	50.0	*50.6*	47.0
Friday-17-Nov-17	*35.4*	45.9	34.8	*48.9*	53.3	48.1
Saturday-18-Nov-17	36.5	41.8	*35.0*	56.5	55.3	*50.0*
Sunday-19-Nov-17	37.2	35.9	*38.5*	45.4	54.2	*52.0*
Monday-20-Nov-17	-	37.6	*31.7*	*41.5*	53.9	*42.2*
Summary RBL Values	**36**	**36**[5]	**33**	**50**	**52**	**46**

1. All noise levels are dBA re 2 x 10^{-5} Pa.
2. '-' indicates periods with too few valid samples due to weather or logger operation.
3. Grey italicised text indicated that some samples were excluded from the ABL due to inclement weather experienced on the day.
4. Summary RBL parameters are rounded to the nearest whole decibel (dB).
5. The evening RBL was measured to be 38 dBA, however in accordance with the INP, where the evening RBL is measured to be higher than the day-time RBL, the RBL adopted for evening time should be no greater than the day-time RBL. Therefore, the daytime RBL has been adopted for the evening period.

Table 3.4 Unattended Environmental Noise Logging (L03)

	Measured Existing Noise Levels					
Date	**ABL Day**	**ABL Evening**	**ABL Night**	**Leq Day**	**Leq Evening**	**Leq Night**
Monday-6-Nov-17	-	40.8	36.3	*39.4*	47.7	46.2
Tuesday-7-Nov-17	*41.6*	37.6	*34.3*	*50.5*	44.0	*45.2*
Wednesday-8-Nov-17	*42.5*	38.0	35.3	*50.6*	45.0	44.2
Thursday-9-Nov-17	42.0	39.5	36.1	49.7	45.9	45.7
Friday-10-Nov-17	41.8	38.4	33.3	50.6	48.1	45.3
Saturday-11-Nov-17	41.2	37.3	*29.6*	52.0	44.4	*46.4*
Sunday-12-Nov-17	40.4	39.6	30.2	48.3	49.2	44.9
Monday-13-Nov-17	38.6	*37.9*	32.8	53.1	*45.1*	45.7
Tuesday-14-Nov-17	40.6	38.6	35.6	51.4	49.8	46.6
Wednesday-15-Nov-17	41.2	38.3	37.0	50.0	52.3	47.2
Thursday-16-Nov-17	*43.7*	38.6	35.6	*50.8*	54.2	45.8
Friday-17-Nov-17	42.8	*39.3*	33.6	51.5	*49.7*	43.9
Saturday-18-Nov-17	*37.9*	36.7	32.5	*50.1*	53.7	43.7
Sunday-19-Nov-17	39.8	37.7	*36.4*	48.2	53.3	*44.3*
Monday-20-Nov-17	40.6	38.2	*37.9*	60.8	57.4	*45.3*
Tuesday-21-Nov-17	41.0	-	-	48.9	-	-
Summary RBL Values	**41**	**38**	**35**	**53**	**51**	**46**

1. All noise levels are dBA re 2 x 10^{-5} Pa.
2. '-' indicates periods with too few valid samples due to weather or logger operation.
3. Grey italicised text indicated that some samples were excluded from the ABL due to inclement weather experienced on the day.
4. Summary RBL parameters are rounded to the nearest whole decibel (dB).

Table 3.5 Unattended Environmental Noise Logging (L04)

	Measured Existing Noise Levels					
Date	**ABL Day**	**ABL Evening**	**ABL Night**	**Leq Day**	**Leq Evening**	**Leq Night**
Monday-6-Nov-17	-	44.8	39.1	-	53.2	-
Tuesday-7-Nov-17	*46.4*	43.4	*40.4*	*56.0*	49.4	*46.4*
Wednesday-8-Nov-17	*45.0*	42.3	41.6	*50.6*	48.9	*45.0*
Thursday-9-Nov-17	46.4	42.4	43.9	52.1	49.3	46.4
Friday-10-Nov-17	45.7	41.7	39.3	51.7	50.2	45.7
Saturday-11-Nov-17	42.7	37.9	*34.4*	50.7	50.0	42.7
Sunday-12-Nov-17	39.5	37.5	35.4	48.1	52.0	39.5
Monday-13-Nov-17	39.1	*43.3*	40.8	48.0	*49.7*	39.1
Tuesday-14-Nov-17	42.1	39.6	40.8	49.3	53.1	42.1
Wednesday-15-Nov-17	41.5	39.9	41.2	49.0	50.3	41.5
Thursday-16-Nov-17	*41.7*	40.8	40.6	*50.3*	52.5	*41.7*
Friday-17-Nov-17	40.8	*41.8*	41.6	48.2	*52.8*	40.8
Saturday-18-Nov-17	*41.7*	38.3	38.5	*50.6*	54.7	*41.7*
Sunday-19-Nov-17	41.2	39.4	*45.7*	47.4	54.4	41.2
Monday-20-Nov-17	43.5	44.0	-	49.4	54.8	43.5
Summary RBL Values	**42**	**42**	**41**	**51**	**52**	**50**

1. All noise levels are dBA re 2 x 10^{-5} Pa.
2. '-' indicates periods with too few valid samples due to weather or logger operation.
3. Grey italicised text indicated that some samples were excluded from the ABL due to inclement weather experienced on the day.
4. Summary RBL parameters are rounded to the nearest whole decibel (dB).

3.3.3 Operator Attended Noise Measurement Results

The results of short-term operator attended noise measurements are presented in *Table 3.6*. Operator attended noise measurement locations are presented in *Figure 1.3*.

Table 3.6 Operator Attended Noise Measurements

Location ID	Date	Start time	Measured Noise Levels, dBA					
			LAmax	LAmin	LAeq	LA1	LA10	LA90
A5	6/11/2017	16:00	57	41	47	54	50	43
A6	7/11/2017	10:00	64	35	46	55	47	38
A1	7/11/2017	10:30	66	40	49	60	52	41
A2	7/11/2017	11:00	84	37	55	61	49	40
A3	7/11/2017	11:30	83	41	60	74	55	43
A4	7/11/2017	12:00	75	40	54	66	56	44
A7	7/11/2017	13:15	63	44	52	58	55	48
A8	22/11/2017	11:00	58	36	42	47	44	39
A7	22/11/2017	12:00	63	32	42	53	45	36
A6	22/11/2017	13:00	60	36	43	53	46	38
A5	22/11/2017	13:45	62	40	46	53	48	42

Discussion

The results of unattended noise logging conducted between Monday, 6 November 2017 and Wednesday 22 November 2017 were analysed and compared to the operator attended measurements conducted on Monday, 6 November; Tuesday, 7 November and Wednesday 22 November 2017.

The operator attended measurements were found to be consistent with the unattended logging results, therefore no adjustments to ambient and background noise levels were considered necessary for varying receptor locations.

The measured ambient and background noise levels presented in *Table 3.6* vary significantly, with background noise levels ranging between 36 and 48 dBA and ambient noise levels ranging between 42 and 60 dBA. However, most measurements were dominated by Pacific Highway traffic, wind-blown vegetation, some local traffic, birds and insects.

3.3.4 Rating Background Noise Levels

The Rating Background Noise Levels (RBL) for all potentially sensitive noise receptor were established based on the data presented in *Table 3.2* to *Table 3.5* and with regard to the INP as summarised above.

Unattended noise logging was conducted at four locations, hence, where background noise levels were not measured at a receptor, data from the closest or most representative noise logging location was adopted. These RBL values, for each receptor and assessment period are presented in *Table 3.7* below.

These RBL values are adopted to establish ICNG, 2009 noise management levels and INP criteria for residential receptors as identified in *Chapter 4* of this report. RBL values for commercial receptors are provided for general reference only and are not utilised to derive any criteria.

Table 3.7 Rating Background Noise Levels

	Rating Background Noise Levels (RBL)			
Location ID	**Day**	**Evening**	**Night**	**Morning Shoulder**
13	38	36	32	35
14	38	36	32	35
1	38	36	32	35
16	38	36	32	35
2	38	36	32	35
17	38	36	32	35
4	38	36	32	35
18	36	36	33	35
19	36	36	33	35
24	36	36	33	35
20	36	36	33	35
6	41	38	35	38
30	41	38	35	38
11	41	38	35	38
48	41	38	35	38
33	42	42	41	41
38	42	42	41	41
7	42	42	41	41
47	42	42	41	41
34	42	42	41	41
35	42	42	41	41
8	42	42	41	41
46	42	42	41	41
9	42	42	41	41
10	42	42	41	41

1. In accordance with the INP the assessment periods are defined as follows: Daytime is the period from 7am to 6pm - Monday to Saturday; or 8am to 6pm on Sundays and Public Holidays, Evening is the period from 6pm to 10pm and Night time is all remaining periods. The morning shoulder period is within the night time period, specifically between 5am and 7am.

Morning Shoulder Period

In accordance with the INP, the morning shoulder period is defined as part of the night time period between 5am and 7am.

This shoulder period is specifically identified in the INP for circumstances where existing ambient and background noise levels are steadily rising in these early morning hours, as is the case for areas surrounding the Project site, where transport sources (road traffic) increases noise during this period, when compared to the overall night time period.

To quantify existing overall background noise levels associated with the morning shoulder period, ERM has calculated the mid-point value between the measured daytime and night time period RBLs. The values outlined in *Table 3.4* are adopted here for the purposes of quantify existing conditions and establishing criteria by which impacts during that period may be assessed.

4 NOISE MANAGEMENT LEVELS AND CRITERIA

4.1 CONSTRUCTION NOISE MANAGEMENT LEVELS

All Project-specific "Noise Management Levels" (NML) have been established based on the representative RBL values presented in *Table 3.4* (where relevant) and in accordance with the ICNG.

During construction, the "Highly Noise Affected Management Level" (HNML) also applies to residential receptors during standard daytime hours and is a fixed value of $L_{eq,\ 15\ minute} \leq 75$ dBA.

The sleep disturbance criteria of RBL + 15 dBA have been adopted for all residential receptors, consistent with the ICNG and INP.

In accordance with the ICNG, NML values for other sensitive receptors i.e. places of worship, commercial/industrial premises, schools or recreational areas are fixed levels based on usage. They do not reply on the RBL utilised for residential receptors.

The ICNG assessment periods are defined as follows:

- Daytime is the period from 7am to 6pm - Monday to Saturday; or 8am to 6pm on Sundays and Public Holidays;
- Evening is the period from 6pm to 10pm; and
- Night time is all remaining periods.

The Project-specific NMLs, for works within and outside the recommended standard hours for construction, are presented in *Table 4.1* below.

Table 4.1 Construction Noise Management Levels (NML)

ID	Type	Standard Hours[1]	Non-Standard Hours[1]				Sleep Disturbance[2]	
		Daytime	Daytime	Evening	Night	Morning Shoulder	Night	Morning Shoulder
13	Residential[3]	48	43	41	37	40	47	50
14	Residential[3]	48	43	41	37	40	47	50
1	Residential[3]	48	43	41	37	40	47	50
16	Residential[3]	48	43	41	37	40	47	50
2	Residential[3]	48	43	41	37	40	47	50
17	Residential[3]	48	43	41	37	40	47	50
4	Residential[3]	48	43	41	37	40	47	50
18	Residential[3]	46	41	41	38	40	48	50
19	Residential[3]	46	41	41	38	40	48	50
24	Residential[3]	46	41	41	38	40	48	50
20	Residential[3]	46	41	41	38	40	48	50
6	Residential[3]	51	46	43	40	43	50	53
30	Residential[3]	51	46	43	40	43	50	53
11	Residential[3]	51	46	43	40	43	50	53
48	Potential Future Industrial	75	75	75	75	75	-	-
33	Residential[3]	52	47	47	46	46	56	56
38	Residential[3]	52	47	47	46	46	56	56
7	Commercial	70	70	70	70	70	-	-
47	Potential Future Industrial	75	75	75	75	75	-	-
34	Residential[3]	52	47	47	46	46	56	56
35	Residential[3]	52	47	47	46	46	56	56
8	Industrial	75	75	75	75	75	-	-
46	Commercial	70	70	70	70	70	-	-
9	Industrial	75	75	75	75	75	-	-
10	Industrial	75	75	75	75	75	-	-

1. $L_{eq,\ 15\ minute}$ noise level in dBA.
2. Lmax noise level in dBA.
3. The HNAML ($L_{eq,\ 15\ minute} \leq 75$ dBA) applies.

4.2 CONSTRUCTION AND OPERATIONAL ROAD TRAFFIC NOISE CRITERIA

Construction and operational road traffic noise criteria were developed with due regard to the NSW Department of Environment, Climate Change and Water (DECCW) NSW *Road Noise Policy* (RNP), March 2011 and are presented in *Table 4.2*. The proposed transportation routes will mostly follow sub-arterial roads, however local roads are also considered in this assessment to ensure impacts are comprehensively assessed.

Table 4.2 Road Traffic Noise Criteria

Assessment Classification	Daytime (7am to 10pm) Assessment Period	Night time (10pm to 7am) Assessment Period
Road traffic noise criteria for existing residences affected by **additional traffic on existing sub-arterial roads** generated by land use developments.	Leq, (15 hour) 60 dB (external)	Leq, (9 hour) 55 dB (external)
Road traffic noise criteria for existing residences affected by **additional traffic on existing local roads** generated by land use developments.	Leq, (1 hour) 55 dB (external)	Leq, (1 hour) 50 dB (external)

1. The RNP is applied here as a guide to assess the potential impacts associated with construction and operational traffic noise from the Project.

Guidance Note

The RNP also presents permissible increases in noise levels above the existing road traffic noise of the area. However, the relative increase criteria are primarily intended to protect existing quiet areas from excessive changes in amenity due to noise from a road project.

Where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce them through feasible and reasonable measures to meet the assessment criteria. A secondary objective is to protect against excessive decreases in amenity as the result of a project by applying the relative increase criteria. In assessing feasible and reasonable mitigation measures, an increase of up to 2 dBA represents a minor impact that is considered barely perceptible to the average person.

4.3 OPERATIONAL NOISE CRITERIA

4.3.1 Operational (Quarry) Emissions

All Project-specific operational noise criteria ("Project-Specific Noise Levels", PSNL) have been established based on the representative RBL values presented in *Table 4.3* (where relevant) and in accordance with the INP.

The term PSNL is defined by the INP and considers the lowest of the intrusive or amenity criterion, so that the most stringent threshold is set with regard to existing industrial noise in the area. For this assessment the intrusiveness criteria have been adopted.

The sleep disturbance criteria of RBL + 15 dBA have been adopted for all residential receptors, consistent with the INP.

In accordance with the ICNG, PSNL values for other sensitive receptors i.e. places of worship, commercial/industrial premises, schools or recreational areas are fixed levels based on usage. They do not rely on the RBL utilised for residential receptors. Where the INP presents internal thresholds, a 10 dBA addition has been made to convert these to external criteria.

The INP assessment periods for Daytime, Evening and Night time are the same as those defined by the ICNG (refer to *Section 4.1*).

The PSNL are presented in *Table 4.3* below.

Table 4.3 Project-Specific Noise Levels (PSNL)

ID	Type	Project-Specific Noise Levels (Intrusiveness Criteria) [1]				Sleep Disturbance [2]	
		Daytime	Evening	Night	Morning Shoulder	Night	Morning Shoulder
13	Residential	43	41	37	40	47	50
14	Residential	43	41	37	40	47	50
1	Residential	43	41	37	40	47	50
16	Residential	43	41	37	40	47	50
2	Residential	43	41	37	40	47	50
17	Residential	43	41	37	40	47	50
4	Residential	43	41	37	40	47	50
18	Residential	41	41	38	40	48	50
19	Residential	41	41	38	40	48	50
24	Residential	41	41	38	40	48	50
20	Residential	41	41	38	40	48	50
6	Residential	46	43	40	43	50	53
30	Residential	46	43	40	43	50	53
11	Residential	46	43	40	43	50	53
48	Potential Future Industrial	75	75	75	75	-	-
33	Residential	47	47	46	46	56	56
38	Residential	47	47	46	46	56	56
7	Commercial	70	70	70	70	-	-
47	Potential Future Industrial	75	75	75	75	-	-
34	Residential	47	47	46	46	56	56
35	Residential	47	47	46	46	56	56
8	Industrial	75	75	75	75	-	-
46	Commercial	70	70	70	70	-	-
9	Industrial	75	75	75	75	-	-
10	Industrial	75	75	75	75	-	-

1. $L_{eq,\ 15\ minute}$ noise level in dBA.
2. Lmax noise level in dBA.

4.3.2 *Quarry Blasting Emissions*

Blasting limits are applicable to two main effects of blasting:

- air blast noise overpressure; and
- ground-borne vibration.

The limits for blasting described below are based on ANZEC (1990) guideline and Australian Standard *AS 2187.2 – 2006 Explosives - Storage and Use, Part 2: use of Explosives.*

Air Blast Overpressure

The air blast overpressure should not exceed 115 dBZ (Lpeak) for more than 5% of the total number of blasts over the 12 month reporting period. However, the maximum level should not exceed 120 dBZ (Lpeak) at any time. The dBZ (Lpeak) unit of sound measurement considers the low frequency sounds which are not audible to the human ear but can be 'felt'. Such limits will also ensure damage from blast noise overpressure is avoided.

Table 4.4 Allowable Air Blast Overpressure Levels

Air Blast Overpressure	Allowable Exceedances
115dBZ	5% of the total number of blasts over a 12 month period
120dBZ	0%

Ground-Borne Vibration

The Peak Particle Velocity (PPV, in mm/s) at any residence or noise sensitive receiver from ground vibration should not exceed 5 mm/s for more than 5% of the total number of blasts over the 12 month reporting period and the maximum level should not exceed 10 mm/s at any time.

Table 4.5 Allowable Vibration Levels

Peak Particle Velocity	Allowable Exceedances
5mm/s	5% of the total number of blasts over a period of 12 months
10mm/s	0%

Industrial and Commercial Receptors

The following criteria was approved by DA 1995/193, condition 25, clause (c) in 2009 by Port Macquarie Hastings Council (PMHC), although was not amended to the current Environmental Protection Licence (EPL) 5289 for the premises issued in November 2014. The criterion was developed to enable the industrial precinct to be established directly to the north of the quarry.

Ground vibration and air-blast overpressure levels from blasting undertaken at the site should not exceed the levels within *Table 4.6* at any existing or future industrial or commercial receiver on privately owned land.

Table 4.6 Allowable Limits with Regards to Commercial and Industrial Receivers

Parameter	Allowable Limits
Vibration (peak particle velocity)	25mm/s
Air-blast overpressure	125 dBZ

It is recommended that Hanson negotiate with the NSW EPA to have these limits included in the EPL upon development of the adjacent commercial and industrial precinct.

These criteria apply to minimise human annoyance and discomfort and were not developed to control possible structural damage. However, if ground vibration peak particle velocities comply with criteria for minimising human annoyance and discomfort, they would also be below levels that may cause structural damage to buildings.

Time and Frequency of Blasting

In accordance with the existing EPL, blasting at the premises may only be completed between the hours of 9.00 am to 3.00 pm Monday to Friday. Blasting is not permitted on Weekends or Public Holidays without the written approval of NSW EPA.

Monitoring Requirements

In accordance with the existing EPL, air-blast overpressure and ground vibration levels must be measured at any point within 1m of any affected residential boundary or other noise sensitive location, such as a school or hospital for all blasts carried out in or on the premises.

In addition, the licensee must monitor all blasts carried out in or on the premises at or near the nearest residence or noise sensitive location that is likely to be most affected by the blast.

This applies where the residence or noise sensitive location is not owned by the licensee or subject of a private agreement between the owner of the residence or noise sensitive location and the licensee relating to alternative blasting limits.

Instrumentation used to measure the air-blast overpressure and ground vibration levels must meet the requirements of Australian Standard *2187.2*.

Fly-rock

Blasting practices at the quarry are to be undertaken in accordance with Australian Standard *AS 2187.2* in order to*:*

- minimize the potential for fly-rock;
- protect the safety of people, property and livestock; and
- minimize dust and fumes emissions from blasting on the site.

Notification

According to DA 1995/193 (2009), Hanson are required to ensure the following notifications are in place prior to blasting:

- notify the landowner/occupier of any residence within 1km of the quarry pit who registers an interest in being notified about the blasting schedule on-site; and
- publicly display a number on the primary entrance to the site where information regarding blasting at the quarry can be obtained.

5 QUALITATIVE ASSESSMENTS

This section presents the qualitative assessment of lower risk acoustical factors that were considered during the preliminary stages of the data and information review process. The remainder of the assessment focuses on higher risk acoustical factors - construction and operational noise.

Construction and operational noise management plans are recommended to be prepared and implemented as detailed in *Chapter 8* of this report. These management plans act as a suitable provision and safeguard to evaluate these lower risk acoustical factors once the construction methodology and detailed design of the quarry occurs.

5.1 ROAD TRAFFIC NOISE – CONSTRUCTION

Based on the flow and mix of vehicles (mostly heavy vehicles) required to service the construction work for the Project, and the construction Road traffic noise impacts are temporary, any impacts from project traffic on public roads will be minimal, if any at all.

As stated in the Traffic assessment prepared for the EIS, the construction of the new ancillary infrastructure is assumed to take approximately 12 weeks for each plant. The delivery of all the infrastructure for site would be delivered in approximately 40 heavy vehicle movements importing items to site over these 12 weeks. During this time, personnel will be transported to site via light vehicles (approximately 10 trips per day during construction).

As such, it is expected that road traffic noise generated by the quarry will comply with the requirements of the RNP at the majority of receptors and any change in overall road traffic noise, however unlikely, would be barely perceptible to the average person such that cumulative impacts are also acceptable. Is also noted that the RNP primarily targets the assessment of operational road traffic noise impacts and is not intended for the assessment of short-term or temporary impacts associated with construction, especially where significant impacts are unlikely to occur.

Construction road traffic noise from the quarry may be audible at times but with the traffic management measures outlined in the broader environmental assessment for the quarry, will assist any adverse effects to be maintained at acceptable levels. The measures described in the broader environmental assessment are considered adequate to reduce the potential impacts (if any) associated with road traffic. Therefore, no further recommendations for construction road traffic noise mitigation and management measures are warranted or provided in this assessment.

5.2 *VIBRATION – CONSTRUCTION AND OPERATION*

Based on the equipment and activities identified for the construction and general operation of the quarry, potential sources of vibration are limited. This feature combined with the ≥ 100m distance offset (vibration dissipates rapidly with distance) to the closest sensitive receptor or buildings identifies that any vibration impacts will be minimal, if any at all.

It is expected that vibration generated by the construction works will comply with the requirements of the NSW Vibration Guideline and DIN 4150-3. During operation and maintenance, no vibration is expected to be generated and hence compliance with the requirements of the NSW Vibration Guideline and DIN 4150-3 will be achieved.

Vibration may be perceptible at times during construction but with standard construction planning and vibration management practices in place, the potential for human comfort (annoyance) impacts, or any adverse effects on buildings (cosmetic or structural damage) will be maintained at acceptable levels.

Given the limited potential for any vibration impacts to occur, no further recommendations for vibration mitigation and management measures are warranted or provided in this assessment.

5.3 *GROUND-BORNE NOISE – CONSTRUCTION AND OPERATION*

Based on the equipment and activities identified for the construction and general operation of the quarry, potential sources of vibration are limited. Ground-borne construction noise is usually present on tunnelling projects when significant tunnel boring equipment is operated underground.

Ground-borne noise impacts (generated by vibration) from the quarry are therefore not anticipated, as significant vibration generating sources with the potential to generate perceptible ground-borne noise do not form part of the Project design.

It is highly unlikely that any ground-borne noise would be audible or perceptible at any times during the Project. Therefore, it is expected that ground-borne noise generated by the construction works will comply with the requirements of the ICNG, and will comply with the INP (and other relevant requirements for ground-borne noise) during operation.

Given the limited potential for any ground-borne noise impacts to occur, no further recommendations for specific mitigation and management measures are warranted or provided in this assessment.

6 CONSTRUCTION NOISE ASSESSMENT

6.1 ASSESSMENT SCENARIOS

Although other construction activities will likely be required, works with the potential to generate the most significant noise emissions are represented by the three following activities:

- Demolition of existing structures.
- Site preparation and establishment.
- General construction of infrastructure.

Assessment scenarios have been developed based on the construction activities described above. The plant, equipment, and/or machinery with the potential to generate noise impacts at the closest and/or potentially most affected sensitive receptors or structures located off-site have been considered in each case.

The construction assessment scenarios are identified in *Table 6.1* and have been adopted for the purposes of predicting noise levels and comparison to management levels. As part of the project design, the infrastructure of the existing quarry will be re-located/replaced as part of the quarry expansion. Therefore overlap between construction and operational scenarios will be minimal if any at all.

As outlined in *Section 2.10*, a number of modelling features adopted for the construction noise model are described in *Table 6.1*:

- **Quantity** is the number of equipment operating per 15 minute assessment period.
- **Duty Factor** is the percentage of time the equipment operates per 15 minute assessment period, or represents a reduced emission for part of the period.
- **Base LW Value** is source emission or 'Sound Power Level' (LW) directly allocated to the equipment, unadjusted.
- **INP Penalty** considers any annoying characteristic such as tonality, low frequency noise or impulsiveness.
- **Total LW Value** is the overall equipment source emission (LW) adjusted for the quality, duty factor and INP penalty.

Table 6.1 Construction Noise Assessment Scenarios (Works, Activities and Equipment)

Scenario	Description	Equipment	Quantity	Duty Factor	Base LW Value	Total LW Value	Source
SCN01	Demolition of Existing Structures	Excavator (approx. 20 tonne)	2	100%	105	108.0	Australian Standard AS2436
		Excavator (approx. 40 tonne)[2]	1	100%	115	120.0	TfNSW CNS
		Generator	1	100%	99	99.0	Australian Standard AS2436
		Jackhammer[2]	1	100%	113	118.0	TfNSW CNS
		Front end loader[2]	1	100%	113	118.0	Australian Standard AS2436
		Light Vehicle (idle)	6	50%	95	99.8	Australian Standard AS2436
		Heavy Vehicle (idle)	6	50%	107	111.8	Australian Standard AS2436
		Light Vehicle (moving)	6	70%	95	101.2	Australian Standard AS2436
		Heavy Vehicle (moving)	6	70%	107	113.2	Australian Standard AS2436
SCN02 a/b	Site Preparation and Establishment a) Concrete Batching Plant b) Processing Plant & Asphalt Production Plant	Excavator (approx. 20 tonne)	1	75%	105	103.8	Australian Standard AS2436
		Excavator (approx. 30 tonne)	1	75%	110	108.8	Australian Standard AS2436
		Concrete agitator truck	1	50%	109	106.0	Australian Standard AS2436
		Concrete pencil vibrator	1	50%	103	100.0	Australian Standard AS2436
		Concrete pump truck	1	50%	108	105.0	Australian Standard AS2436
		Scraper	1	75%	116	114.8	Australian Standard AS2436
		Roller	1	100%	108	108.0	Australian Standard AS2436
		Grader	1	75%	110	108.8	Australian Standard AS2436
		Light Vehicle (idle)	6	50%	95	99.8	Australian Standard AS2436
		Heavy Vehicle (idle)	6	50%	107	111.8	Australian Standard AS2436
		Light Vehicle (moving)	6	70%	95	101.2	Australian Standard AS2436
		Heavy Vehicle (moving)	6	70%	107	113.2	Australian Standard AS2436

Scenario	Description	Equipment	Quantity	Duty Factor	Base LW Value	Total LW Value	Source
SCN03 a/b	General Construction of Infrastructure a) Concrete Batching Plant b) Processing Plant & Asphalt Production Plant	Cherry Picker	1	50%	105	102.0	Australian Standard AS2436
		Crane (mobile)	1	75%	104	102.8	Australian Standard AS2436
		Hand tools (electric)	6	50%	102	106.8	Australian Standard AS2436
		Hand tools (pneumatic)	1	50%	116	113.0	Australian Standard AS2436
		Welder	2	50%	105	105.0	Australian Standard AS2436
		Light Vehicle (idle)	6	50%	95	99.8	Australian Standard AS2436
		Heavy Vehicle (idle)	6	50%	107	111.8	Australian Standard AS2436
		Light Vehicle (moving)	6	70%	95	101.2	Australian Standard AS2436
		Heavy Vehicle (moving)	6	70%	107	113.2	Australian Standard AS2436
Lmax	Maximum Noise Level Assessment	Metal on Metal Contact	2[1]	100%	120.0	123.0	

1. Three Lmax sources were modelled, one at the Northern, Eastern, and Southern extent of the site boundary.
2. INP penalty applied for offensive noise characteristics.

6.2 *PREDICTED CONSTRUCTION NOISE LEVELS*

Based on the construction assessment scenarios and LW values identified in *Table 6.1,* noise levels have been predicted at all receptors (via modelling), and compared to the NML identified in *Table 4.1* above.

A comparison of the predicted values is provided in *Table 6.2* for the daytime NML. Lmax noise levels are also compared to the most stringent night time sleep disturbance criterion for works outside the recommended standard hours for construction. Any noise levels that exceed criteria are highlighted in **bold** typeset.

Guidance Note

As described in *Section 2.10*, Construction noise level predictions have been conducted to identify results for representative worst-case scenarios, as the predicted values consider the cumulative emission (and potential impact) of all equipment sources working concurrently.

It is not possible or warranted to reflect potential impacts, to model every plausible activity, task or usage for each noise generating source and location, hence the conservative approach adopted here has been applied to ensure that representative worst-case noise predictions were conducted. Furthermore, area sources were utilised were possible to reflect the potential distribution of noise across the site, and the potential emissions from activities undertaken at various locations within and around the site.

Table 6.2 Predicted Construction Noise Levels – All Scenarios (SCN01 to SCN03, Lmax)

ID	Type	Predicted Noise levels, $L_{eq,\ 15\ minute}$ in dBA						Comparison to Daytime NML					Sleep Disturbance
		SCN01	SCN02a	SCN02b	SCN03a	SCN03b	Lmax[1]	SCN01	SCN02a	SCN02b	SCN03a	SCN03b	
13	Residential[2]	41	37	**52**	36	**50**	38 - **57**	-7	-11	**4**	-12	**2**	**10**
14	Residential[2]	46	40	**49**	39	47	43 - **53**	-2	-8	**1**	-9	-1	**6**
1	Residential[2]	43	38	44	36	43	40 - **48**	-5	-10	-4	-12	-5	**1**
16	Residential[2]	44	39	46	37	45	41 - **51**	-4	-9	-2	-11	-3	**4**
2	Residential[2]	42	37	45	36	43	40 - **49**	-6	-11	-3	-12	-5	**2**
17	Residential[2]	43	38	46	36	44	40 - **50**	-5	-10	-2	-12	-4	**3**
4	Residential[2]	42	37	48	35	46	40 - **52**	-6	-11	0	-13	-2	**5**
18	Residential[2]	35	32	28	30	27	29 - 32	-11	-14	-18	-16	-19	-16
19	Residential[2]	37	36	36	34	35	30 - 40	-9	-10	-10	-12	-11	-8
24	Residential[2]	36	27	32	26	30	33 - 35	-10	-19	-14	-20	-16	-13
20	Residential[2]	27	25	36	24	34	24 - 28	-19	-21	-10	-22	-12	-20
6	Residential[2]	34	32	23	31	22	29 - 38	-17	-19	-28	-20	-29	-12
30	Residential[2]	38	35	26	34	25	26 - 38	-13	-16	-25	-17	-26	-12
11	Residential[2]	43	40	34	39	33	34 - 44	-8	-11	-17	-12	-18	-6
48	Potential Future Industrial	57	60	41	58	40	36 - 64	-18	-15	-34	-17	-35	-
33	Residential[2]	45	42	34	40	33	37 - 45	-7	-10	-18	-12	-19	-11
38	Residential[2]	44	40	34	39	33	36 - 43	-8	-12	-18	-13	-19	-13
7	Commercial	57	54	43	53	41	44 - 57	-13	-16	-27	-17	-29	-
47	Potential Future Industrial	56	49	46	48	45	47 - 53	-19	-26	-29	-27	-30	-
34	Residential[2]	50	46	41	44	39	41 - 50	-2	-6	-11	-8	-13	-6
35	Residential[2]	49	45	41	43	40	44 - 48	-3	-7	-11	-9	-12	-8
8	Industrial	52	48	48	46	46	48 - 52	-23	-27	-27	-29	-29	-
46	Commercial	56	51	50	49	48	50 - 55	-14	-19	-20	-21	-22	-
9	Industrial	52	47	46	45	44	47 - 50	-23	-28	-29	-30	-31	-
10	Industrial	46	39	49	37	48	44 - 53	-29	-36	-26	-38	-27	-

1. Lmax noise level in dBA.
2. The HNAML ($L_{eq,\ 15\ minute} \leq 75$ dBA) applies.
3. Sleep disturbance criterion not applicable for Commercial and Industrial receptors (i.e. not a residence/dwelling).
4. " – " indicates that an assessment of this feature does not apply for this circumstance/receptor.

6.2.2 *Summary of Results*

The results presented in *Table 6.2* and *Table 6.3* identify the following:

- The predicted $L_{eq,\ 15\ minute}$ noise levels range between 22 and 65 dBA for noise generating construction works and activities associated with the Project.
- The L_{max} noise levels are presented as a range, these noise levels are dependent on the location of the L_{max} noise source and the receptor.
- The highest predicted L_{max} noise levels range between 28 and 57 dBA at residential receptors for maximum noise level events generated by construction works and activities associated with the Project.
- The highest $L_{eq,\ 15\ minute}$ and L_{max} noise levels are predicted at residential receptors 13 and 14, generally the first row of receptors south of the Project site.
- The majority of predicted $L_{eq,\ 15\ minute}$ noise levels are below the daytime NML applicable at residential and other sensitive receptors for works within the recommended standard hours of construction.
- Exceedance of the daytime NML at residential receptors for works within the recommended standard hours of construction are predicted at receptors 13 and 14 in SCN02b and at receptor 13 in SCN03b.
- All predicted $L_{eq,\ 15\ minute}$ noise levels are below the daytime HNML value of $L_{eq,\ 15\ minute} \leq 75$ dBA applicable at residential receptors for works within the recommended standard hours of construction.
- Exceedance of the evening, night time and morning shoulder NML at residential receptors for works outside the recommended standard hours of construction are predicted at receptors to the south of the Project site across all scenarios.
- Exceedance of Lmax noise levels for the sleep disturbance criteria (night time and morning shoulder) applicable at residential receptors for works outside the recommended standard hours of construction are predicted at receptors to the south of the Project site.

6.2.3 *Discussion of Findings*

The predicted noise levels identified above are typical of construction works and activities undertaken in the vicinity of residential, commercial and other sensitive land use precincts.

These predicted values do not represent a constant noise emission that would be experienced by the community on a daily basis throughout the construction schedule. The predicted noise levels will only be experienced for limited periods of time when works are occurring; they will not be experienced over whole daytime, evening or night time periods. The construction schedule will involve the following key phases, demolition of existing structures (approximately 1-2 months) and construction of new infrastructure (approximately 12 months).

Construction noise may be audible at times, however impacts associated with these works will be temporary and do not represent a permanent impact on the community and surrounding environment. Some noise from construction sites is inevitable, such that the ICNG focuses on minimising construction noise impacts, rather than only on achieving numeric noise levels.

These results identify that general good-practice construction noise management and control techniques will be necessary to maintain acceptable noise levels at all receptors.

The discussion above also highlights that construction works should be limited to the recommended standard construction hours where possible, to minimise exceedances of the NMLs and reduce construction noise impacts.

6.2.4 Sleep Disturbance

It is important to consider potential sleep disturbance noise impacts associated with construction noise sources and with construction road traffic. Based on the results presented in *Table 6.2*, the sleep disturbance criteria is exceeded at a number of receptors to the south of the Project site. It is recommended that the majority (if not all) of construction works are limited to the recommended standard construction hours.

Construction outside of the recommended standard hours is not scheduled to occur. If construction is required outside the recommended standard hours, it is anticipated that general construction or construction road traffic will generate peak or maximum noise events with the potential to impact sleep during the night time period.

If there is a requirement for out of hours work due to an unforeseen reason, the closest and most sensitive receptors (13, 14, 1, 16, 2, 17 and 4) will be notified at least one week prior. With due regard to the requirements of the ICNG and RNP, suitable recommendations which can be practically implemented are provided in *Chapter 8*.

6.3 POTENTIAL CUMULATIVE IMPACTS

As noted in *Chapter 4*, the NML are based on existing noise levels measured at locations surrounding the site and focus on the direct impacts from the site under assessment. Furthermore, cumulative construction noise impacts are beyond the control of Hanson, are temporary in most circumstances and are best managed by local or state consent authorities for significant projects.

Although cumulative impacts are unlikely, as there are no other construction projects proposed for the area, due care may be required of the local or state consent authorities to manage any works occurring concurrently. Where issues arise, Hanson may be able to assist by scheduling certain works or activities to minimise cumulative impacts.

Given that the majority of predicted construction noise levels are compliant during the recommended standard hours of construction, cumulative impacts are highly unlikely to occur or to be dominated by this Project, if construction is limited to standard hours.

6.4 ASSESSMENT OUTCOMES

Based on the findings summarised above and in accordance with the requirements of the ICNG, suitable noise mitigation and management measures which may be feasibly and reasonably implemented are recommended in *Section 8.1*.

Construction noise levels will be reduced and impacts minimised with the successful implementation of these recommendations. Impacts may not be reduced to negligible levels for all receptors during all construction activities; however the recommendations will assist to ensure that any residual impacts are minimised as far as is practically achievable.

7 OPERATIONAL NOISE ASSESSMENT

7.1 ASSESSMENT SCENARIOS

Unlike construction, where noise will vary with the activity undertaken, operational emissions are predicted based on the known Project design available at the time of the assessment. Indicative Project layout drawings, as well as supporting information and data provided by Hanson, have been used to establish the operational assessment scenarios.

The operational plant, equipment, and/or machinery with the potential to generate noise impacts at the closest and/or potentially most affected receptors have been considered in each scenario.

The operational assessment scenarios are identified in *Table 7.1* and have been adopted for the purposes of predicting noise levels and comparison to criteria, PSNL. As part of the project design, the infrastructure of the existing quarry will be re-located/replaced as part of the quarry expansion. Therefore overlap between construction and operational scenarios will be minimal if any at all.

As outlined in *Section 2.10*, a number of modelling features adopted for the operational noise model are described in *Table 7.1*:

- **Quantity** is the number of equipment operating per 15 minute assessment period.
- **Duty Factor** is the percentage of time the equipment operates per 15 minute assessment period, or represents a reduced emission for part of the period.
- **Base LW Value** is source emission or 'Sound Power Level' (LW) directly allocated to the equipment, unadjusted.
- **INP Penalty** considers any annoying characteristic such as tonality, low frequency noise or impulsiveness.
- **Total LW Value** is the overall equipment source emission (LW) adjusted for the quality, duty factor and INP penalty. INP penalties were not included for operational stages of the noise assessment as plant/equipment can be procured/mitigated to avoid offensive noise characteristics.

Mitigation and management measures to avoid offensive noise characteristics are outlined in *Section 8.2*.

Table 7.1 Operational Noise Assessment Scenario (Activities and Equipment)

Scenario	Description	Equipment	Quantity	Duty Factor	Base LW Value	Total LW Value	Source
OPP01	Existing Operation of Quarry	Front End Loader (FEL) - Komatsu WA500	1	100%	110	110	LW derived based on measured activity: stock piling and loading out.
		Front End Loader (FEL) - CAT980H	1	100%	105	105	LW derived based on measured activity: stock piling and loading out.
		Dump truck - CAT769C	1	100%	112	112	LW derived based on measured activity: loading out.
		Cone Crusher	1	100%	118	118	LW measured crushing
		Jaw Crusher	1	100%	115	115	LW measured crushing
		Barmac VSI Crusher	1	100%	107	107	LW measured crushing
		Feeder (Dump Truck - tipping into crusher)	1	30%	113	108	Brandy Hill Quarry Report
		Excavator - Komatsu PC350LC	1	100%	107	107	Australian Standard AS2436
		Excavator - Komatsu PC400LC	1	100%	114	114	LW derived based on measured activity: loading dump truck
		Screen	4	100%	115	121	Australian Standard AS2436
		Conveyors (LW/m)	14	100%	91	91 LW/m	ERM library of measured equipment
		Conveyor Motor	14	100%	87	87	ERM library of measured equipment
		Conveyor Transfer Point	11	100%	95	95	ERM library of measured equipment
		Water Cart	1	100%	103	103	Brandy Hill Quarry Report
		Truck and Dog	2	75%	105	107	Brandy Hill Quarry Report
OPP02 - OPP06 (Stage 1 to Final)	Quarry Processing Plant, Asphalt Production Plant, and Equipment operating in new locations.	Front End Loader (FEL) - Komatsu WA500	1	100%	110	110	LW derived based on measured activity: stock piling and loading out.
		Front End Loader (FEL) - CAT980H	1	100%	105	105	LW derived based on measured activity: stock piling and loading out.
		Dump truck - CAT769C	1	100%	112	112	LW derived based on measured activity: loading out.
		Cone Crusher	1	100%	118	118	LW measured crushing
		Jaw Crusher	1	100%	115	115	LW measured crushing
		Barmac VSI Crusher	1	100%	107	107	LW measured crushing
		Feeder (Dump Truck - tipping into crusher)	1	30%	113	108	Brandy Hill Quarry Report

Scenario	Description	Equipment	Quantity	Duty Factor	Base LW Value	Total LW Value	Source
		Excavator - Komatsu PC350LC	1	100%	107	107	Australian Standard AS2436
		Excavator - Komatsu PC400LC	1	100%	114	114	LW derived based on measured activity: loading dump truck
		Screen	4	100%	115	121	Australian Standard AS2436
		Conveyors (LW/m)	21	100%	91	91 LW/m	ERM library of measured equipment
		Conveyor Motor	21	100%	87	87	ERM library of measured equipment
		Conveyor Transfer Point	14	100%	95	95	ERM library of measured equipment
		Water Cart	1	100%	103	103	Brandy Hill Quarry Report
		Truck and Dog	2	75%	105	107	Brandy Hill Quarry Report
	Concrete Batching Plant & Recycling Facility	Blending Plant	1	100%	106	106	Rooty Hill NIA
		Concrete Truck	1	75%	112	111	TfNSW CNS
		Concrete Agitator	1	100%	109	109	Australian Standard AS2436
		Concrete Pump	1	100%	108	108	Australian Standard AS2436
		Conveyors (LW/m)	2	100%	91	91 LW/m	ERM library of measured equipment
		Conveyor Motor	2	100%	87	87	ERM library of measured equipment
		Conveyor Transfer Point	1	100%	95	95	ERM library of measured equipment
		Water Supply Pump	1	100%	97	97	ERM library of measured equipment
	Asphalt Plant	Asphalt Plant	1	100%	110	110	Downer EIS - Oberon 2015
		Asphalt Stack	1	100%	112	112	Downer EIS - Oberon 2015
Lmax	Maximum Noise Level Assessment	Metal on Metal Contact	2[1]	100%	120	123	-

1. Four Lmax sources were modelled, one at the Northern, Eastern, Western and Southern extent of the site boundary.
2. Location of noise sources will be based on proposed infrastructure and project design (refer Annex C).
3. A combination of point, line, moving, and areas sources were utilised in the noise model to predict the likely distribution of noise sources associated with each work area.

7.2 *PREDICTED OPERATIONAL NOISE LEVELS*

Based on the operational assessment scenarios and LW values identified in *Table 7.1*, noise levels have been predicted at all receptors (via modelling), and compared to the PSNL identified in *Table 4.3* above. It should be noted that noise modelling includes conceptual mitigation (described in *Section 2.10.2*) based on reasonable and feasible mitigation measures determined through consultation with Hanson. The predicted noise levels presented below are therefore contingent on the implementation of this mitigation.

A comparison of the predicted $L_{eq,\ 15\ minute}$ values (general operations) is provided in *Table 7.2* for the day time PSNL. A comparison to the evening PSNL and the most stringent night time PSNL are provided in *Table 7.3* to *Table 7.5*. Predicted L_{max} values are also provided in in *Table 7.4* and *Table 7.5* for the sleep disturbance criteria. Compliance with the most stringent night time PSNL indicates that compliance is achieved with other PSNL (i.e. Morning Shoulder). Any noise levels that exceed criteria are highlighted in **bold** typeset.

Operational noise level predictions have been conducted to identify results for representative worst-case scenarios, as the predicted values consider the cumulative emission (and potential impact) of all equipment sources working concurrently.

Guidance Note

This noise assessment has been completed with due regard to and in accordance with the INP and other relevant acoustical standards. Noise has been assessed at receptor locations in accordance with the INP i.e. the most-affected point on or within the property boundary or, if that is more than 30 m from the residence, at the most-affected point within 30 m of the residence.

The objective of the noise assessment and broader EIS is to identify that emissions from the quarry will comply (with noise reducing mitigation implemented) at the most affected location for all receptors assessed. Hence, further assessment as demonstrated in the *Figure 2.1* process chart, including assessment of noise exceedance over more than 25% of a property is not necessary.

Table 7.2 Predicted Daytime Operational Noise Levels – All Scenarios (Calm Meteorological Conditions)

ID	Type	Predicted Noise levels, $L_{eq,\ 15\ minute}$ in dBA						Comparison to Daytime PSNL					
		Existing	Stage 1	Stage 2	Stage 3	Stage 4	Final Stage	Existing	Stage 1	Stage 2	Stage 3	Stage 4	Final Stage
13	Residential[3]	33	33	32	33	33	34	-10	-10	-11	-10	-10	-9
14	Residential[3]	43	34	35	34	34	34	0	-9	-8	-9	-9	-9
1	Residential[3]	40	32	33	32	32	32	-3	-11	-10	-11	-11	-11
16	Residential[3]	41	32	33	32	32	32	-2	-11	-10	-11	-11	-11
2	Residential[3]	40	32	33	32	32	32	-3	-11	-10	-11	-11	-11
17	Residential[3]	40	31	31	31	31	31	-3	-12	-12	-12	-12	-12
4	Residential[3]	39	30	30	30	30	30	-4	-13	-13	-13	-13	-13
18	Residential[3]	19	18	19	18	18	25	-22	-23	-22	-23	-23	-16
19	Residential[3]	26	31	32	31	31	33	-15	-10	-9	-10	-10	-8
24	Residential[3]	30	32	32	32	32	32	-11	-9	-9	-9	-9	-9
20	Residential[3]	25	24	32	30	37	37	-16	-17	-9	-11	-4	-4
6	Residential[3]	34	29	33	32	33	33	-12	-17	-13	-14	-13	-13
30	Residential[3]	37	30	30	29	29	29	-9	-16	-16	-17	-17	-17
11	Residential[3]	44	34	34	33	33	33	-2	-12	-12	-13	-13	-13
48	Potential Future Industrial	57	44	43	43	43	43	-18	-31	-32	-32	-32	-32
33	Residential[3]	45	34	34	34	34	34	-2	-13	-13	-13	-13	-13
38	Residential[3]	44	33	33	33	33	33	-3	-14	-14	-14	-14	-14
7	Commercial	56	44	44	44	44	44	-14	-26	-26	-26	-26	-26
47	Potential Future Industrial	54	47	47	47	47	47	-21	-28	-28	-28	-28	-28
34	Residential[3]	50	39	39	39	39	39	3	-8	-8	-8	-8	-8
35	Residential[3]	49	40	40	40	40	40	2	-7	-7	-7	-7	-7
8	Industrial	52	43	43	43	43	43	-23	-32	-32	-32	-32	-32
46	Commercial	54	46	46	46	46	46	-16	-24	-24	-24	-24	-24
9	Industrial	49	47	47	47	47	47	-26	-28	-28	-28	-28	-28
10	Industrial	43	42	42	42	42	42	-32	-33	-33	-33	-33	-33

1. $L_{eq,\ 15\ minute}$ noise levels in dBA.

Table 7.3 Predicted Evening Operational Noise Levels – All Scenarios (Prevailing W Wind)

ID	Type	Predicted Noise levels, $L_{eq,\ 15\ minute}$ in dBA					Comparison to Evening PSNL				
		Stage 1	Stage 2	Stage 3	Stage 4	Final Stage	Stage 1	Stage 2	Stage 3	Stage 4	Final Stage
13	Residential[3]	34	33	34	34	35	-7	-8	-7	-7	-6
14	Residential[3]	35	36	35	35	35	-6	-5	-6	-6	-6
1	Residential[3]	33	34	33	33	33	-8	-7	-8	-8	-8
16	Residential[3]	33	34	33	33	33	-8	-7	-8	-8	-8
2	Residential[3]	33	34	33	33	34	-8	-7	-8	-8	-7
17	Residential[3]	31	32	31	31	32	-10	-9	-10	-10	-9
4	Residential[3]	30	31	30	30	31	-11	-10	-11	-11	-10
18	Residential[3]	18	19	18	18	25	-23	-22	-23	-23	-16
19	Residential[3]	31	32	31	31	33	-10	-9	-10	-10	-8
24	Residential[3]	32	32	32	32	32	-9	-9	-9	-9	-9
20	Residential[3]	24	32	30	37	37	-17	-9	-11	-4	-4
6	Residential[3]	29	33	32	33	33	-14	-10	-11	-10	-10
30	Residential[3]	30	30	29	29	29	-13	-13	-14	-14	-14
11	Residential[3]	37	37	35	35	36	-6	-6	-8	-8	-7
48	Potential Future Industrial	46	44	44	44	44	-29	-31	-31	-31	-31
33	Residential[3]	37	37	37	37	37	-10	-10	-10	-10	-10
38	Residential[3]	36	36	35	35	36	-11	-11	-12	-12	-11
7	Commercial	47	47	46	46	47	-23	-23	-24	-24	-23
47	Potential Future Industrial	48	49	48	48	48	-27	-26	-27	-27	-27
34	Residential[3]	42	42	42	42	42	-5	-5	-5	-5	-5
35	Residential[3]	43	43	43	43	43	-4	-4	-4	-4	-4
8	Industrial	46	46	46	46	46	-29	-29	-29	-29	-29
46	Commercial	48	48	48	48	48	-22	-22	-22	-22	-22
9	Industrial	48	48	48	48	48	-27	-27	-27	-27	-27
10	Industrial	43	43	43	43	43	-32	-32	-32	-32	-32

1. $L_{eq,\ 15\ minute}$ noise levels in dBA

Table 7.4 Predicted Night Time Operational Noise Levels – All Scenarios (Prevailing NW Wind)

ID	Type	Predicted Noise levels, $L_{eq,\ 15\ minute}$ in dBA						Comparison to Night time PSNL					
		Stage 1	Stage 2	Stage 3	Stage 4	Final Stage	Lmax	Stage 1	Stage 2	Stage 3	Stage 4	Final Stage	Lmax
13	Residential[3]	35	34	35	35	35	35 - 43	-2	-3	-2	-2	-2	-4
14	Residential[3]	37	37	37	37	37	34 - 46	0	0	0	0	0	-1
1	Residential[3]	35	35	35	35	35	30 - 45	-2	-2	-2	-2	-2	-2
16	Residential[3]	35	36	35	35	35	32 - 45	-2	-1	-2	-2	-2	-2
2	Residential[3]	35	36	35	35	35	31 - 44	-2	-1	-2	-2	-2	-3
17	Residential[3]	34	34	33	33	34	31 - 44	-3	-3	-4	-4	-3	-3
4	Residential[3]	32	33	32	32	33	33 - 44	-5	-4	-5	-5	-4	-3
18	Residential[3]	21	22	20	21	27	18 - 31	-17	-16	-18	-17	-11	-17
19	Residential[3]	31	32	31	31	33	25 - 39	-7	-6	-7	-7	-5	-9
24	Residential[3]	32	32	32	32	32	26 - 35	-6	-6	-6	-6	-6	-13
20	Residential[3]	24	32	30	37	37	35 - 42	-14	-6	-8	-1	-1	-6
6	Residential[3]	29	33	32	33	33	31 - 38	-11	-7	-8	-7	-7	-12
30	Residential[3]	30	30	29	29	29	26 - 38	-10	-10	-11	-11	-11	-12
11	Residential[3]	34	34	33	33	33	30 - 44	-6	-6	-7	-7	-7	-6
48	Potential Future Industrial	45	44	44	44	44	41 - 63	-30	-31	-31	-31	-31	-
33	Residential[3]	36	36	36	36	36	26 - 48	-10	-10	-10	-10	-10	-8
38	Residential[3]	36	36	35	35	36	32 - 46	-10	-10	-11	-11	-10	-10
7	Commercial	47	47	46	46	47	40 - 61	-23	-23	-24	-24	-23	-
47	Potential Future Industrial	48	49	48	48	48	33 - 63	-27	-26	-27	-27	-27	-
34	Residential[3]	42	42	42	42	42	38 - 53	-4	-4	-4	-4	-4	-3
35	Residential[3]	43	43	43	43	43	38 - 52	-3	-3	-3	-3	-3	-4
8	Industrial	46	46	46	46	46	33 - 56	-29	-29	-29	-29	-29	-
46	Commercial	48	48	48	48	48	32 - 59	-22	-22	-22	-22	-22	-
9	Industrial	48	48	48	48	48	34 - 58	-27	-27	-27	-27	-27	-
10	Industrial	44	44	44	44	44	37 - 51	-31	-31	-31	-31	-31	-

1. $L_{eq,\ 15\ minute}$ noise levels in dBA.
2. Sleep disturbance criterion not applicable for Commercial and Industrial receptors (i.e. not a residence/dwelling).
3. " – " indicates that an assessment of this feature does not apply for this circumstance/receptor.

Table 7.5 Predicted Night Time Operational Noise Levels – All Scenarios (Prevailing W Wind)

ID	Type	Predicted Noise levels, $L_{eq,\ 15\ minute}$ in dBA						Comparison to Night time PSNL					
		Stage 1	Stage 2	Stage 3	Stage 4	Final Stage	Lmax	Stage 1	Stage 2	Stage 3	Stage 4	Final Stage	Lmax
13	Residential[3]	34	33	34	34	35	33 - 41	-3	-4	-3	-3	-2	-6
14	Residential[3]	35	36	35	35	35	34 - 44	-2	-1	-2	-2	-2	-3
1	Residential[3]	33	34	33	33	34	30 - 42	-4	-3	-4	-4	-3	-5
16	Residential[3]	33	34	33	33	33	32 - 42	-4	-3	-4	-4	-4	-5
2	Residential[3]	33	34	33	33	34	31 - 42	-4	-3	-4	-4	-3	-5
17	Residential[3]	31	32	31	31	32	29 - 41	-6	-5	-6	-6	-5	-6
4	Residential[3]	30	31	30	30	31	30 - 41	-7	-6	-7	-7	-6	-6
18	Residential[3]	18	19	18	18	25	15 - 28	-20	-19	-20	-20	-13	-20
19	Residential[3]	31	32	31	31	33	25 - 39	-7	-6	-7	-7	-5	-9
24	Residential[3]	32	32	32	32	32	25 - 35	-6	-6	-6	-6	-6	-13
20	Residential[3]	24	32	30	37	37	35 - 42	-14	-6	-8	-1	-1	-6
6	Residential[3]	29	33	32	33	33	31 - 38	-11	-7	-8	-7	-7	-12
30	Residential[3]	30	30	29	29	29	29 - 38	-10	-10	-11	-11	-11	-12
11	Residential[3]	37	37	35	35	36	30 - 44	-3	-3	-5	-5	-4	-6
48	Potential Future Industrial	46	44	44	44	44	41 - 63	-29	-31	-31	-31	-31	-
33	Residential[3]	37	37	37	37	37	26 - 48	-9	-9	-9	-9	-9	-8
38	Residential[3]	36	36	35	35	36	32 - 46	-10	-10	-11	-11	-10	-10
7	Commercial	47	47	46	46	47	40 - 61	-23	-23	-24	-24	-23	-
47	Potential Future Industrial	48	49	48	48	48	33 - 63	-27	-26	-27	-27	-27	-
34	Residential[3]	42	42	42	42	42	38 - 53	-4	-4	-4	-4	-4	-3
35	Residential[3]	43	43	43	43	43	38 - 52	-3	-3	-3	-3	-3	-4
8	Industrial	46	46	46	46	46	33 - 56	-29	-29	-29	-29	-29	-
46	Commercial	48	48	48	48	48	32 - 59	-22	-22	-22	-22	-22	-
9	Industrial	48	48	48	48	48	34 - 58	-27	-27	-27	-27	-27	-
10	Industrial	43	43	43	43	43	37 - 49	-32	-32	-32	-32	-32	-

1. $L_{eq,\ 15\ minute}$ noise levels in dBA
2. Sleep disturbance criterion not applicable for Commercial and Industrial receptors (i.e. not a residence/dwelling).
3. " – " indicates that an assessment of this feature does not apply for this circumstance/receptor

7.2.2 *Summary of Results*

The results presented in *Table 7.2* and *Table 7.5* for general mitigated operations associated with the quarry i.e. Stage 1 to 4, and the Final Stage identifies the following

- The predicted $L_{eq,\ 15\ minute}$ noise levels for existing operations range between 19 and 57 dBA for general operational noise associated with the quarry.
- The predicted $L_{eq,\ 15\ minute}$ noise levels for future operations range between 18 and 49 dBA for general operational noise associated with the quarry.
- The L_{max} noise levels are presented as a range, these noise levels are dependent on the location of the L_{max} noise source and the receptor.
- The highest predicted L_{max} noise levels range between 28 and 53 dBA at residential receptors for maximum noise level events generated by operational activities associated with the quarry.
- The highest $L_{eq,\ 15\ minute}$ and L_{max} noise levels vary depending upon the location the prevailing wind conditions. In general daytime (or calm conditions) noise levels are expected to be approximately 2 dBA lower when compared to prevailing (noise enhancing) conditions. The highest levels are generally associated with the worst-case north-westerly and westerly wind conditions during night time and are experienced at receptors to the south of the site across all scenarios (stages of operation).
- Minor exceedance of the PSNL are predicted for daytime existing quarry operations at receptors 34 and 35 to the east of the Project site.
- Contingent to the conceptual mitigation modelled for all future operational scenarios, predicted noise levels are compliant with PSNL across all assessment periods and operational stages. Mitigation and management recommendations are detailed in *Chapter 8*.

7.2.3 *Discussion of Findings*

Preliminary results indicated that noise emissions from the expansion of quarry operations would exceed the PSNL during all modelled conditions. This is primarily due to the close proximity of residential receptors to the proposed Processing Plant and Asphalt Production Plant in the southern part of the Project site. Conceptual mitigation was therefore modelled to ensure that the Project would meet the requirements of the INP and comply with PSNLs. These results are presented in *Section 7.2* above. Recommendations for mitigation and management measures required to meet the PSNL are provided in *Section 8.2*.

It is also important to note that INP penalties were not included for conceptual mitigation noise modelling, as plant/equipment can be procured/mitigated to avoid offensive noise characteristics.

7.3 *ROAD TRAFFIC – OPERATION*

To assess potential noise impacts associated with operational road traffic, the estimated traffic data presented in the EIS was utilised. The EIS traffic assessment presents estimated maximum overall and average heavy vehicle movements that the quarry could be expected to generate. This includes:

- an increase from the current **average** of approximately 42 heavy vehicle trips per day (42 movements in, 42 movements out for a total of 84 movements) to approximately 127 additional heavy vehicle trips per day (127 movements in, 127 movements out for a total of 254 movements); and

- an increase from the current **maximum** of 130 heavy vehicle trips per day (130 movements in, 130 movements out for a total of 260 movements) to approximately 396 additional heavy vehicle trips per day (396 movements in, 396 movements out for a total of 792 movements).

Conservative estimates were also prepared to determine the likely maximum number of truck trips (i.e. movements in + movement out) per hour, based on the most stringent night time road traffic noise criteria.

Assumed posted speed limits of 100 km/h for sub-arterial roads and 50 km/h for local roads, have been adopted to predict quarry road traffic noise levels for comparison to the RNP criteria i.e. $L_{eq,\ 15\ hour}$, $L_{eq,\ 9\ hour}$ and $L_{eq,\ 1\ hour}$.

Due to the distance offsets to nearby residential receptors (>250m), road traffic noise levels were predicted at a range of distances; 150m, 200m, 250m and 300m). This precautionary approach was adopted as actual road and dwelling façade distances will vary from property to property along the length of the overall road alignments.

Although truck movements are anticipated to occur primarily in the daytime period, 1.5% of daily traffic movements were estimated to occur during the night time to provide an evaluation of site traffic occurring in this period, especially in the early morning between 6am and 7am. Daytime peak $L_{eq,\ 1\ hour}$ noise levels were calculated based on 13% of daily truck movements occurring between 11am and 12pm as per the traffic assessment of the EIS. The traffic volumes based on these percentages are outlined below:

- Daytime $L_{eq,\ 15\ hour}$: 390 (maximum) and 125 (average) trips.

- Night time $L_{eq,\ 9\ hour}$: 6 (maximum) and 2 (average) trips.

- Daytime $L_{eq,\ 1\ hour}$: 51 (maximum) and 17 (average) trips.

- Night time $L_{eq,\ 1\ hour}$: 6 (maximum) and 2 (average) trips.

The predicted operational road traffic noise levels for local and sub-arterial roads are presented in *Table 7.6* below.

Based on a comparison of predicted operational road traffic noise levels to the applicable RNP criteria, the resultant noise levels from quarry heavy vehicles are below the RNP criteria values. Compliance with these RNP criteria is demonstrated for both the daytime (7am to 10pm) and night time (10pm to 7am) assessment periods. On this basis the introduction of quarry road traffic to sub-arterial and local roads is unlikely to generate significant noise impacts, if any at all.

Indicative Permissible Quarry Vehicle Flows

Further evaluation of road traffic noise levels occurred considering both assumed public traffic and maximum quarry vehicle flows. It identified that an additional flow of up to a) approximately 150 trips (300 quarry vehicle movements) could occur on sub-arterial roads during the daytime (a 15 hour assessment period) and b) approximately 12 trips (25 movements) during the night time (a nine hour assessment period) without a major risk of overall road traffic noise levels exceeding criteria.

Similarly and for local roads (a one hour assessment period for daytime and night time) this evaluation identified that an additional flow of up to approximately 12 trips (25 quarry vehicles movements) could occur during the daytime and approximately 6 trips (12 movements) during the night time without a major risk of overall road traffic noise levels exceeding criteria.

These indicative maximum vehicle flows were determined on the basis of existing road traffic contributing a noise level of 5 dBA less than the RNP road traffic noise criteria i.e.

- 55 dBA $L_{eq,\ 15\ hour}$ for the daytime period / sub-arterial roads;
- 50 dBA $L_{eq,\ 9\ hour}$ for the night time period / sub-arterial roads;
- 50 dBA $L_{eq,\ 1\ hour}$ for the daytime period / local roads; and
- 45 dBA $L_{eq,\ 1\ hour}$ for the night time period / local roads.

This evaluation is demonstrated in full in *Table 7.7* below.

These indicative flows are significantly in excess of the anticipated quarry vehicle requirements and these noise emissions will unlikely be realised, further reinforcing the finding of this report that the introduction of quarry road traffic to sub-arterial and local roads is unlikely to generate significant noise impacts, if any at all.

In summary, and with consideration of the data presented in both *Table 7.6* and *Table 7.7* below, operational road traffic noise levels are predicted to comply with the relevant RNP criteria despite the increase in proposed truck trips. Operational road traffic noise from the Project may be audible at times, but noise levels will be reduced and impacts (if any) minimised with the successful implementation of the recommendations and safeguards provided in *Section 8.2* of this report.

Table 7.6 Predicted Operational Road Traffic Noise Levels

Assessment Classification	RNP Road Traffic Noise Criteria		Predicted Noise Level (Day / Night) and Distance from Road Alignment, m				
	Daytime (7am to 10pm) assessment period	**Night time (10pm to 7am) assessment period**	**Assessment Type**	**150 m**	**200 m**	**250 m**	**300 m**
Road traffic noise criteria for existing residences affected by **additional traffic on existing sub-arterial roads** generated by land use developments.	Leq, (15 hour) 60 dB (external)	Leq, (9 hour) 55 dB (external)	Average	47/31	45/29	44/28	43/27
			Maximum	54/34	52/32	51/30	50/29
Road traffic noise criteria for existing residences affected by **additional traffic on existing local roads** generated by land use developments.	Leq, (1 hour) 55 dB (external)	Leq, (1 hour) 50 dB (external)	Average	47/38	45/36	44/35	43/34
			Maximum	52/43	50/41	49/40	48/38

1. Predicted road traffic noise levels include a +2.5 dB façade correction.
2. All noise levels are dBA re 2 x 10^{-5} Pa.

Table 7.7 Indicative Permissible Quarry Vehicle Flows

Assessment Classification	Estimated Existing Traffic Noise *(RNP Road Traffic Noise Criteria Minus 5 dBA)*		Traffic Parameter	Existing Assessment – 150 metre Scenario, refer Table 7.6					
				Predicted Noise Level		Comparison to Estimated Existing Traffic Noise (predicted – existing)		Quarry Heavy Vehicle Traffic (Trips)	
	Daytime	Night time		Daytime	Night time	Daytime	Night time	Daytime	Night time
Road traffic noise criteria for **existing residences affected by additional traffic on existing sub-arterial roads** generated by land use developments.	55 dBA Leq, 15 hour	50 dBA Leq, 9 hour	Ave.	47	31	-8	-19	125	2
			Max.	54	34	-1	-16	390	6
Road traffic noise criteria for **existing residences affected by additional traffic on existing local roads** generated by land use developments.	50 dBA Leq, 1 hour	45 dBA Leq, 1 hour	Ave.	47	38	-3	-7	17	2
			Max.	52	43	+2	-2	51	6

Assessment Classification	Predicted TOTAL Noise Level Estimated Existing + Quarry		Comparison to RNP Criteria (TOTAL predicted – criteria)		Indicative Additional Quarry Heavy Vehicles (Trips) before TOTAL road traffic noise equals criteria	
	Daytime	**Night time**	**Daytime**	**Night time**	**Daytime**	**Night time**
Road traffic noise criteria for **existing residences affected by additional traffic on existing sub-arterial roads** generated by land use developments.	56	50	-4	-5	175	4
	58	50	-2	-5	150	12
Road traffic noise criteria for **existing residences affected by additional traffic on existing local roads** generated by land use developments.	52	46	-3	-4	17	3
	54	47	-1	-3	12	6

1. All noise levels are dBA re 2 x 10-5 Pa.
2. Daytime is 7am to 10pm and Night time is 10pm to 7am.
3. For example, 55 dBA existing plus 47 dBA (quarry) equals 56 dBA total road traffic noise level.
4. To avoid misunderstanding the indicative flows are only presented to justify that the introduction of quarry road traffic to sub-arterial and local roads is unlikely to generate significant noise impacts.

7.4 SLEEP DISTURBANCE

It is important to consider potential sleep disturbance noise impacts associated with operational noise sources and operational road traffic. Road traffic noise impacts are not anticipated for night time / morning shoulder periods and Lmax noise levels from general operations are not predicted to exceed sleep disturbance criteria at residential receptors surrounding the Project site.

It should be noted that predicted noise levels are contingent to the conceptual mitigation modelled for all future operational scenarios. This mitigation is detailed in *Section 8.2.*

With due regard to the requirements of the INP and RNP, suitable recommendations which can be practically implemented are provided in *Chapter 8* of this report.

7.5 BLASTING

7.5.1 Blasting Overpressure

At the closest receptor (approximately 340m from potential blasting locations), blasting overpressure is predicted to comply with the Lpeak threshold of 120 dBZ for blasts with MIC value up to 270 kg. Blasting overpressure is predicted to comply with the 115 dBZ (Lpeak) 5% threshold for blasts with MIC value up to 113 kg. Regarding the DA approved industrial and commercial blasting limits; blasting overpressure is predicted to comply with the Lpeak threshold of 125 dBZ for blasts with MIC values up to 840 kg at a distance of 340 m.

Overpressure levels from blasts with MIC values greater than those outlined above are predicted to exceed the thresholds. This is contingent on the blast event location and the charge used; both of which are easily managed by good blasting practices.

As is evident in the results provided for the blasting overpressure assessment these emissions can vary significantly but are easily manageable. Any potential for impacts can be minimised such that adverse effects are fully avoided.

7.5.2 Blasting Vibration

At the closest receptor (approximately 340 m from potential blasting locations), blasting vibration is predicted to comply with the PPV threshold of 10 mm/s for blasts with MIC value up to 270 kg. Blasting vibration is predicted to comply with the 5 mm/s (PPV) 5% threshold for blasts with MIC value up to 113 kg. Regarding the DA approved industrial and commercial blasting limits; blasting overpressure is predicted to comply with the PPV threshold of 25 mm/s for blasts with MIC values up to 840 kg at a distance of 340 m.

Vibration levels from blasts with MIC values greater than those outlined above are predicted to exceed the thresholds. This is contingent on the blast event location and the charge used; both of which are easily managed by good blasting practices.

As is evident in the results provided for the blasting overpressure assessment these emissions can vary significantly but are easily manageable. Any potential for impacts can be minimised such that adverse effects are fully avoided.

7.6 POTENTIAL CUMULATIVE IMPACTS

As noted in *Section 4*, the operational noise criteria (PSNL) are based on existing noise levels measured at locations surrounding the Project site, such that existing conditions and industrial noise contributions are considered as part of the assessment approach.

The criteria are designed to prevent any long-term increase in cumulative industrial noise. By complying with these PSNL the quarry's noise contribution, combined with that of the existing industrial noise of the area is unlikely to generate any significant cumulative noise impacts.

Future cumulative impacts (i.e. due to other new developments approved in the future) are beyond the control of Hanson and are best managed by local or state consent authorities for significant projects.

7.7 ASSESSMENT OUTCOMES

Based on the findings summarised above, suitable blasting overpressure and vibration mitigation and management measures which may be feasibly and reasonably incorporated in to the blasting designs for the quarry are recommended in *Section 8.2* of this report.

8 RECOMMENDATIONS

This section presents the recommendations for construction and operational noise mitigation and management measures.

Qualitative assessments of potential impacts associated with construction road traffic and ground-borne noise, and impacts associated with construction and operational vibration were undertaken. No impacts are anticipated and no further recommendations are provided.

The focus of this section is construction and operational noise associated with the Project that have the potential to generate impacts at the closest and/or potentially most affected receptors. These recommendations reflect the intent of the relevant NSW noise guidelines.

8.1 CONSTRUCTION NOISE

To ensure noise emissions associated with construction works and activities are kept to acceptable levels, the following noise mitigation and management measures are recommended:

- Noise generating work and activities will be carried out during the ICNG recommended standard hours (i.e. 7am to 6pm Monday to Friday and 8am to 1pm Saturdays), with no work on Sundays or public holidays. Any work that is required outside the recommended standard hours must be suitably managed with a goal of achieving compliant noise levels at all residential receptors or undertaken with agreement from any potentially affected neighbours.

- Where unforeseen works will occur in close proximity (<100m) to a receptor and these works are anticipated to generate high levels of noise e.g. >75 dBA, potential respite periods e.g. three hours of work, followed by one hour of respite will be considered. Respite will be implemented if it is the preference of the affected receptors and if it is feasible and reasonable to achieve during the works. In some circumstances, respite may extend the duration of works and inadvertently increase noise impacts, hence due care should be taken when considering this management measure.

- During construction planning, choose appropriate machines for each task and adopt efficient work practices to minimise the total construction period and the number of noise sources on the site. Select the quietest item of plant available where options that suit the design permit.

- During the works, avoid unnecessary noise due to idling diesel engines and fast engine speeds when lower speeds are sufficient.

- During the works, instruct drivers to travel directly to site and avoid any extended periods of engine idling at or near residential areas, especially at night.

- During any night works, any activity that has the potential to generate impulsive noise will be avoided. These types of events are particularly annoying; especially at night and have the limited potential to generate sleep disturbance or awakening impacts. Any impulsive or transient noise events expected to exceed the sleep disturbance criteria at residential receptors will be strictly avoided at night.

- During the works, ensure all machines used on the site are in good condition, with particular emphasis on exhaust silencers, covers on engines and transmissions and squeaking or rattling components. Excessively noisy machines will be repaired or removed from the site.

- During the works, ensure that all plant, equipment and vehicles movements are optimised in a forward direction to avoid triggering motion alarms that are typically required when these items are used in reverse.

- If any validated noise complaints are received, operator attended noise measurements will be undertaken to measure and compare the site noise level contributions ($L_{eq,\ 15\ minute}$ and L_{max} in dBA) to:

    - the predicted values; and

    - the NMLs presented in this report.

- All site noise levels will be measured in the absence of any influential source not associated with the site. If the measured site noise levels are below the predicted values and comply with the NMLs presented in this report, no further mitigation or management measures are required. If the measured site noise levels are above the predicted noise levels or NML presented in this report, further mitigation and/or management measures will be considered.

- Prior to commencement of works, a Construction Noise Management Plan (CNMP) will be prepared and implemented, and will consider all potential acoustical factors identified in this report including those addressed in *Chapter 5* and *Chapter 6*. The CNMP will detail any noise monitoring and take into consideration measures for reducing the source noise levels of construction equipment by construction planning and equipment selection where reasonable and feasible.

8.2 OPERATIONAL (QUARRY) NOISE

Contingent to the conceptual mitigation modelled for all future operational scenarios, predicted noise levels are compliant with PSNL across all assessment periods and operational stages. It is therefore recommended that the mitigation outlined in *Section 2.10.2* be implemented on site in order to comply with the PSNL. In summary, this mitigation involves the following measures:

Boundary Mitigation:

- Earth Bunding (approximately 25 m in height, 450 m in length and 75 m in width) is required along the southern boundary of the site to provide additional shielding from the processing plant and asphalt production plant.

- Earth Bunding (approximately 20 m in height, 250 m in length and 60 m in width) is also required at the western boundary of the pit to provide shielding from in pit activities from Stage 2 of the quarry expansion when in pit activities progress closer to Receptor 20 to the west.

Plant / Equipment Procurement:

- During the operational design, choose appropriate machines for each task and adopt efficient work practices to minimise the total number of noise sources on the site. Select the quietest item of plant available where options that suit the design permit, with consideration to offensive noise characteristics such as tonality, low frequency noise or impulsiveness.

- The key items of plant/equipment are presented below in *Table 2.3*. Operational LW emissions should be at or below those presented in *Table 2.3* and *Table 7.1* of this report. Where items of procured plant generate offensive noise characteristics, INP penalties will be applied prior to meeting the LW values presented above.

At Source Mitigation:

- Where LW values for plant/equipment outlined in *Table 2.3* are not reasonable or feasible, the operational design will incorporate acoustic enclosures / barriers to assist in reducing the noise emission of identified plant/equipment. Design of acoustic enclosures / barriers will also consider offensive noise characteristics as tonality, low frequency noise or impulsiveness.

INP penalties for offensive noise characteristics such as tonality, low frequency noise or impulsiveness were not included for conceptual mitigation noise modelling, as plant/equipment can be procured/mitigated to avoid offensive noise characteristics.

In addition to the mitigation measures outlined above, the following management measures are recommended to ensure noise emissions associated with the operation of the quarry are kept to acceptable levels:

- Avoid unnecessary noise due to idling diesel engines and fast engine speeds when lower speeds are sufficient.

- Instruct drivers to travel directly to site and avoid any extended periods of engine idling at or near residential areas, especially at night.

- During any night works, any activity that has the potential to generate impulsive noise will be avoided. These types of events are particularly annoying; especially at night and have the limited potential to generate sleep disturbance or awakening impacts. Any impulsive or transient noise events expected to exceed the sleep disturbance criteria at residential receptors will be strictly avoided at night.

- Ensure all machines used on the site are in good condition, with particular emphasis on exhaust silencers, covers on engines and transmissions and squeaking or rattling components. Excessively noisy machines will be repaired or removed from the site.

- Ensure that all plant, equipment and vehicles movements are optimised in a forward direction to avoid triggering motion alarms that are typically required when these items are used in reverse.

- Noisy plant and equipment will be located as far as possible from noise sensitive areas.

- The location of activities, plant and equipment will optimise attenuation effects through measures such as topography, natural and purpose built barriers.

- If any validated noise complaints are received, operator attended noise measurements will be undertaken to measure and compare the site noise level contributions ($L_{eq,\ 15\ minute}$ and L_{max} in dBA) to:

  - the predicted values; and

  - the PSNLs presented in this report.

- All site noise levels will be measured in the absence of any influential source not associated with the site. If the measured site noise levels are below the predicted values and comply with the PSNLs presented in this report, no further mitigation or management measures are required. If the measured site noise levels are above the predicted noise levels or PSNLs presented in this report, further mitigation and/or management measures will be considered.

- A Detailed Design Noise Impact Assessment will be undertaken during the final stages of the Project design to ensure that noise emissions from the Processing Plant and Asphalt Production Plant can be effectively reduced to compliant levels through plant / equipment procurement and construction of acoustic enclosures / barriers. An Operational Noise Management Plan (ONMP) will be also prepared based on the detailed design, and will consider all potential acoustical factors identified in this report including those addressed in *Chapter 5* and *Chapter 7*. The ONMP will detail any noise monitoring and take into consideration measures for reducing the source noise levels of operational equipment by equipment selection, management and mitigation where reasonable and feasible.

In accordance with the SEARs, this assessment has considered the characterisation of impacts and potential treatment as per the INP and with due regard to the principles presented in the Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum Production and Extractive Industry Developments (VLAMP, September 2018). As stated in *Section 7.2*, noise has been assessed at receptor locations in accordance with the INP i.e. the most-affected point on or within the property boundary or, if that is more than 30 m from the residence, at the most-affected point within 30 m of the residence. The objective of the noise assessment and broader EIS is to identify that emissions from the quarry will comply (with noise reducing mitigation implemented) at the most affected location for all receptors assessed. Hence, further assessment regarding the VLAMP as demonstrated in *Figure 2.1*, including assessment of noise exceedance over more than 25% of a property is not necessary.

8.3 OPERATIONAL (BLASTING) OVERPRESSURE AND VIBRATION

Based on the results presented in *Section 7.5*, blasting overpressure and vibration are predicted to comply with the ANZEC 1990 guideline, AS 2187.2 and the approved DA 1995/193 criteria. This is contingent on the blast event location and the charge used; both of which are easily managed by good blasting practices.

As is evident in the results provided for the blasting overpressure assessment, these emissions can vary significantly but are easily manageable. Any potential for impacts can be minimised such that adverse effects are fully avoided. Blasting emissions will be reduced and impacts (if any) minimised by complying with the criteria and requirements outlined in *Section 4.3.2*.

Hanson will remain aware of the potential impacts associated with quarry blasting and continue to plan for and then manage the quarry blasting and design accordingly.

8.4 POTENTIAL MONITORING OPTIONS

Blast Monitoring

As outlined in *Section 4.3.2* monitoring is required for all blast events carried out in or on the premises. Air-blast overpressure and ground vibration levels must be measured at any point within one metre of any affected residential boundary or other noise sensitive location, such as a school or hospital for all blasts carried out in or on the premises. In addition, the licensee must monitor all blasts carried out in or on the premises at or near the nearest residence or noise sensitive location that is likely to be most affected by the blast.

Construction / Operational Noise Monitoring

Construction and operational noise monitoring will also be undertaken for the Project however, the type and frequency would be adapted according to type of work. Noise monitoring would occur in the form of attended noise measurements and/or unattended real-time noise monitoring.

As stated above the details of these monitoring measures will be outlined in the Construction Noise Management Plan and the Operation Noise Management Plan.

Key Technical Features

All noise measurement procedures adopted for the Project will be conducted in accordance with the requirements of Australian Standard (AS) 1055:1997 *Acoustics - Description and Measurement of Environmental Noise*.

Attended noise measurements would be conducted by an operator using a hand held Type 1 or Type 2 'integrating-averaging' sound level meter. All measurements will be completed with the sound level meter mounted to a tripod (if possible) and with a windscreen fitted. The preferred measurement height is 1.2 m to 1.5 m above the ground.

The device will be calibrated prior to and after all measurement rounds, with any change in calibration levels noted. Instantaneous noise levels for all noted noise emission sources (extraneous or otherwise), meteorological conditions (average and maximum wind speeds, temperature, precipitation and cloud cover etc.) would be recorded during all measurements. The location of monitoring, time of measurement and all relevant measurement parameters (i.e. L_{eq}, L_{min}, L_{max}, L_1, L_{10} and L_{90}) would also be recorded. Noise monitoring will not be completed during periods where wind speeds exceed 5 m/s at the microphone or during any rain events.

Unattended noise measurements would be conducted using a Type 1 or Type 2 environmental noise logger. The device will be calibrated prior to and after installation, with any change in calibration levels noted. Measurements will be completed with a windscreen fitted.

Noise monitoring would not be completed within 3.5 m of any reflective structure or wall, if possible. Where it is not possible to measure more than 3.5 m from any reflective structure or wall, a reduction of up to 2.5 dB would be applied to the measured ambient and site noise contribution ($L_{eq,\ 15\ minute}$) to account for the likely increase in noise associated with reflective surfaces.

Monitoring will be conducted with due regard to AS1055; AS61672, AS1259 (or similar); IEC60942; or the NSW Vibration Guideline as relevant to the monitoring being conducted.

All noise samples would be recorded using the "fast" time response of the sound level meter or environmental noise logger. Site activity records would be maintained during any noise (or vibration) monitoring events.

Noise Monitoring Locations

Noise measurements would be undertaken at the potentially most affected receptor locations identified in this report (dependant on phase of works/scenario). Monitoring would occur at the following receptors at minimum to represent receptors surrounding the site: Receptors 13 and 14 to the south, receptor 20 to the west, receptor 11 to the north and receptor 34 to the east. Refer *Figure 3.3* in *Chapter 1* of this report.

Recommendations

Within the first three months of commercial operation, noise verification and compliance monitoring is recommended to measure and compare the site noise level contributions ($L_{eq,\ 15\ minute}$ in dBA) to a) the predicted values, and b) the criteria presented in this report.

The same will occur if any validated noise complaints are received. All site noise levels would be measured in the absence of any influential sources not associated with the project. If the measured site noise levels are below the predicted values and noise levels comply with the criteria presented in this report, no further mitigation or management measures would be required. If the measured site levels are above the predicted noise levels and/or criteria presented in this report, further mitigation and/or management measures will be required.

9 CONCLUSION

The assessment was conducted to achieve a scope of works that allowed for the successful identification of potential receptors situated in the vicinity and potential area of influence of site emission sources and identification of significant noise and vibration generating plant, equipment and/or activities associated with the quarry and their likely/known emissions. The overall assessment methodology is presented in *Chapter 2*.

The existing ambient and background noise level of the area was measured and quantified via long-term unattended noise logging and short-term operator attended noise measurements. The existing conditions at and near the Project site and the measured existing ambient and background noise levels are presented in *Chapter 3*.

Noise and vibration criteria (refer to *Chapter 4*) were developed with due regard to and in accordance with recognised NSW standards and guidelines as applicable to the quarry activities. The focus of the assessment was establishing construction noise compliance with due regard to the ICNG and INP.

The focus of the (blasting) overpressure and vibration assessment was establishing compliance with regard to Standards Australia *AS2187.2-2006.*

Applicable construction, operational and blasting assessment scenarios were developed based on Project information provided by Hanson and likely noise, overpressure and vibration levels were predicted, and compared to criteria to establish compliance, evaluate potential impacts and establish potential mitigation measures if necessary to reduce levels and minimise impacts.

Potential impacts associated with construction road traffic and ground-borne noise, and impacts associated with construction and operational vibration were qualitatively assessed. Due to the type of equipment in use, activities that will be undertaken in the known sensitivity/distance offset to nearby receptors no impacts are anticipated and as such no further recommendations for noise and vibration mitigation, management measures or monitoring options are warranted. Further information regarding these qualitative assessments is presented in *Chapter 5*.

A quantitative construction and operational noise impact assessment was conducted by predicting noise levels via modelling. The predictions were completed for the applicable assessment scenarios and resultant noise levels compared to Project-specific criteria and/or management levels at each receptor location, and any significant or characteristic features identified. These construction and operational noise assessments are the focus of this report and the details of each assessment presented in *Chapter 6* (for construction) and *Chapter 7* (for operation).

The assessment has identified that both construction and operational noise levels have the potential to exceed the applicable criteria, limits and thresholds of the INP and ICNG if they are not suitably mitigated. The assessment also identified the blasting overpressure and vibration levels have only a limited potential to exceed the applicable *AS2187* criteria and thresholds, as long as normal blast design planning and consideration for potential environmental impacts occurs.

Based on the findings summarised above noise mitigation, management measures and monitoring options were recommended as considered suitable to the magnitude and extent of the predicted construction and operational impacts. They are designed to reduce noise levels and minimise impacts as far as is commonly feasible and reasonable to do so and practical to implement. These measures and options are presented in *Chapter 8*.

Construction noise levels will be reduced and impacts (if any) minimised with the successful implementation of the recommendations provided in *Section 8.1*. Construction noise impacts may not be reduced to imperceptible or negligible levels for all receptors during all construction activities; however the recommendations will ensure that any residual impacts are minimised as far as possible and commonly achievable via good construction management practices.

Preliminary operational noise levels were predicted to exceed the applicable INP operational noise criteria and limits for all modelled conditions. As such, noise mitigation and management measures were established to assist achieve compliance with the INP. These measures are presented in *Section 8.2* of this report.

REFERENCES

Australian and New Zealand Environment Council (ANZEC) – 1990, **Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration**, September 1990.

Department of Planning and Environment (DPE) - **Voluntary Land Acquisition and Mitigation Policy (VLAMP)** for State Significant Mining, Petroleum and Extractive Industry Developments, September 2018.

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NSW Environment Protection Authority – **NSW Environmental Noise Management – Industrial Noise Policy** (INP), January 2000 and relevant application notes.

NSW Environment Protection Authority – **Implementation and transitional arrangements for the Noise Policy for Industry (2017)**, October 2017.

NSW Department of Environment and Climate Change – **NSW Interim Construction Noise Guideline** (ICNG), July 2009.

NSW Department of Environment, Climate Change and Water – **NSW Road Noise Policy** (RNP), March 2011.

NSW Department of Environment and Conservation – **NSW Environmental Noise Management – Assessing Vibration: a Technical Guideline** (the NSW vibration guideline), February 2006.

NSW Government – Transport for NSW (TfNSW) **Construction Noise Strategy** (7TP-ST-157/2.0), dated April 2013.

Standards Australia AS1055–1997™ (AS1055) – **Description and Measurement of Environmental Noise**: Parts 1, 2 and 3 as applicable.

Standards Australia AS IEC 61672.1–2004™ (AS61672) – **Electro Acoustics - Sound Level Meters Specifications Monitoring** or Standards Australia AS1259.2-1990™ (AS1259) – **Acoustics – Sound Level Meters – Integrating Averaging as relevant to the devic**e.

Standards Australia AS/IEC 60942:2004/IEC 60942:2003 (IEC60942) – Australian Standard™ – **Electroacoustics – Sound Calibrators.**

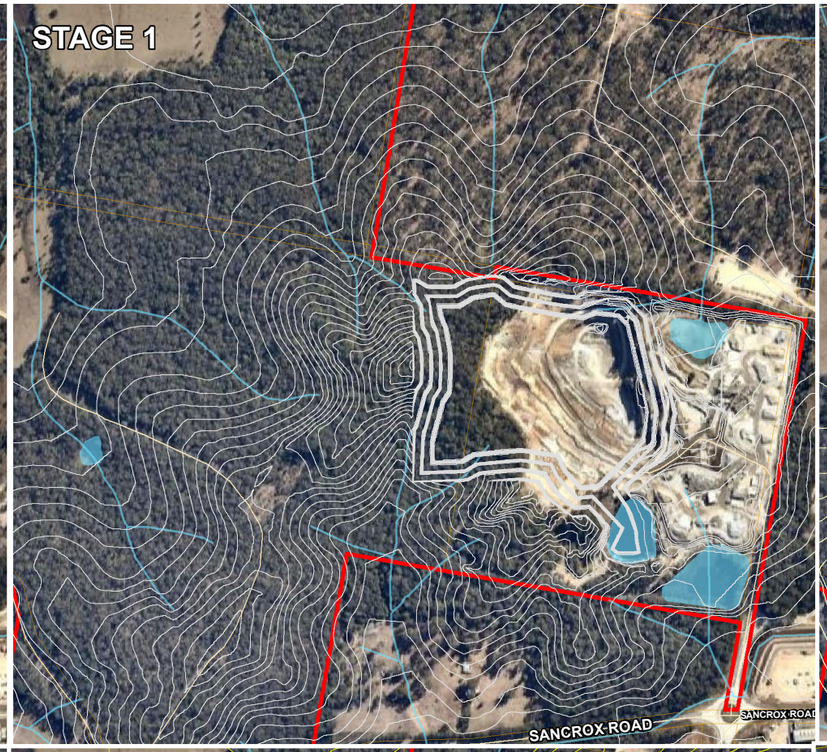
Standards Australia AS2187.2-2006™ (AS2187.2) – **Explosives—Storage and Use Part 2: Use of Explosives.**

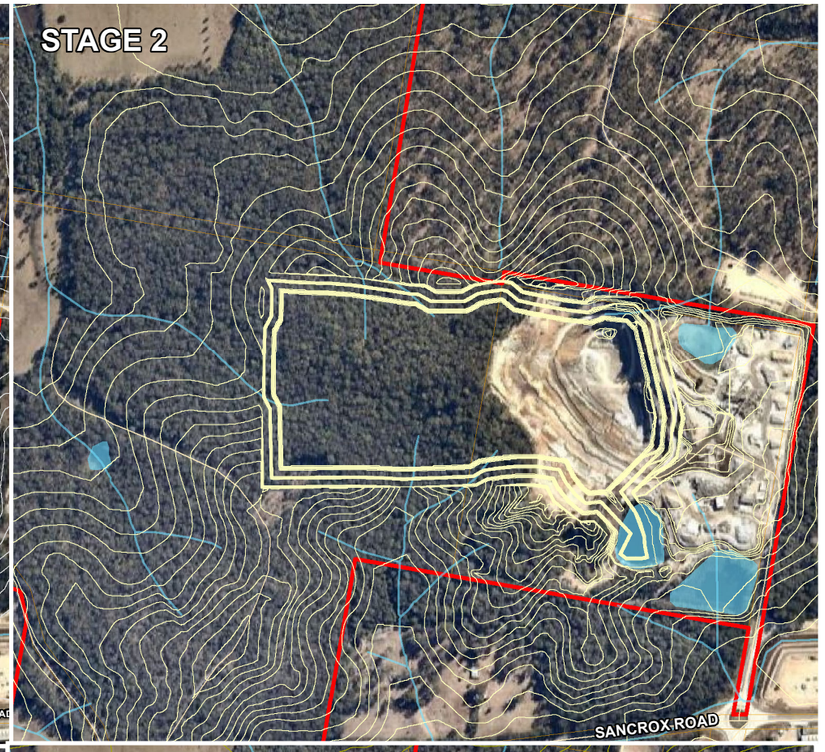
Standards Australia AS 2436–2010™ (AS2436) – **Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites.**

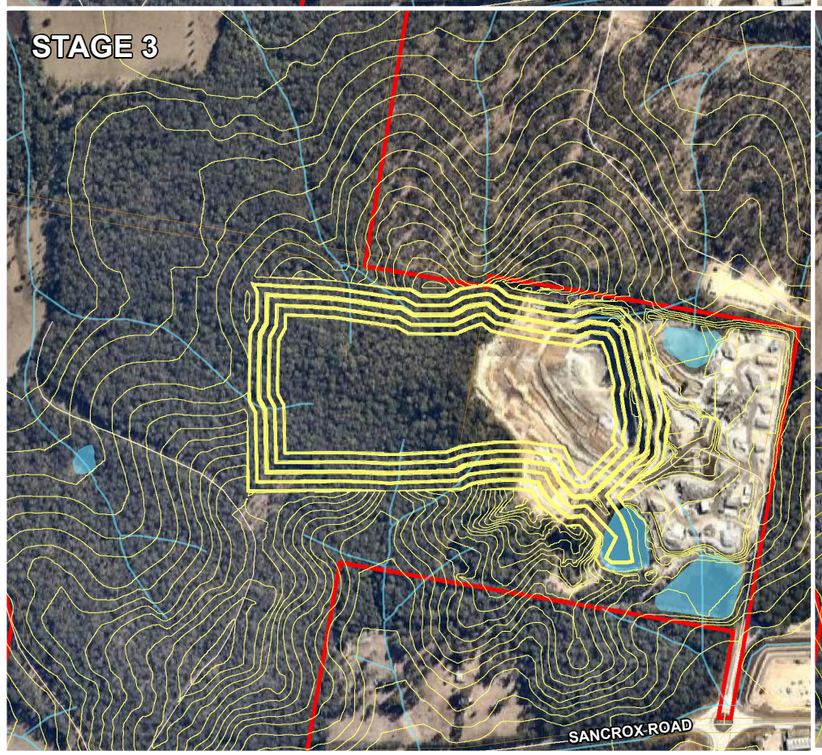
United Kingdom (UK) – **Calculation of Road Traffic Noise** (CoRTN) calculative methods, adapted to Australia conditions.

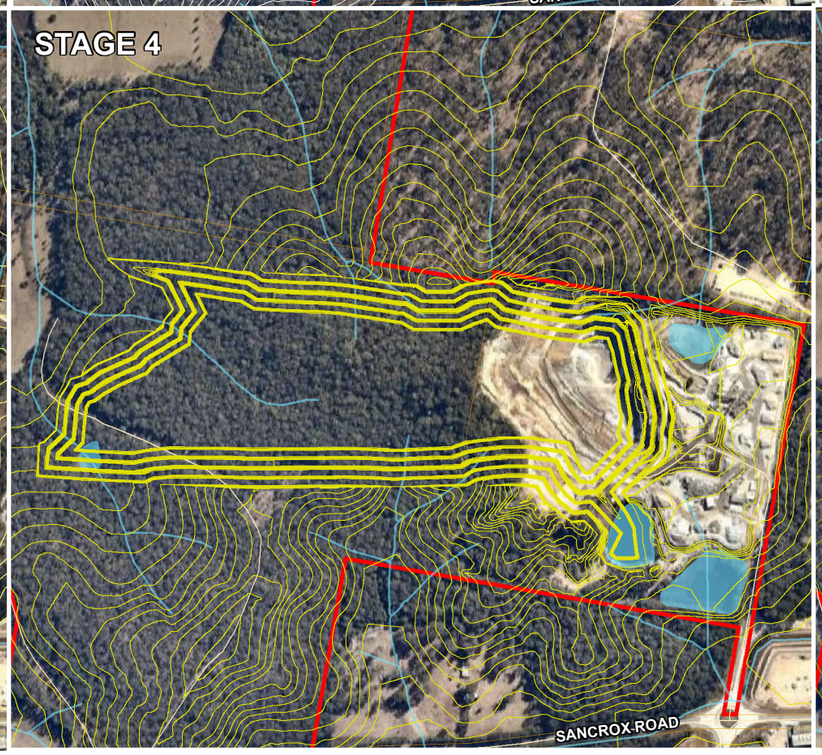
Annex A

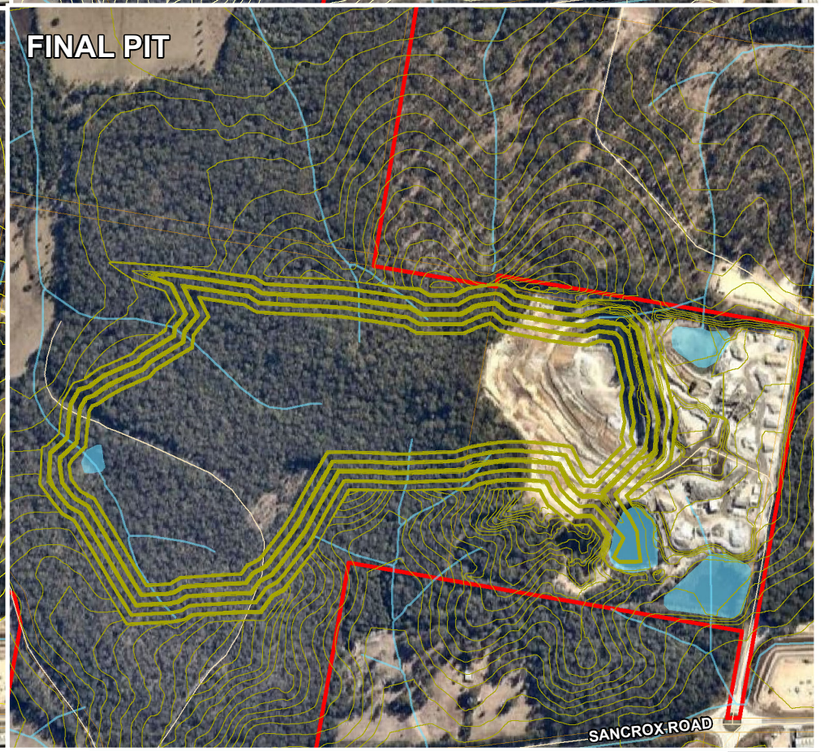
Staging and Layout











Legend

- Existing Property Ownership
- Lot Boundary
- Road Network
- Watercourses

Quarry Staging:

- Stage 1 (RL-14m)
- Stage 2 (RL-14m)
- Stage 3 (RL-40m)
- Stage 4 (RL-40m)
- Final Pit (RL-40m)

Source:
Spatial Data: DFSI DCDB, DTDB 2017
Imagery Data: nearmap August 2017

Quarry Staging

F.A1

Drawing No:	0418291s_EIS_G002_R2.mxd		**Sancrox Quarry Expansion Project**
Date:	27/07/2018	Drawing Size: A4	
Drawn By:	LT	Reviewed By: ME	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 100 200m

N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

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Annex B

Acoustics Glossary

B.1 GLOSSARY – ACOUSTICAL CONCEPTS AND TERMINOLOGY

B.1.1 What Is Noise And Vibration?

Noise

Noise is often defined as a sound, especially one that is loud or unpleasant or that causes disturbance[1] or simply as unwanted sound, but technically, noise is the perception of a series of compressions and rarefactions above and below normal atmospheric pressure.

Vibration

Vibration refers to the oscillating movement of any object. In a sense noise is the movement of air particles and is essentially vibration, though in regards to an environmental assessment vibration is typically taken to refer to the oscillation of a solid object(s). The impact of noise on objects can lead to vibration of the object, or vibration can be experienced by direct transmission through the ground, this is known as ground-borne vibration.

Essentially, noise can be described as what a person hears, and vibration as what they feel.

B.1.2 What Factors Contribute To Environmental Noise?

The noise from an activity received at any location can be affected by a number of factors the most significant being:

- How loud the activity is?
- How far away the activity is from the receiver.
- What type of ground is between the activity and the receiver location e.g. concrete, grass, water or sand?
- How the ground topography varies between the activity and the receiver, is it flat, hilly, mountainous? Blocking the line of sight to a noise source will generally reduce the level of noise.
- Any other obstacles that block the line of sight between the source to receiver e.g. buildings or purpose built noise walls.

[1] Copyright © 2011 Oxford University Press

B.1.3 How to Measure and Describe Noise?

Noise is measured using a specially designed 'sound level' meter, which must meet internationally recognised performance standards. Audible sound pressure levels vary across a range of 10^7 Pascals (Pa), from the threshold of hearing at 20μPa to the threshold of pain at 200Pa. Scientists have defined a statistically described logarithmic scale called Decibels (dB) to more manageably describe noise.

To demonstrate how this scale works, the following points give an indication of how the noise levels and differences are perceived by an average person:

- 0 dB - represents the threshold of human hearing (for a young person with ears in good condition).
- 50 dB – represents average conversation.
- 70 dB – represents average street noise, local traffic etc.
- 90 dB – represents the noise inside an industrial premises or factory.
- 140 dB - represents the threshold of pain – the point at which permanent hearing damage may occur.

B.1.4 Human Response to Changes in Noise Levels

The following concepts offer qualitative guidance in respect of the average response to changes in noise levels:

- Differences in noise levels of less than approximately 2 dBA are generally imperceptible in practice. An increase of 2 dB is hardly perceivable.
- Differences in noise levels of around 5 dBA are considered to be significant.
- Differences in noise levels of around 10 dBA are generally perceived to be a doubling (or halving) of the perceived loudness of the noise. An increase of 10 dB is perceived as twice as loud. Therefore an increase of 20 dB is four times as loud and an increase of 30 dB is eight times as loud etc.
- The addition of two identical noise levels will increase the dB level by about 3 dB. For example, if one car is idling at 40 dB and then another identical car starts idling next to it, the total dB level will be about 43 dB.
- The addition of a second noise level of similar character which is at least 8 dB lower than the existing noise level will not add significantly to the overall dB level.

- A doubling of the distance between a noise source and a receiver results approximately in a 3 dB decrease for a line source (for example, vehicles travelling on a road) and a 6 dB decrease for a point source (for example, the idling car discussed above).

- A doubling of traffic volume for a line source results approximately in a 3 dB increase in noise, halving the traffic volume for a line source results approximately in a 3 dB decrease in noise.

B.1.5 Terms to Describe the Perception of Noise

The following terms offer quantitative and qualitative guidance in respect of the audibility of a noise source:

- **Inaudible / Not Audible** - the noise source and/or event could not be heard by the operator, masked by extraneous noise sources not associated with the source. If a noise source is 'inaudible' its noise level may be quantified as being less than the measured L_{A90} background noise level, potentially by 10 dB or greater.

- **Barely Audible –** the noise source and/or event are difficult to define by the operator, typically masked by extraneous noise sources not associated with the source. If a source is 'barely audible' its noise level may be quantified as being 5 - 7 dB below the measured L_{A90} or L_{Aeq} noise level, depending on the nature of the source e.g. constant or intermittent.

- **Just Audible** – the noise source and/or event may be defined by the operator. However there are a number of extraneous noise sources contributing to the measurement. The noise level should be quantified based on instantaneous noise level contributions, noted by the operator.

- **Audible** - the noise source and/or event may be easily defined by the operator. There may be a number of extraneous noise sources contributing to the measurement. The noise level should be quantified based on instantaneous noise level contributions, noted by the operator.

- **Dominant –** the noise source and/or event are noted by the operator to be significantly 'louder' than all other noise sources. The noise level should be quantified based on instantaneous noise level contributions, noted by the operator.

The following terms offer qualitative guidance in respect of acoustic terms used to describe the frequency of occurrence of a noise source during an operator attended environmental noise measurements:

- **Constant –** this indicates that the operator has noted the noise source(s) and/or event to be constantly audible for the duration of the noise measurement e.g. an air-conditioner that runs constantly during the measurement.

- **Intermittent** – this indicates that the operator has noted the noise source(s) and/or event to be audible, stopping and starting intervals for the duration of the noise measurement e.g. cars passing by.

- **Infrequent** – this indicates that the operator has noted the noise source(s) and/or event to be constantly audible, however; not occurring regularly or at intervals for the duration of the noise measurement, e.g. a small number of aircraft are noted during the measurement.

B.1.6 How to Calculate or Model Noise Levels?

There are two recognised methods, which are commonly adopted to determine the noise at particular location from a proposed activity. The first is to undertake noise measurements whilst the activity is in progress and measure the noise, the second is to calculate the noise based on known noise emission data for the activity in question.

The second option is preferred as the first option is largely impractical in terms of cost and time constraints, notwithstanding the meteorological factors that may also influence its quantification. Furthermore, it is also generally considered unacceptable to create an environmental impact simply to measure it. In addition, the most effective mitigation measures are determined and implemented during the design phase and often cannot be readily applied during or after the implementation phase of a project.

Because a number of factors can affect how 'loud' a noise is at a certain location, the calculations can be very complex. The influence of other ambient sources and the contribution from a particular source in question can be difficult to ascertain. To avoid these issues, and to quantify the direct noise contribution from a source/site in question, the noise level is often calculated using noise modelling software packages. The noise emission data used in may be obtained from the manufacturer or from ERM's database of measured noise emissions.

B.1.7 Acoustic Terminology & Statistical Noise Descriptors

Environmental noise levels such as noise generated by industry, construction and road traffic are commonly expressed in dBA. The A-weighting scale follows the average human hearing response and enables comparison of the intensity of noise with different frequency characteristics. Time varying noise sources are often described in terms of statistical noise descriptors. The following descriptors are commonly used when assessing noise and are referred to throughout this acoustic assessment:

- **Decibel (dB is the adopted abbreviation for the decibel)** – The unit used to describe sound levels and noise exposure. It is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure.

- **dBA** - unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.

- **dBC** – unit used to measure 'C-weighted' sound pressure levels. C-weighting is an adjustment made to sound-level measurements which takes account of low-frequency components of noise within the audibility range of humans.

- **dBZ or dBL** – unit used to measure 'Z-weighted' sound pressure levels with no weighting applied, linear.

- **Hertz (Hz)** - the measure of frequency of sound wave oscillations per second. 1 oscillation per second equals 1 hertz.

- **Octave –** a division of the frequency range into bands, the upper frequency limit.

- **1/3 Octave –** single octave bands divided into three parts.

- **Leq** - this level represents the equivalent or average noise energy during a measurement period. The $L_{eq, 15min}$ noise descriptor simply refers to the L_{eq} noise level calculated over a 15 minute period. Indeed, any of the below noise descriptors may be defined in this way, with an accompanying time period (e.g. $L_{10, 15\ minute}$) as required.

- **Lmax** - the absolute maximum noise level in a noise sample.

- **LN -** the percentile sound pressure level exceeded for N % of the measurement period calculated by statistical analysis.

- **L10 -** the noise level exceeded for 10 % of the time. It is approximately the average of the maximum noise levels.

- **L90** - the noise level exceeded for 90 % of the time. It is approximately the average of the minimum noise levels. The L_{90} level is often referred to as the "background" noise level and is commonly used as a basis for determining noise criteria for assessment purposes.

- **Sound Power Level (LW)** - this is a measure of the total power radiated by a source. The Sound Power of a source is a fundamental property of the source and is independent of the surrounding environment.

- **Sound Pressure Level (LP)** - the level of sound pressure; as measured at a distance by a standard sound level meter with a microphone. This differs from L_W in that this is the received sound as opposed to the sound 'intensity' at the source.

- **Background noise –** the underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the L_{A90} descriptor.

- **Ambient noise –** the all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far. This is described using the L_{Aeq} descriptor.

- **Cognitive noise –** noise in which the source is recognised as being annoying.

- **Masking –** the phenomenon of one sound interfering with the perception of another sound. For example, the interference of traffic noise with use of a public telephone on a busy street.

Industrial Noise Policy (INP) Terminology

The following terminology is from the NSW Environment Protection Authority – *NSW Environmental Noise Management – Industrial Noise Policy* (INP), January 2000 and relevant application notes:

- **Assessment Background Level (ABL)** - is defined in the INP as a single figure background level representing each assessment period (day, evening and night). Its determination is by the tenth percentile method (of the measured L_{A90} statistical noise levels) described in Appendix B on the INP.

- **Rating Background Level (RBL)** - is defined in the INP as the overall single figure background level representing each assessment period (day, evening and night) over the whole monitoring period (as opposed to over each 24 hour period used for the ABL). This is the level used for assessment purposes. It is defined as the median value of:

  - all the day assessment background levels over the monitoring period for the day;

  - all the evening assessment background levels over the monitoring period for the evening; or

  - all the night assessment background levels over the monitoring period for the night.

- **Extraneous noise –** noise resulting from activities that are not typical of the area. Atypical INP activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.

- **Most affected location(s) –** locations that experience (or will experience) the greatest noise impact from the noise source under consideration. In determining these locations, one needs to consider existing background levels, exact noise source location(s), distance from source (or proposed source) to receiver, and any shielding between source and receiver.

- **Noise criteria** – the general set of non-mandatory noise level targets for protecting against intrusive noise (for example, background noise plus 5 dB) and loss of amenity (for example, noise levels for various land uses).

- **Noise limits –** enforceable noise levels that appear in conditions on consents and licences. The noise limits are based on achievable noise levels, which the proponent has predicted can be met during the environmental assessment. Exceedance of the noise limits can result in the requirement for either the development of noise management plans or legal action.

- **Project Specific Noise Levels** – target noise levels for a particular noise generating facility. They are based on the most stringent of the intrusive criteria or amenity criteria. Which of the two criteria is the most stringent is determined by measuring the level and nature of existing noise in the area surrounding the actual or propose noise-generating facility.

- **Compliance –** the process of checking that source noise levels meet with the noise limits in a statutory context.

- **Non-compliance –** development is deemed to be in non-compliance with its noise consent/ licence conditions if the monitored noise levels exceed its statutory noise limit by more than 2 dB.

- **Feasible and Reasonable measures –** feasibility relates to engineering considerations and what is practical to build; reasonableness relates to the application of judgement in arriving at a decision, taking into account the following factors:

    - noise mitigation benefits (amount of noise reduction provided, number of people protected);

    - cost of mitigation (cost of mitigation versus benefit provided);

    - community views (aesthetic impacts and community wishes); and

    - noise levels for affected land uses (existing and future levels, and changes in noise levels).

- **Meteorological Conditions –** wind and temperature inversion conditions.

- **Temperature Inversion –** an atmospheric condition in which temperature increases with height above the ground.

- **Adverse Weather** – weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).

B.2 VIBRATION - GLOSSARY OF TERMS, DEFINITIONS AND METHODOLOGY

B.2.1 How to Measure and Control Vibration

Vibration refers to the oscillating movement of any object. In relation to construction projects, ground-borne vibration is the most likely outcome of works and potentially has three (3) effects on vibration sensitive receivers, these are:

- Ground-borne vibration that may cause annoyance;
- Ground-borne vibration that may have adverse effect on a structure e.g. a building; and
- Regenerated noise due to ground-borne vibration.

Each of these potential effects can be assessed in accordance with the relevant standard. Perceptible levels of vibration often create concern for the surrounding community at levels well below structural damage guideline values; this issue needs to be managed as part of the vibration-monitoring program.

Vibration is typically measured using specific devices that record the velocity or acceleration at a designated receiver location – usually being the closest premises to works. Modern vibration monitoring devices will typically capture amplitude data for the three (3) orthogonal axes being, the transverse, longitudinal and vertical and also the frequency at which the measured vibration event occurs.

Monitoring of this level of detail enables analysis of significant vibration events to determine compliance with relevant guidelines such as the NSW Department of Environment and Conservation – NSW Environmental Noise Management – *Assessing Vibration: a Technical Guideline* (the NSW vibration guideline), February 2006 and the German Institute for Standardisation – DIN 4150 (1999-02) Part 3 (DIN4150-3) – *Structural Vibration - Effects of Vibration on Structures*.

Vibration propagates in a different manner to noise and can be difficult to control depending on the frequency of the source in question, although identifying the strategy best suited to controlling vibration follows a similar approach to that of noise. This includes elimination, control at the source, control along the propagation path and control at the receiver and/or a combination of these, such as no work/respite periods.

B.2.2 Vibration Descriptors

The following terms are often used to describe measured vibration levels.

- **Parameter** – an attribute with a value - for example, weighting;
- **Particle Velocity** – the instantaneous value of the distance travelled by a particle per unit time in a medium that is displaced from its equilibrium state by the passage of a sound or vibration wave;
- **Peak Component Particle Velocity (PCPV)** – is the highest (maximum or peak) particle velocity, which is recorded during a particular vibration event over the three (3) axes. PCPV is measured in the unit, mm/s;
- **Phase** – the relative position of a sound wave to some reference point, the phase of a wave is given in radians, degrees, or fractions of a wavelength;
- **Acceleration** – the change in velocity over time. Acceleration is dependent on the velocity and the frequency of the vibration event (velocity is a vector), as such acceleration changes in two ways - magnitude and/or direction. Acceleration is measured in the unit; m/s^2;
- **Perceptible** – vibration levels that a receiver of building occupant may 'feel'. 0.2mm/s is typically considered to be the human threshold for perception of vibration;
- **Geophone or accelerometer** – the transducer/device typically used to measure vibration;
- **Damage** – is defined in DIN 4150-3 to include minor non-structural effects such as cosmetic damage or superficial cracking in paint or cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls;
- **Vibration Dose Value (VDV)** – a concept outlined in the NSW vibration guideline, which is a calculative approach to assessing the impact of intermittent vibration or extended periods of impulsive vibration. VDV require the measurement of the overall weighted RMS (Root Mean Square) acceleration levels over the frequency range 1Hz to 80Hz. To calculate VDV the following formula (refer Section 2.4.1 of the guideline) is used:

$$VDV = \left[\int_0^T a^4(t)dt \right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, *a (t)* is the frequency-weighted RMS of acceleration in m/s^2 and *T* is the total period of the day (in seconds) during which vibration may occur;

- **MIC** - Maximum Instantaneous Charge or explosive charge mass (kg) detonated per delay (any 8ms interval); and

- **SD** (m) - The scaled distance for air-blast and ground vibration from the charge to the receiver.

Annex C

INP Methodology

C.1 NSW INP - NOISE IMPACT ASSESSMENT PROCEDURES

Responsibility for the control of noise emissions in NSW is typically vested in Local Government and the EPA – Environment Protection Authority.

The NSW *Industrial Noise Policy* (INP) first published by the EPA in January 2000, provides a framework and methodology for deriving limit conditions for consent and licence conditions. Using this policy the EPA regulates premises that are scheduled under the *Protection of the Environment Operations Act, 1997* (POEO Act). The specific INP objectives are:

- To establish noise criteria that would protect the community from excessive intrusive noise and preserve amenity for specific land uses.
- To use the criteria as the basis for deriving Project-Specific Noise Levels (PSNL).
- To promote uniform methods to estimate and measure noise impacts, including a procedure for evaluating meteorological effects.
- To outline a range of mitigation measures that could be used to minimise noise impacts.
- To provide a formal process to guide the determination of feasible and reasonable noise limits for consent or licence conditions that reconcile noise impacts with the economic, social and environmental considerations of industrial development.
- To carry out functions relating to the prevention, minimisation and control of noise from premises scheduled under the POEO Act.

The INP is designed for large and complex industrial sources and outlines processes designed to strike a feasible and reasonable balance between the operations of industrial activities and the protection of the community from noise levels that are intrusive or unpleasant. The application of the INP involves the following processes:

- Determining the PSNL from intrusiveness and amenity based measurement of the existing background and ambient noise levels.
- Predicting or measuring the noise levels produced by the development.
- Comparing the predicted noise levels with the PSNL and assessing impacts.

Where the PSNL are predicted to be exceeded the INP provides guidelines on the assessment of feasible and reasonable noise mitigation strategies, including:

- The process of 'weighing up' the benefit of the development against the social and environmental costs resulting from the noise impacts.
- Establishment of achievable and agreed noise limits for the development in consultation with the consent authority.
- Undertaking performance monitoring of environmental noise levels to determine compliance with the consent and licence conditions.

C.2 NSW INP - ASSESSMENT METHODOLOGY

There are two criteria to consider when establishing PSNL for the assessment of industrial noise sources. These criteria are as follows:

- The 'Intrusive Noise' criterion, which is based on the background noise level plus 5 dB. The background noise level, or Rating Background Level (RBL), is determined in accordance with Section 3 of the INP and is based on the use of noise monitoring data to establish the assessable background noise levels; and
- The 'Amenity Noise' criterion, which is based on the recommended noise levels in the INP for prescribed land use. The recommended acceptable and maximum ambient noise levels are outlined in Table 2.1 of the INP. Table 2.2 of the INP outlines the requirements for developments where the existing noise level from industrial noise sources is close to the acceptable noise level.

The relevant tables in Section 2 of the INP relating to the amenity criteria relevant to the project are presented in *Table C.1* and *Table C.2*.

Table C.1 Amenity Criteria - Recommended LAeq Noise Levels from Industrial Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended LAeq Noise Level	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50 dBA	55 dBA
		Evening	45 dBA	50 dBA
		Night	40 dBA	45 dBA
	Suburban	Day	55 dBA	60 dBA
		Evening	45 dBA	50 dBA
		Night	40 dBA	45 dBA
	Urban	Day	60 dBA	65 dBA
		Evening	50 dBA	55 dBA
		Night	45 dBA	50 dBA
	Urban/Industrial Interface - for existing situations only	Day	65 dBA	70 dBA
		Evening	55 dBA	60 dBA
		Night	50 dBA	55 dBA
Area specifically reserved for passive recreation	All	When in use	50 dBA	55 dBA
Active recreation area (School playground, golf course)			55 dBA	60 dBA
Commercial premises			65 dBA	70 dBA
Industrial premises			70 dBA	75 dBA

1. In accordance with the INP the assessment periods are defined as follows: Daytime is the period from 7am to 6pm - Monday to Saturday; or 8am to 6pm on Sundays and Public Holidays, Evening is the period from 6pm to 10pm and Night time is all remaining periods; and
2. The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

Table C.2 ***Modification to Acceptable Noise Level (ANL) to Account for Existing Levels of Industrial Noise***

Total Existing LAeq Noise Level from Industrial Noise Sources	Maximum LAeq Noise Level for Noise from New Sources Alone, dB
≥ Acceptable noise level plus 2 dB	If existing noise level is likely to decrease in future acceptable noise level minus 10 dB If existing noise level is unlikely to decrease in future existing noise level minus 10 dB
Acceptable noise level plus 1 dB	Acceptable noise level minus 8 dB
Acceptable noise level	Acceptable noise level minus 8 dB
Acceptable noise level minus 1 dB	Acceptable noise level minus 6 dB
Acceptable noise level minus 2 dB	Acceptable noise level minus 4 dB
Acceptable noise level minus 3 dB	Acceptable noise level minus 3 dB
Acceptable noise level minus 4 dB	Acceptable noise level minus 2 dB
Acceptable noise level minus 5 dB	Acceptable noise level minus 2 dB
Acceptable noise level minus 6 dB	Acceptable noise level minus 1 dB
< Acceptable noise level minus 6 dB	Acceptable noise level

1. ANL = recommended acceptable LAeq noise level for the specific receiver.

In assessing the noise impacts from industrial sources at residential receivers both criteria are considered. For each period (day, evening and night) the most stringent of either the intrusive or amenity criteria becomes the limiting criterion and forms the project-specific noise level for the industrial source.

If the existing ambient noise level is close to the acceptable noise level, a new source must be controlled to preserve the amenity of the surrounding area. If the overall noise level from the industrial source already exceeds the acceptable noise level for the affected area, the L_{Aeq} noise level from a new source should meet the conditions set out in Table 2.2 of the INP.

C.2.1 INP - Project Specific Noise Levels

The INP states that the criteria outlined in *Table C.1* and *Table C.2* have been selected to protect at least 90 per cent of the population living in the vicinity of industrial noise sources from the adverse effects of noise for at least 90 per cent of the time. Provided the criteria in the INP are achieved, it is unlikely that most people would consider the resultant noise levels excessive.

Table C.3 presents the methodology for assessing noise levels, which may exceed the INP PSNL.

Table C.3 Noise Impact Assessment Methodology

Assessment Criterion	Project Specific Noise Level	Noise Management Zone	Noise Affectation Zone
Intrusive	Rating background level plus 5 dB	≤ 5 dB above project-specific criteria	≥ 5 dB above project-specific criteria
Amenity	INP based on existing industrial level	≤ 5 dB above project-specific criteria	≥ 5 dB above project-specific criteria

For the purposes of assessing the potential noise impacts the project-specific, management and affectation criteria are further defined in the following sections.

Project Specific Noise Level

Most people in the broader community would generally consider exposure to noise levels that achieve the project-specific criteria acceptable.

Noise Management Zone

Depending on the degree, that levels exceed the project-specific noise level (1 dB to 5 dB) noise impacts in this zone could range from negligible to moderate. It is recommended that management procedures be implemented including:

- prompt response to any issues of concern raised by community;
- noise monitoring on-site and within the community;
- refinement of on-site noise mitigation measures and plant operating procedures where practical;
- consideration of acoustical mitigation at receivers; and
- consideration of negotiated agreements with property holders.

Noise Affectation Zone

Exposure to noise levels corresponding to this zone (more than 5 dB above project-specific criteria) may be considered unacceptable by some property holders and implementation of the following measures may be required:

- discussions with relevant property holders to assess concerns and provide solutions;
- implementation of acoustical mitigation at receivers; and
- negotiated agreements with property holders.

C.3 INP - APPLICATION NOTES

These application notes are provided to assist industry and acoustical consultants develop noise impact assessments and apply the provisions of the NSW Industrial Noise Policy (INP), with the aim of reducing processing time. The full list of application notes are extensive and are not reproduced here to avoid presenting an exhaustive list of technical requirements. The application notes have however been considered as relevant to the site and the relevant application notes have been summarised below.

The EPA requires noise impact assessments to apply the provisions of the INP; alternative approaches are not acceptable. The process for identifying project-specific noise levels in Section 2 of the INP must be followed.

The level of mitigation that can be applied to a project is based on what is feasible and reasonable within the circumstances of that project. Valid factors include costs, aesthetics, community preferences, noise reduction achieved, etc. Noise level requirements in a licence are based on what the project can achieve using feasible and reasonable mitigation. For more information on feasible and reasonable levels of mitigation see:

- NSW Road Noise Policy;
- Sections 1.4.5 and 7 of the INP; and
- Interim Construction Noise Guideline.

C.3.1 *Identifying the Existing Level of Noise from Industry*

(See INP Section 2.2 and 3.2)

Table 2.1 Amenity Criteria (INP p. 16) sets out recommended cumulative noise levels for industry. In assessing the amenity effects of noise from a new development, it is essential to determine the level of noise already present.

Where the ambient noise levels are below the Acceptable Noise Level (ANL), then ideally the measurement of the existing level of noise should include only noise from industrial sources. In these situations, however, it may be acceptable to include noise from other sources (for example, roads, and neighbourhoods). The reasons for this are that:

- including noise from other sources typically results in assessing the worst case for impacts on amenity; and
- strictly excluding noise from sources other than industry can be difficult and costly and may not be necessary if the development meets the criteria.

However, where ambient noise levels are above the ANL then noise from other sources should be excluded in establishing existing levels of industrial noise. Where the level of road traffic noise is high enough to make noise from an

industrial source inaudible for the majority of the time or difficult to measure directly, it may be necessary to consider applying the assessment for areas of high traffic noise. Application note: amenity criteria in high traffic noise areas provide further guidance on this.

C.3.2 Assessing Noise at Industrial/Commercial Receivers

(see INP Section 2.2)

The INP does not require that intrusive noise be assessed at industrial or commercial premises. For industrial/commercial receivers, only the amenity criteria apply. Amenity noise levels should be assessed at the most affected point on or within the property boundary. This approach also applies to other non-residential receivers, such as educational facilities, hospitals and places of worship.

C.3.3 Identifying the Appropriate Receiver Amenity Category

(see INP Section 2.2.2)

Amenity criteria in Table 2.1 of the INP vary depending on the type of receiver. INP Section 2.2.2 provides guidance on identifying the appropriate receiver type. Where there is doubt or debate over which receiver category is appropriate, the proponent needs to seek the views of the relevant land use manager (for example, Council or Department of Planning and Infrastructure). Once the land use manager has identified the land use (e.g. zone, allowable density of development and land use patterns), the appropriate amenity criteria can be assigned.

C.3.4 Identifying Which of the Amenity or Intrusive Criteria Apply

(see INP Section 2.4)

The INP notes that the Project-Specific Noise Level (PSNL) is the more stringent of either the amenity or intrusive criteria. This is not necessarily just a matter of comparing the magnitude of the amenity criteria to the intrusive criteria because different time periods apply (intrusive criteria uses 15 minutes while the amenity criteria are over the day, evening or night period).

For example, where the same number applies to amenity and intrusive criteria, the intrusive criteria would typically be more stringent because it is determined over a much shorter period.

Where the predicted amenity noise level is lower than the intrusive level for the proposed development, the proponent needs to ensure that both levels will be satisfied. In this situation, noise limits specified in the licence conditions will include both the intrusive and amenity noise levels predicted to be achieved by the proposal to ensure that the community is protected from intrusive noise impacts at all times.

C.3.5 Assessing Background Noise Levels

(see INP Section 3.1)

To determine the Rating Background Level (RBL) and existing industry-contributed LAeq, the measurement of ambient noise levels should be undertaken in the absence of noise from the development under consideration.

C.3.6 When the RBL for Evening or Night is higher than the RBL for Daytime

(see INP Section 3.1)

The results of long term unattended background noise monitoring can sometimes determine that the calculated Rating Background Level (RBL) for the evening or night period is higher than the RBL for the daytime period. These situations can often arise due to increased noise from, for example, insects or frogs during the evening and night in the warmer months or due to temperature inversion conditions during winter. The objective of carrying out long-term background noise monitoring at a location is to determine existing background noise levels that are indicative of the entire year.

In determining project-specific noise levels from the RBLs, the community's expectations also need to be considered. The community generally expects greater control of noise during the more sensitive evening and night-time periods than the less sensitive daytime period. Therefore, in determining project-specific noise levels for a particular development, it is generally recommended that the intrusive noise level for evening be set at no greater than the intrusive noise level for daytime. The intrusive noise level for night-time should be no greater than the intrusive noise level for day or evening. Alternative approaches to these recommendations may be adopted if appropriately justified.

C.3.7 Maximum Noise Levels during Shoulder Periods

(see INP Section 3.3)

Noise levels in limit conditions for sleep disturbance would typically be set as a maximum noise level. The approach noted in the INP for developing intrusive criteria for the shoulder period is not appropriate for determining maximum noise levels for the shoulder period. That is, assigning a background noise level based on averaging daytime and night-time RBLs may be appropriate for determining intrusive criteria but it is not appropriate for assigning maximum noise levels. The reason for this is that the day or night RBL is based around the 90th percentile of LA90, which is quite different to an RBL based on an average. Additionally, setting maximum noise levels for the shoulder period based on the lowest LA90 during the period is not practical as it can result in the maximum noise limit being set lower than the intrusive noise limit.

In order to generate a statistically valid data set to derive the 90th percentile of LA90 for the shoulder period, a much larger sampling time (than the one week

typically applied) would be required, with associated cost and practicality implications. Therefore, a statistical approach to calculating the RBL for shoulder periods is not required by the INP.

It is the intention of the INP that appropriate noise targets for the shoulder period be negotiated with the regulatory/consent authority on a case-by-case basis. The focus of the INP is on avoiding or minimising noise of a high level and/or with intrusive characteristics, during the shoulder period, through the use of best practice.

Options available to the proponent for managing maximum noise levels during the shoulder period are to:

- avoid noise events during the shoulder period (or at least during the first half and then to meet RBL(shoulder period) +15 dB(A) during the second half of the shoulder period)
- collect sufficient data to calculate a statistically robust 90th percentile-based RBL for the shoulder period and use this to determine RBL+15 dB(A) as the maximum noise level limit
- conduct a detailed analysis of the number and noise level of noise events, and the exceedance of the background noise level, then, present a case comparing the results of the analysis and the research results contained in the NSW Road Noise Policy.

C.3.8 Tonality - Sliding Scale Test

(see INP Section 4.2)

The sliding scale test for tonality outlined in Section 4 of the INP uses a linear (z-weighted) spectrum (that is, no frequency weighting on each of the octave or third octave bands).

C.3.9 Duration Correction

(see INP Section 4.2)

Section 4 of the INP provides guidance on the use of modifying factors to account for certain characteristics of a noise source. The duration factors in Table 4.2 are intended to increase the criterion that is acceptable, whereas the modifying factor corrections in Table 4.1 are intended to increase the measured or predicted level.

C.3.10 Determining What Weather Conditions Should Be Used When Predicting Noise

Background

(see INP Section 5)

The INP intends that the noise levels used in assessing noise impacts at the consent stage include the effects of any weather conditions that are a feature of the area when the development operates. This means that the effects of weather conditions such as temperature inversions and wind on the noise level experienced at sensitive receivers should be adequately assessed at the consent stage.

Wind can enhance noise propagation compared with calm conditions (where there is no wind). When a wind blows, friction causes the air to move more slowly close to the ground than at higher altitudes. This phenomenon of wind speed increasing with height is termed 'wind shear'. The increase in noise occurs because sound waves from the source are bent through this 'wind shear' back towards the ground.

Unlike temperature inversions, wind can enhance propagation during any time of the day, evening or night. Wind does not increase noise in all directions and can also reduce noise. For example, wind blowing from the south to the north (termed a 'southerly' wind) increases noise to the north of an industrial premise and also reduces noise to the south of that premise.

In some instances, where one or more significant weather conditions have been identified as part of a noise assessment, noise levels from the industrial premises under only these significant weather conditions have been assessed, but noise levels under calm conditions have not.

The INP describes in Section 5 when weather is 'significant' (i.e. it occurs more than 30% of the relevant time period) and how to apply this in the noise assessment. This approach may result in noise levels at some receivers being underestimated, as in the southerly prevailing wind scenario described above.

Recommended approach

This application note clarifies that in all cases at each receiver:

- noise levels from the premises under calm conditions as well as any significant weather conditions as defined in the INP should be predicted or measured

- the highest of the noise levels from Step 1 is to be used in the assessment for that receiver.

The intent of the INP is not to require that these conditions should be applied exclusively where the significant weather conditions act to reduce noise at a sensitive receiver.

For example, where a significant prevailing wind of speed less than three metres per second increases noise levels at a receiver to the north of a development (compared with those predicted under calm conditions), the noise levels predicted under that prevailing wind should be used at that receiver. For receiver(s) to the south of the same development, if the noise levels predicted

under calm wind conditions are higher than those predicted under the significant prevailing wind, the noise levels predicted under calm wind conditions should be used at the southern receiver(s).

The EPA has previously accepted (and will accept) noise predictions based on modelling noise emissions using long term weather data, as it can present a higher level of analysis than that required under the INP.

C.3.11 How Calm Is Defined

(see INP Section 5.1)

In the assessment of wind effects, the INP requires the assessment of wind speeds of up to 3 metres per second where these speeds are a feature of the area (they occur for 30 percent of the time or more) but does not specify the minimum wind speed that needs to be assessed. The calm condition is typically represented by wind speeds less than or equal to 0.5 metres per second as this is likely to be the lower limit of measurement.

C.3.12 Presenting Predicted Noise Impacts

(see INP Section 6.3)

In carrying out noise impact predictions for a particular development, predicted noise levels for calm conditions as well as any significant adverse weather conditions should generally be provided. It is particularly useful to provide predicted noise impacts for calm weather conditions where predicted noise impacts under adverse weather conditions exceed the project-specific noise levels. This allows for a better understanding of potential noise impacts from the development.

C.3.13 Noise Impact Assessment for the Modification of Existing Industrial Premises

Background

(see INP Section 10)

Section 10 of the INP outlines the application of the policy to existing industrial premises.

As well as being used to assess noise emissions from new industrial premises, the INP is also applied to situations where existing industrial premises are modified, expanded or upgraded.

Where a modification is proposed, the noise level targets for the premises (termed Project Specific Noise Levels) are to be determined firstly excluding any noise from the subject premises. The noise from the existing premises is then assessed against these targets to determine if there is a need to consider noise mitigation for existing operations. The predicted noise level from the

proposed modification is then assessed, both in isolation and in combination with noise from the existing premises.

The total noise emissions from the modified premises should ideally not exceed the Project Specific Noise Levels. If the existing premises cannot achieve these targets, the allowable noise emissions from the proposed modification will be set so that the modification does not significantly increase the existing noise emissions.

Recommended Approach

This application note outlines these processes together with the degree of information required to support a proper assessment of modifications to an existing industrial premises.

A noise impact assessment for the modification of existing industrial premises should include, as a minimum:

- existing noise criteria contained in consents, approvals or licences, that are applicable to the premises;
- Project Specific Noise Levels (PSNLs) for the premises determined in accordance with the INP and relevant application notes (see, for example, Appendix A4 of the INP). Note: care should be taken to exclude noise from the existing premises when quantifying background and existing industrial noise levels (further guidance is in the INP in Section 11.1.2);
- where application of the INP results in a PSNL more stringent than existing noise criteria, the PSNL should be adopted for noise assessment purposes. Note: the INP acknowledges that the PSNL is a goal sought to be achieved through the application of feasible and reasonable noise mitigation measures and is not necessarily applied as a statutory limit by default;
- measured or predicted noise levels from the existing premises at noise sensitive receiver locations;
- predicted noise contribution from the proposed modification, in isolation, at noise sensitive receiver locations; and
- cumulative noise levels from the entire premises (i.e. combined level from existing and proposed modification) compared to the PSNL.

C.3.14 Where Noise from the Existing Premises Exceeds the PSNL

Where it can be determined that noise from the existing premises alone is currently exceeding the PSNL, a preliminary analysis of potential noise mitigation measures, and conceptual noise reductions, needs to be undertaken for the existing premises. Note: this does not mean that in all circumstances noise mitigation to existing premises will be required as part of a modification. Decisions of this nature will be determined on a case-by-case basis, taking into

account various factors, for example, feasible and reasonable mitigation options, the absolute level of noise and existing measures of community impact, including complaints.

Once the conceptual mitigated level of noise performance of the existing premises (i.e. what can be achieved) has been determined, the contribution noise level goal for the modification can be determined. The noise level goal for the modification should be set at least 10dB below the PSNL, or where it has been determined that the existing premises cannot achieve the PSNL, it should be set at least 10dB below the conceptual mitigated noise performance of the existing premises.

This approach is designed to ensure that noise from the modification does not become the limiting factor in noise from the entire premises potentially meeting the PSNL.

C.3.15 Prosecution Guidelines

(see INP Section 11.1)

EPA's approach to prosecuting offences is described in EPA prosecution guidelines 2012, particularly Sections 2.2.3 to 2.2.7 under 'Discretion' which states that 'not every breach of the criminal law is automatically prosecuted - the laying of charges is discretionary' and 'The EPA has a discretion as to how to proceed in relation to environmental breaches' and 'Each case will be assessed to determine whether prosecution is the appropriate strategic response'. Sections 2.2.8 under 'Factors to be considered' in the Guidelines describe factors that are considered when determining whether prosecution is required, such as 'whether the breach is a continuing or second offence', 'the availability and efficacy of any alternatives to prosecution' and 'the prevalence of the alleged offence and the need for deterrence, both specific and general'.

C.3.16 Sleep Disturbance

Peak noise level events, such as reversing beepers, noise from heavy items being dropped or other high noise level events, have the potential to cause sleep disturbance. The potential for high noise level events at night and effects on sleep should be addressed in noise assessments for both the construction and operational phases of a development. The INP does not specifically address sleep disturbance from high noise level events.

Research on sleep disturbance is reviewed in the NSW Road Noise Policy. This review concluded that the range of results is sufficiently diverse that it was not reasonable to issue new noise criteria for sleep disturbance.

From the research, the EPA recognised that the current sleep disturbance criterion of an $L_{1,\ 1\ minute}$ not exceeding the $L_{90,\ 15\ minute}$ by more than 15 dBA is not ideal. Nevertheless, as there is insufficient evidence to determine what

should replace it, the EPA will continue to use it as a guide to identify the likelihood of sleep disturbance. This means that where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.

The detailed analysis should cover the maximum noise level or $L_{1,\ 1\ minute}$, that is, the extent to which the maximum noise level exceeds the background level and the number of times this happens during the night time period. Some guidance on possible impact is contained in the review of research results in the NSW Road Noise Policy. Other factors that may be important in assessing the extent of impacts on sleep include:

- how often high noise events will occur;
- time of day (normally between 10pm and 7am); and
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).

The $L_{1,\ 1\ minute}$ (in dBA) descriptor is meant to represent a maximum noise level measured under 'fast' time response. The EPA will accept analysis based on either $L_{1,\ 1\ minute}$ or L_{max} statistical parameters.

C.3.17 Addressing Privately Owned Haul Roads

Noise from privately owned haul roads is to be assessed as an industrial noise source according to the INP. The practice of treating access roads as part of the industrial premises with which they are associated is a long established part of noise management in NSW, which the INP has not changed. The basis for treating vehicles on private access roads as part of an industrial noise source lies in the relationship between the enterprise and the noise, and the community's response to noise from vehicles operating on private roads.

The Character of the Noise is Different to General Road Traffic Noise

Traffic on access roads is solely related to the operation of the site served by the access road and is usually composed almost entirely of heavy vehicles, producing noise of a different character to the typical public roadway where smaller vehicles typically predominate.

Factors that influence Community Response are different compared to Public Roads

The distribution of benefits from the operation of a private access road is typically perceived as being different than from a public road. Affected members of the public have been reported as questioning the equity of truck noise degrading their amenity for the benefit of others.

The degree of control possible for traffic on a private access road is typically perceived as greater than for a public road. The result is a higher level of

expectations that more can and should be done to reduce noise from the private road (than from a public one).

C.3.18 Determining Noise Limits for Licence Conditions

Where the proponent predicts that noise levels from the industrial development would be below the project-specific noise levels, then the noise limits specified in the licence/consent conditions should reflect the noise levels that the proponent states would be achieved (that is, the predicted noise levels, however a minimum intrusive criterion of 35 dB(A) still applies). This is for a number of reasons:

- to ensure that the best-management practices and best available technology described in the noise impact assessment report are actually adopted by the proponent
- to ensure that the level of achievable performance presented by the proponent to the public, though public documentation such as Environmental Impact Statements, is achieved
- to optimise the opportunity for further industrial development in the area without an unacceptable degradation of the acoustic amenity of the area
- to fulfil a general aim of the environmental assessment process to minimise environmental impacts.

It should be noted that noise limits would apply to the contributed noise levels from only the premise or site of concern. In setting noise limits, judgement needs to be made as to whether the predicted noise levels warrant noise limits on the licence/consent. Where the predicted noise levels from the premises of concern are well below the project-specific noise levels, there may be no need for noise limit conditions.

Any tolerances to the predicted noise levels should be addressed in the proponent's assessment of impacts so that the predicted noise levels can be applied in conditions.

Annex D

ICNG Methodology

D.1 NSW ICNG - NOISE IMPACT ASSESSMENT PROCEDURES

This ICNG has been developed by a number of agencies including the Department of Environment and Climate Change NSW (DECC), NSW Department of Planning, Roads and Traffic Authority, NSW (RTA), WorkCover NSW and NSW Health together with the Local Government and Shires Associations of NSW.

In preparing the document there was extensive public consultation. The views of industry stakeholders were sought at an early stage and have contributed significantly to this document. The Standards Australia committee was consulted to address any potential inconsistencies between the Guideline and relevant standards.

It recognises that construction noise (and vibration) is one of the major environmental noise issues in NSW; not only from building works but also from demolition, remediation, renewal and maintenance. Construction can occur close to residences or other sensitive land uses and be variable in times of occurrence. These aspects of construction can exacerbate noise levels and their effects. Construction noise by its nature is temporary, may not be amenable to purpose-built noise control measures applied to industrial processes, and may move as construction progresses.

With these constraints in mind, the ICNG has been developed to focus on applying a range of work practices most suited to minimise construction noise impacts, rather than focusing only on achieving numeric noise levels. While some noise from construction sites is inevitable, the aim of the Guideline is to protect the majority of residences and other sensitive land uses from noise pollution most of the time.

D.2 NOISE MANAGEMENT LEVELS

People's reaction to noise from construction will depend on the time of day that works are undertaken. Residents are usually most annoyed by work at night time as it has the potential to disturb sleep. Noise from work on evenings, Saturday afternoons, Sundays and public holidays can also be annoying to most residents as it may interrupt leisure activities.

D.2.1 Residential Receptors

Table 2 of the ICNG sets out management levels for noise at residences and how they are to be applied. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level. In Table 2, the RBL is used when determining the management level, consistent with the approach described for the INP. Table 2 of the ICNG is reproduced below.

Table D.0.1 Residential Receptors (NML)

Time of Day	Management Level	How to Apply
Recommended Standard Hours: Monday to Friday 7 am to 6 pm, Saturday 8 am to 1 pm, No work on Sundays or public holidays.	Noise affected RBL + 10 dB	The noise-affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured LAeq (15 min) is greater than the noise-affected level, the proponent should apply all feasible and reasonable work practices to meet the noise-affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise.
		• Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:
		  • 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences.
		  • 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Outside recommended standard hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise-affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise-affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see Section 7.2.2 of the ICNG.

D.2.2 Other Sensitive Land Uses

Other sensitive land uses, such as schools, typically consider noise from construction to be disruptive when the properties are being used (such as during school times). Table 3 of the ICNG presents management levels for noise at other sensitive land uses based on the principle that the characteristic activities for each of these land uses should not be unduly disturbed. Table 3 of the ICNG is reproduced below.

Table D.0.2 Other Sensitive Receptors (NML)

Land Use	Management level, LAeq (15 min) (applies when properties are being used)
Classrooms at schools and other educational institutions	Internal noise level 45 dBA
Hospital wards and operating theatres	Internal noise level 45 dBA
Places of worship	Internal noise level 45 dBA
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dBA
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dBA
Community centres	Depends on the intended use of the centre. Refer to the recommended 'maximum' internal levels in AS2107 for specific uses.

D.2.3 Commercial and Industrial Receptors

Due to the broad range of sensitivities that commercial or industrial land can have to noise from construction, the process of defining management levels is separated into three categories. As defined by the ICNG the external noise levels should be assessed at the most-affected occupied point of the premises:

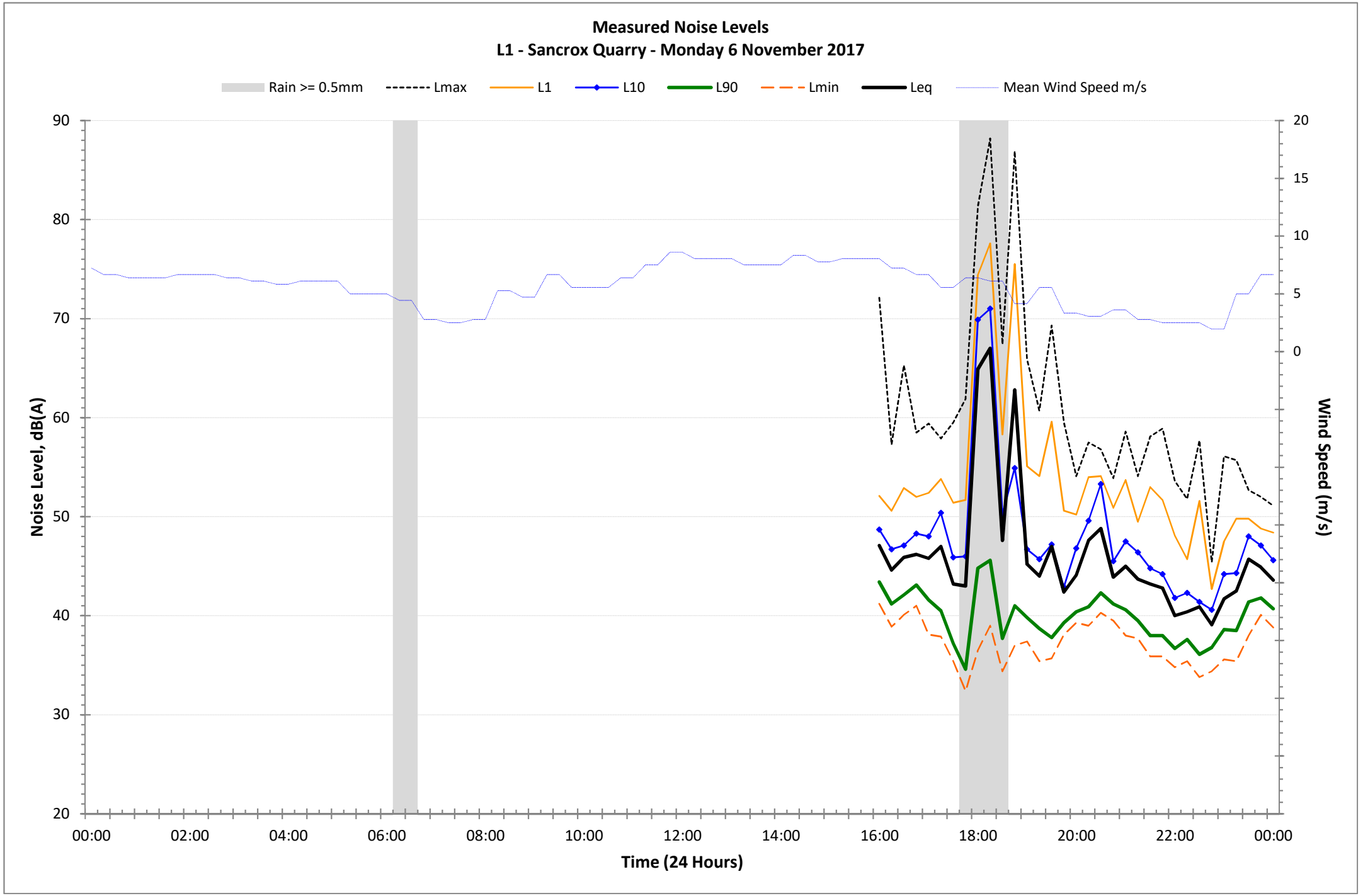
- Industrial premises: external $L_{eq,\ 15\ minute} \leq 75$ dBA.
- Offices, retail outlets: external $L_{eq,\ 15\ minute} \leq 70$ dBA.
- Other businesses that may be very sensitive to noise, where the noise level is project specific as discussed in the ICNG.

D.2.4 Other Features

The ICNG goes on to describe criteria for ground-borne noise but these values are not relevant to this assessment. The ICNG also references vibration standards however these are addressed separately by applicable guidelines.

Annex E

Unattended Noise Logging Charts


Measured Noise Levels
L1 - Sancrox Quarry - Monday 6 November 2017
Rain >= 0.5mm
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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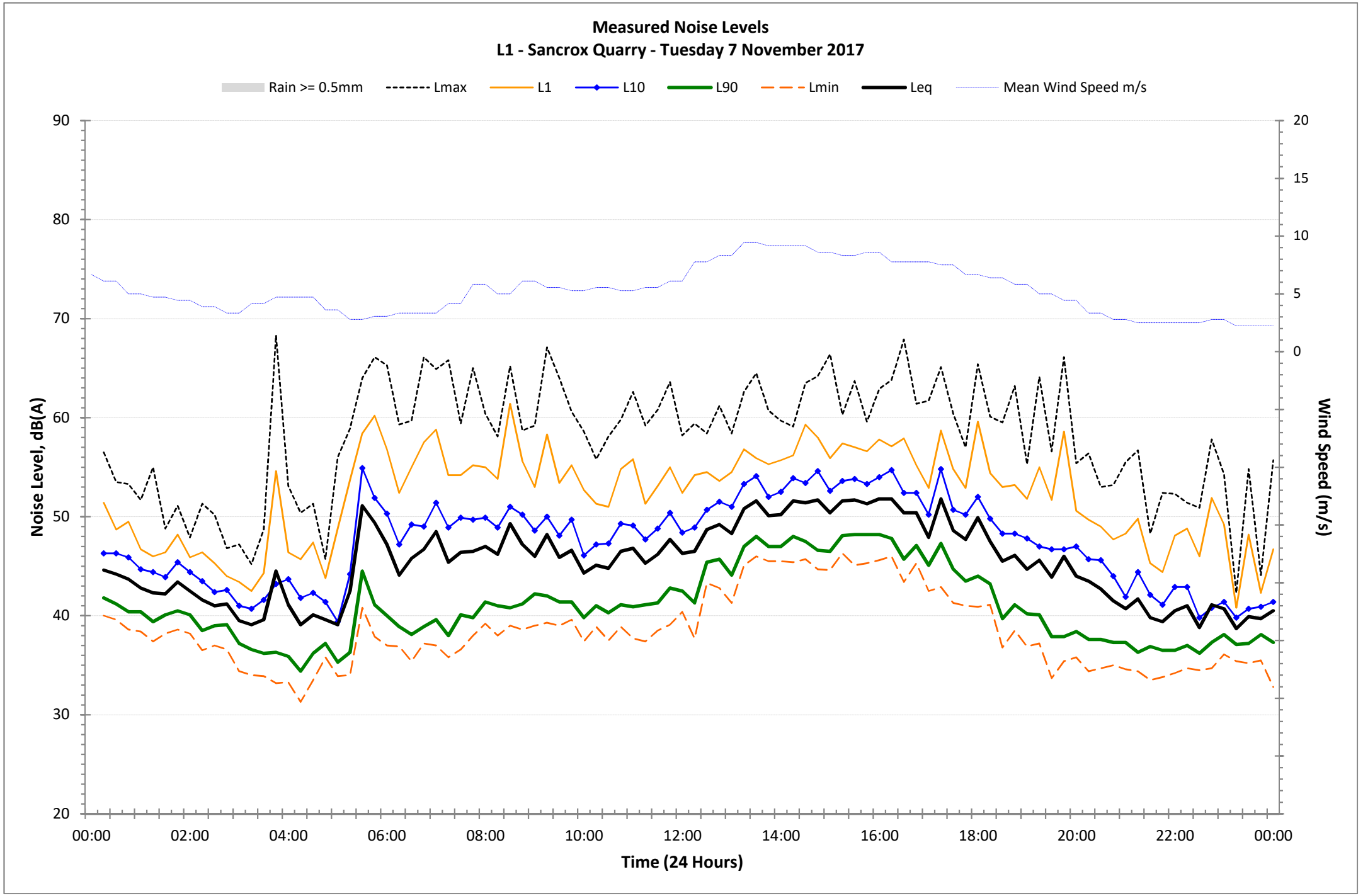
Measured Noise Levels
L1 - Sancrox Quarry - Tuesday 7 November 2017
Rain >= 0.5mm
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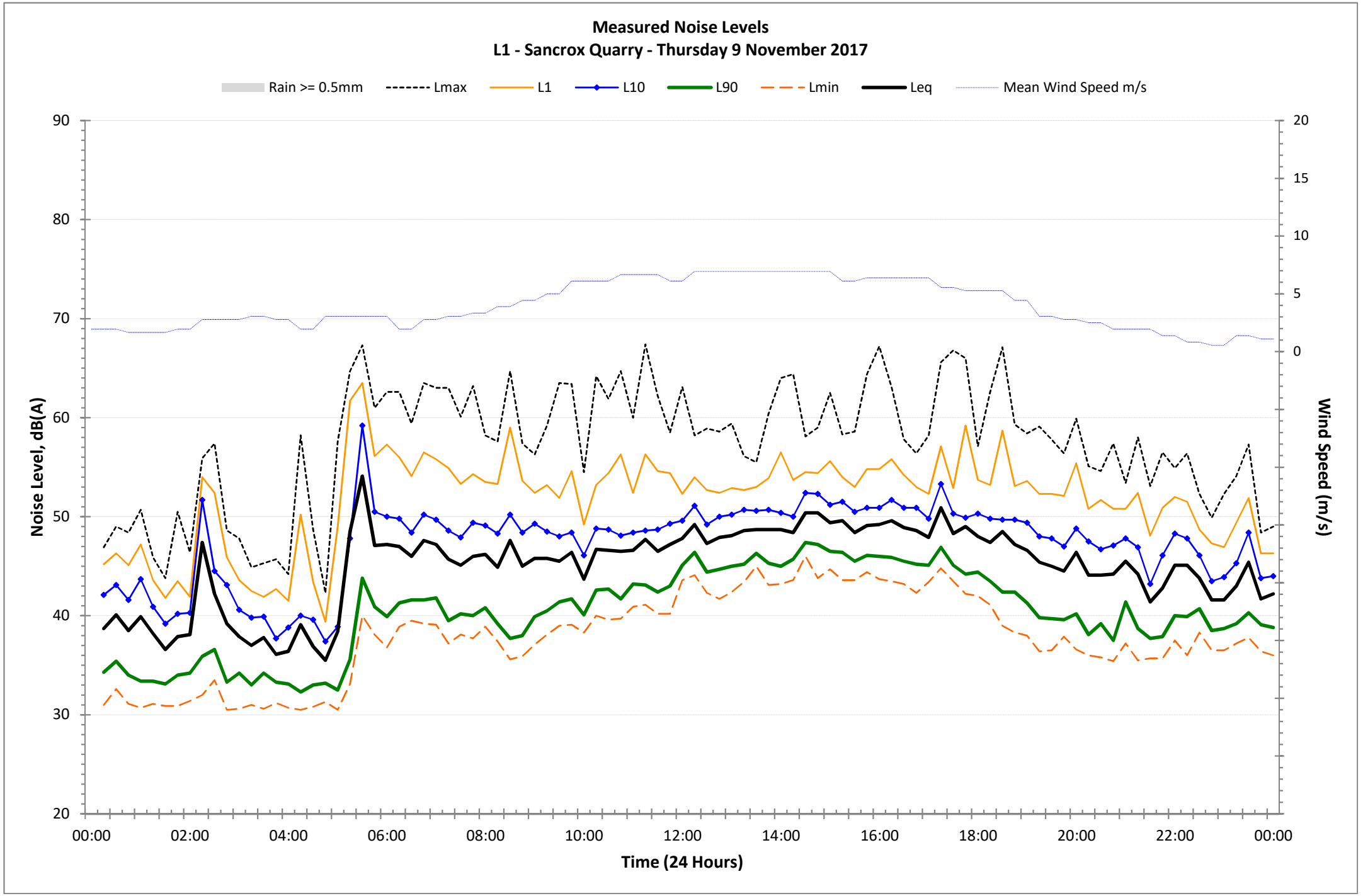
Measured Noise Levels
L1 - Sancrox Quarry - Thursday 9 November 2017
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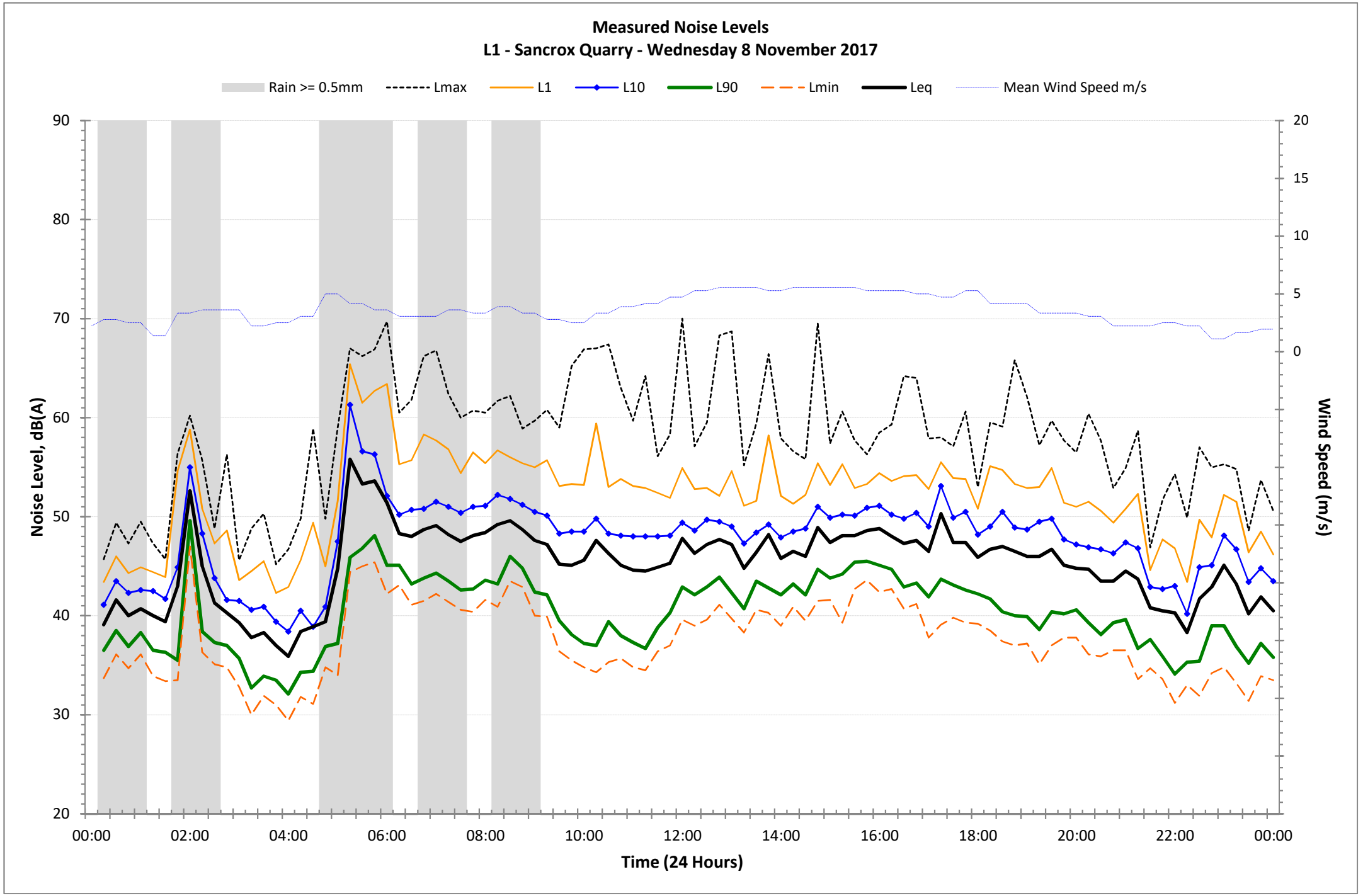
Measured Noise Levels
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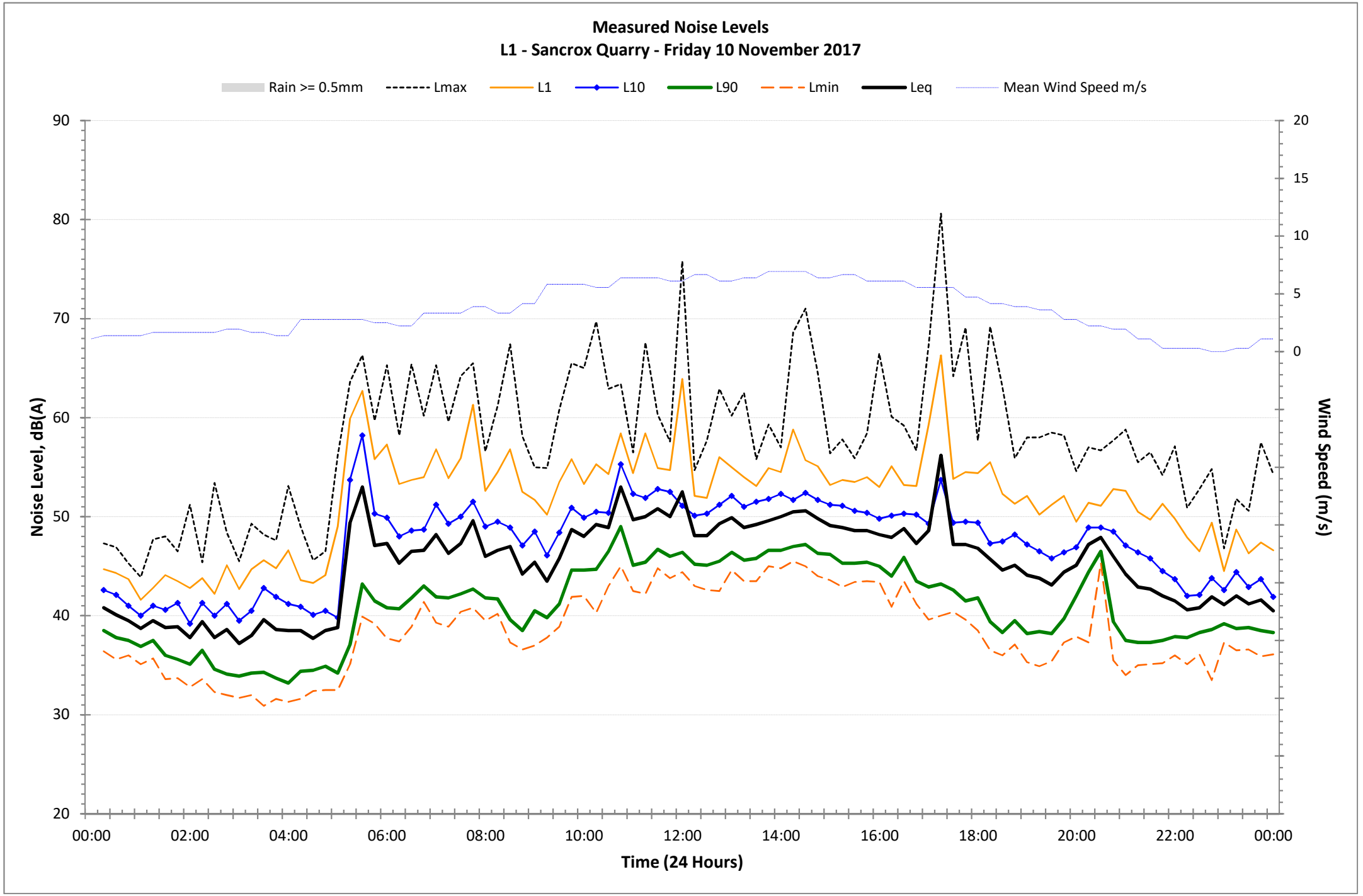
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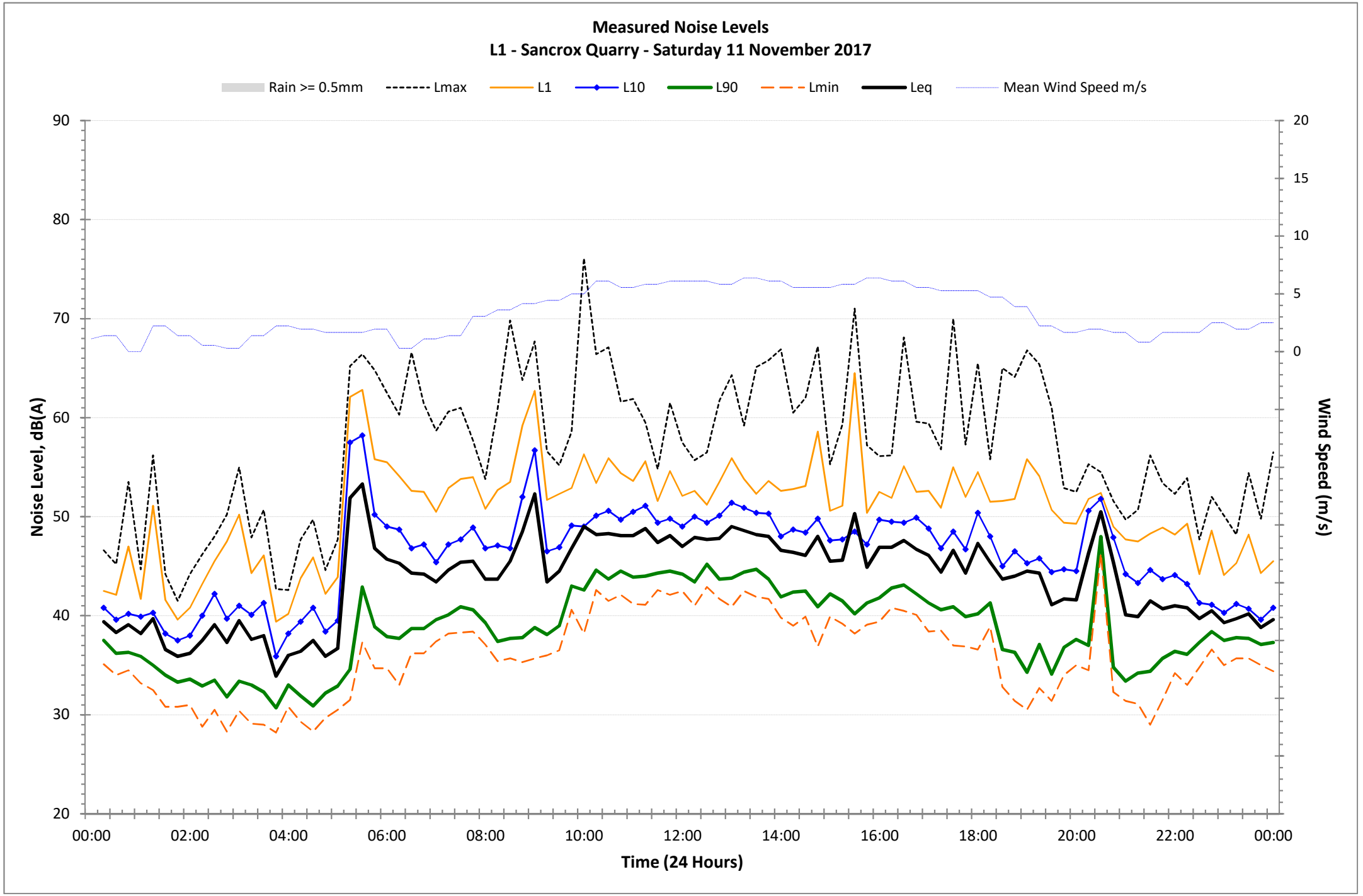
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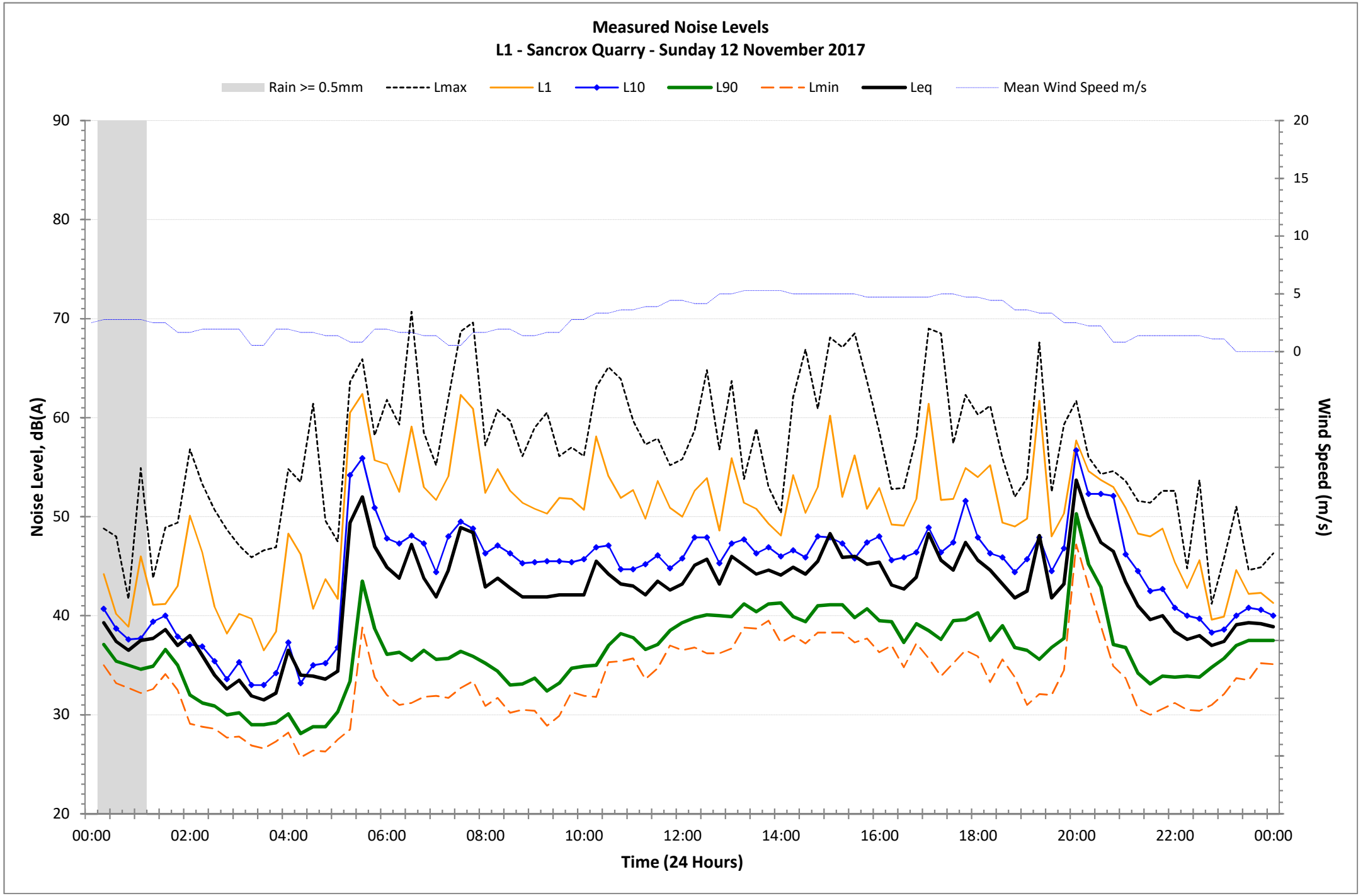
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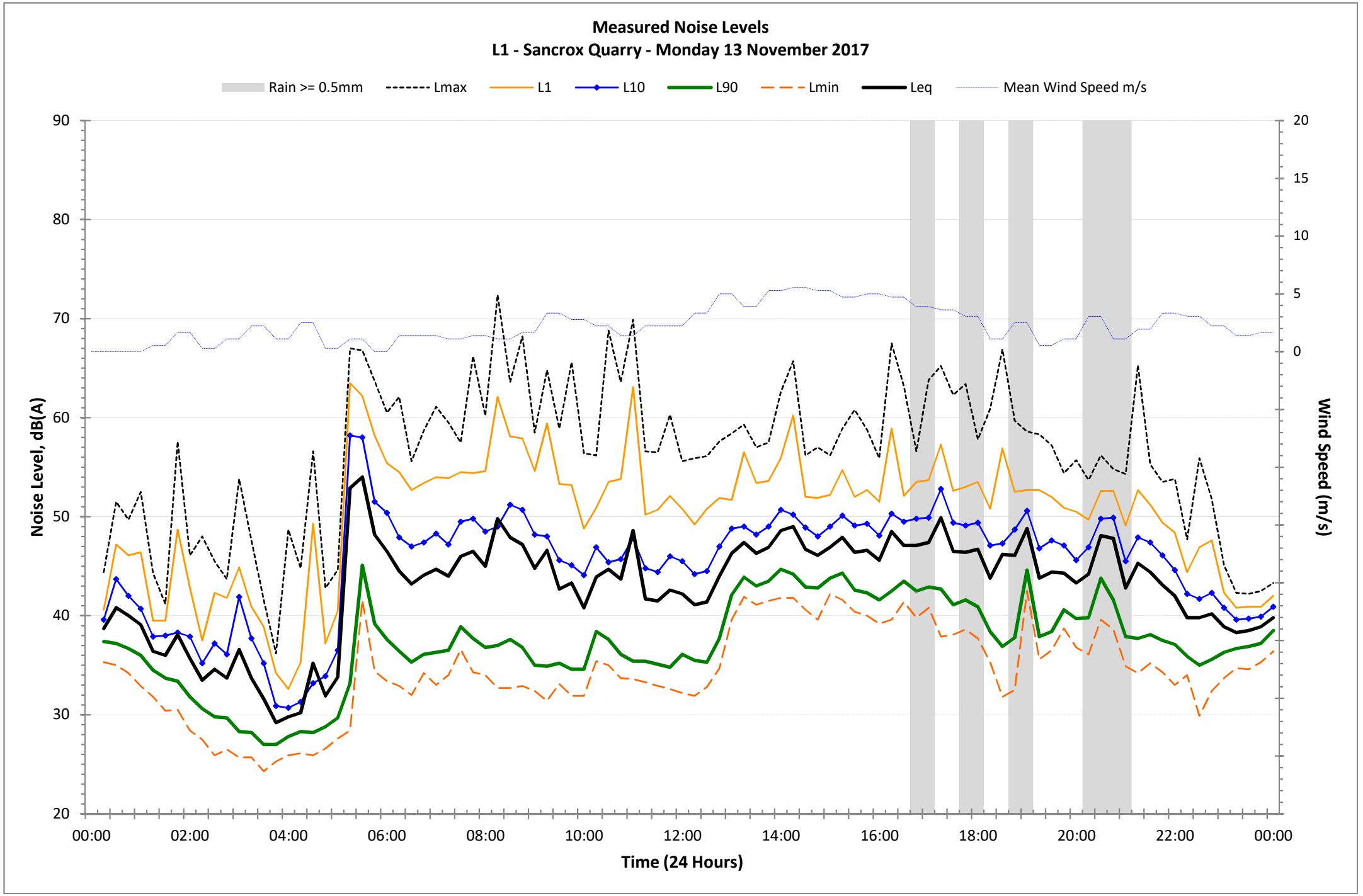
Measured Noise Levels
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Rain >= 0.5mm
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Noise Level, dB(A)
Wind Speed (m/s)
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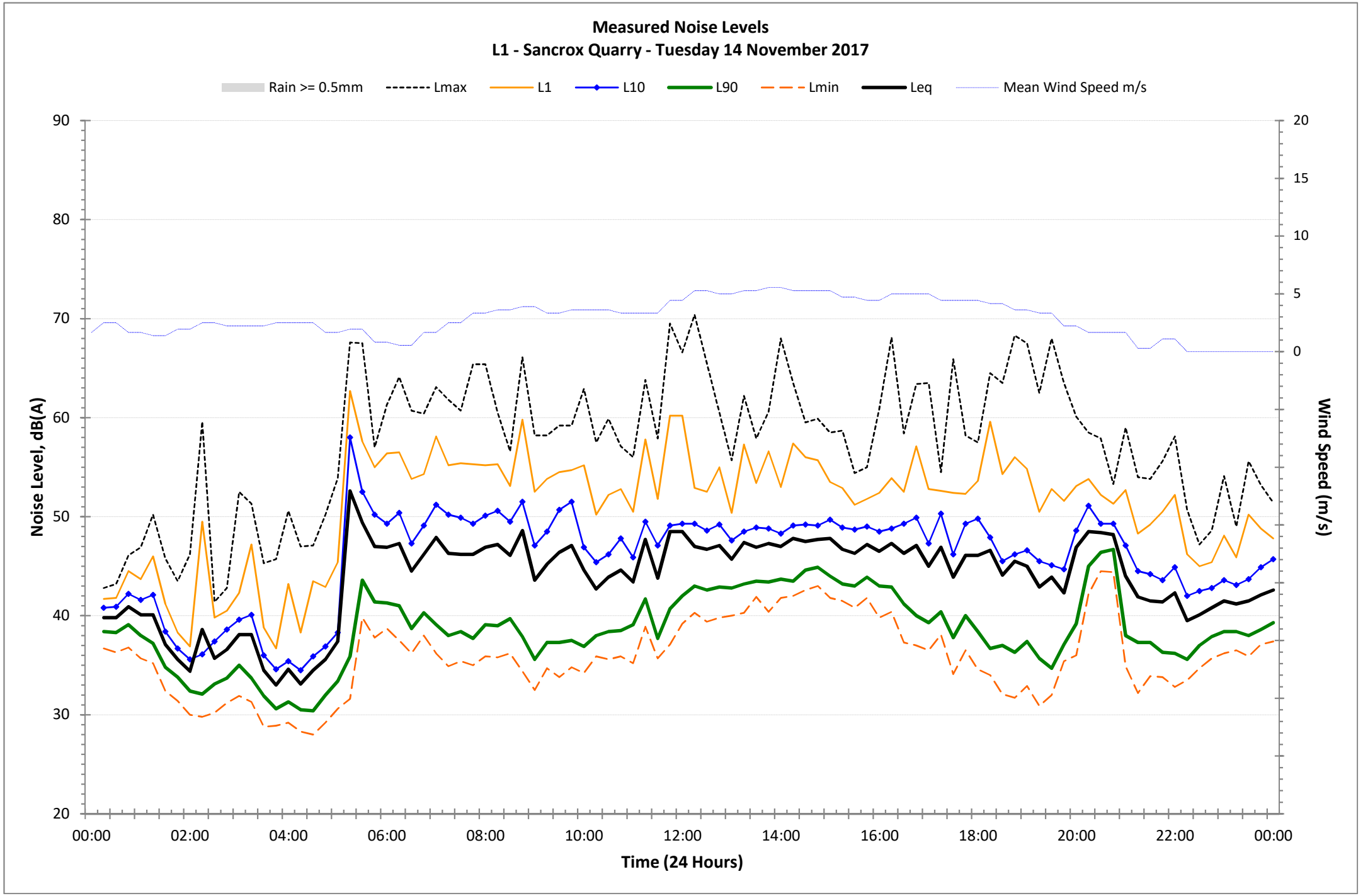
Measured Noise Levels
L1 - Sancrox Quarry - Tuesday 14 November 2017
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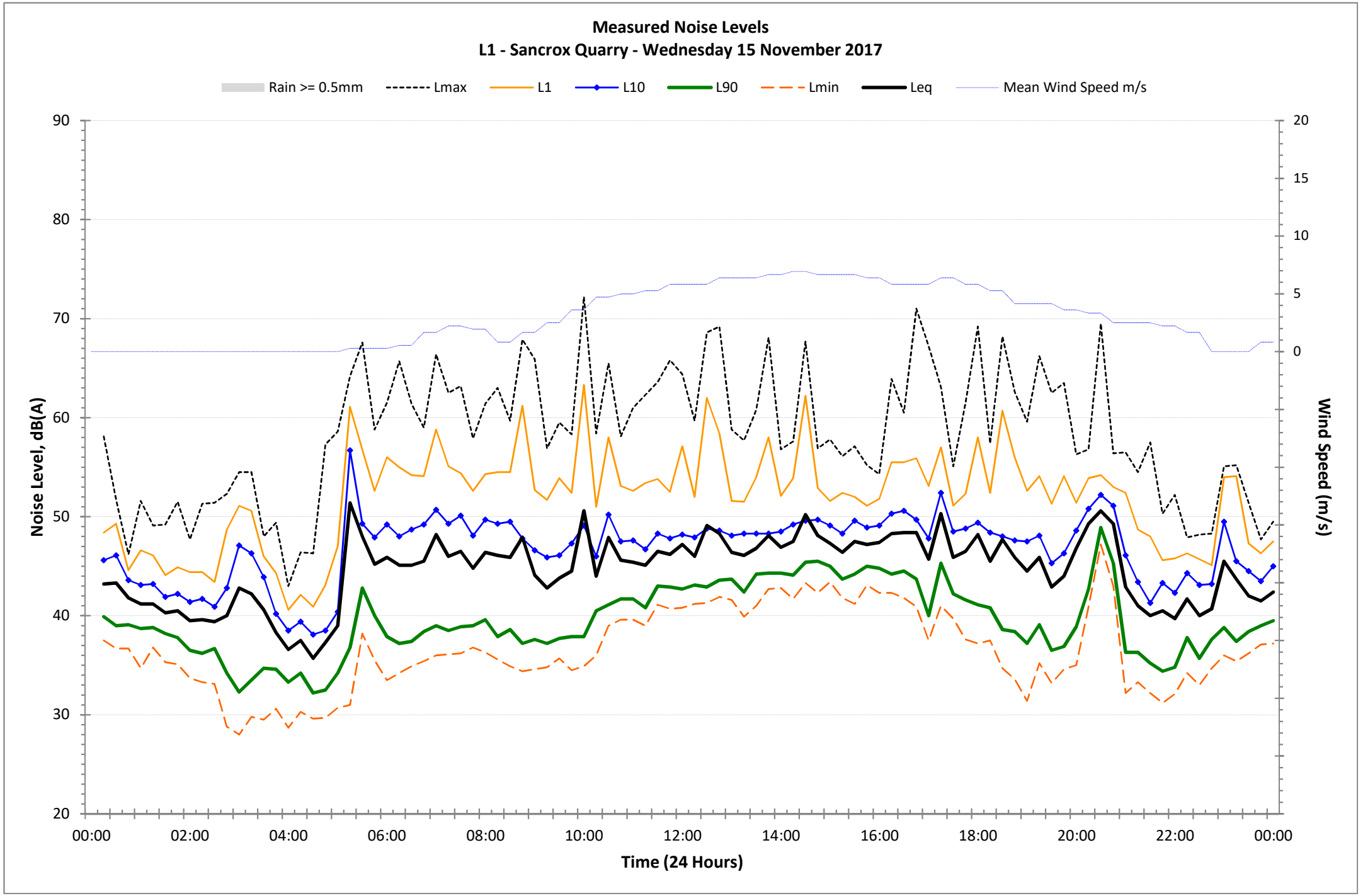
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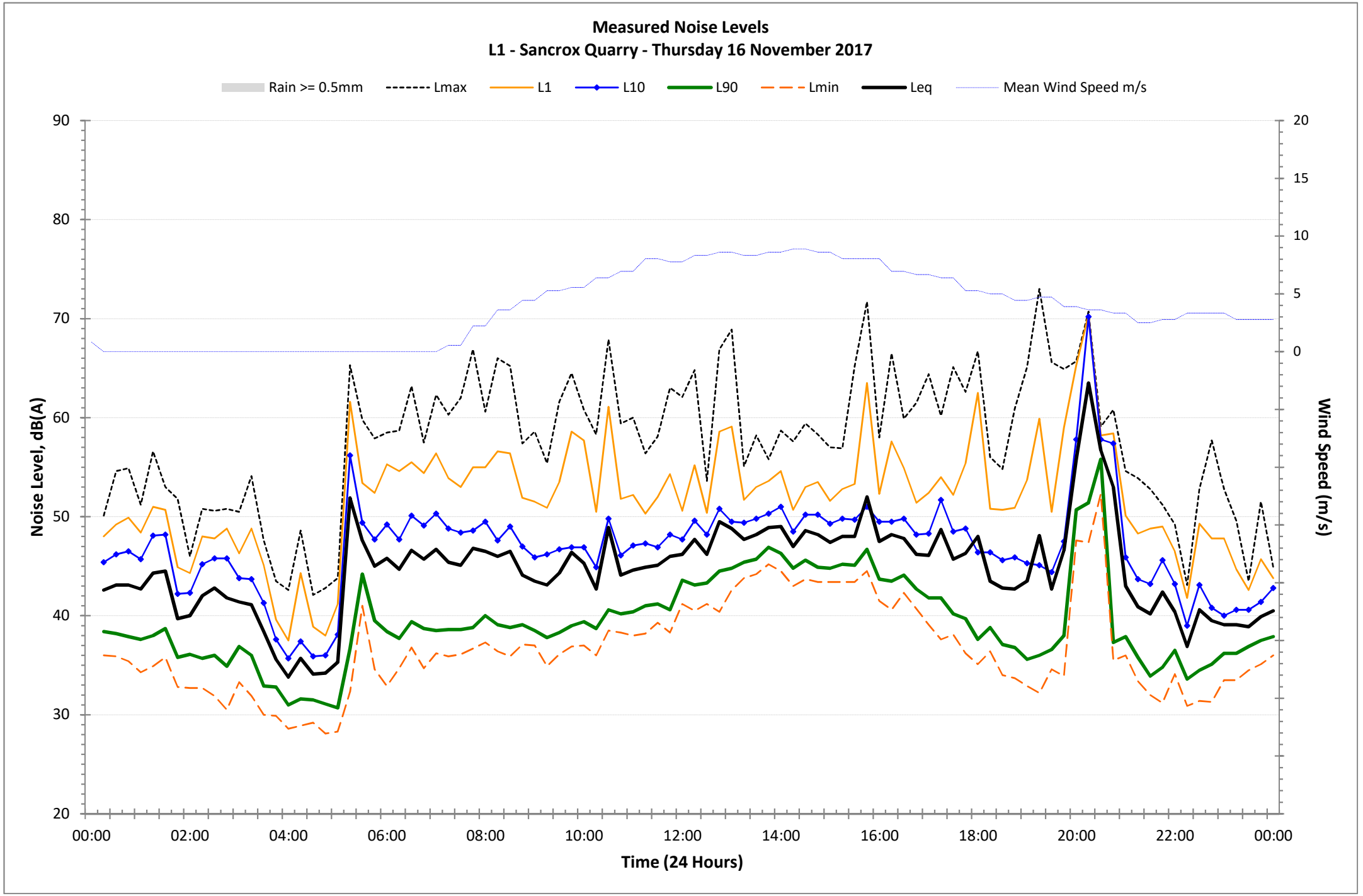
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L1 - Sancrox Quarry - Thursday 16 November 2017
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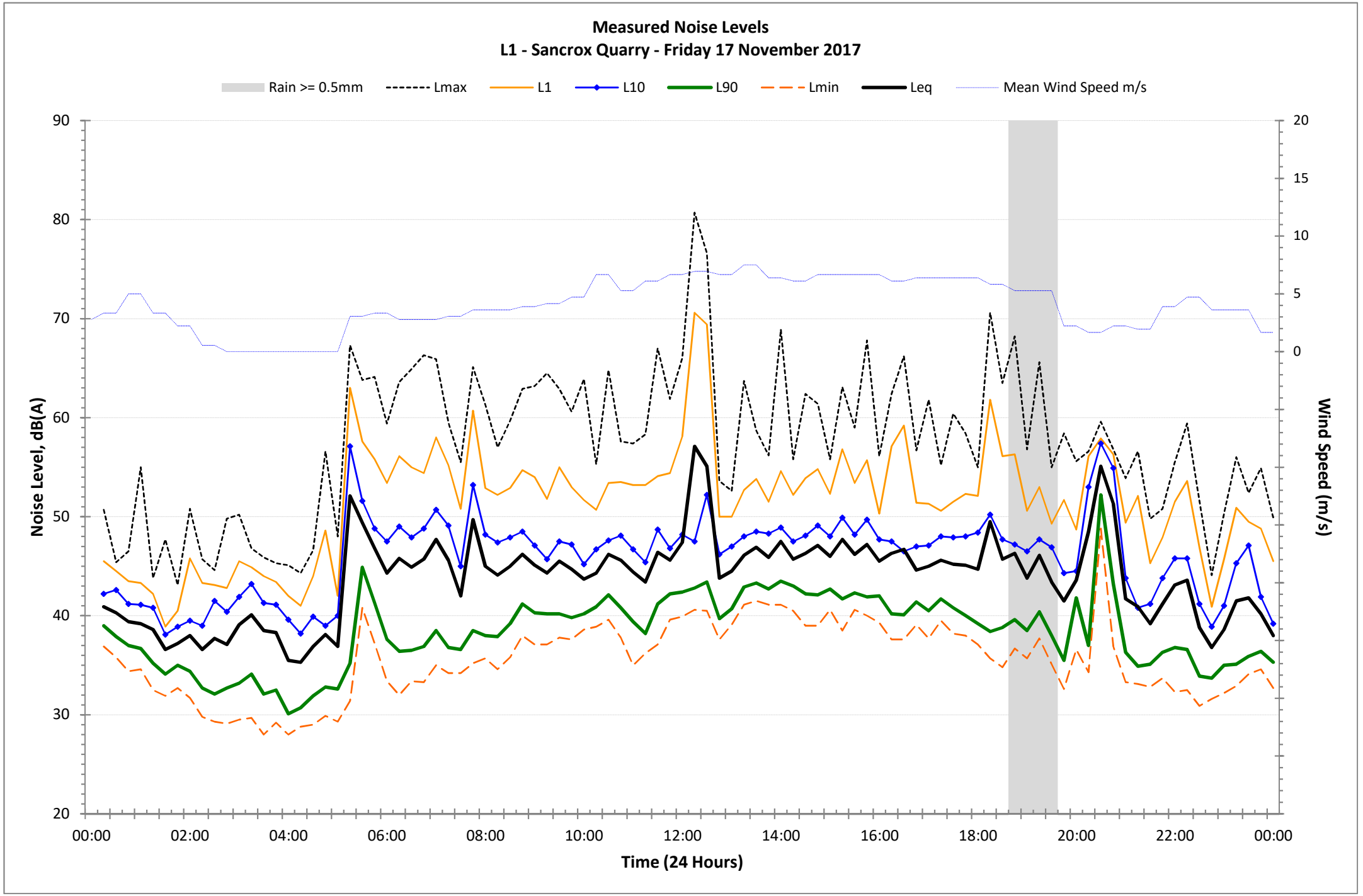
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Rain >= 0.5mm
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Mean Wind Speed m/s
Noise Level, dB(A)
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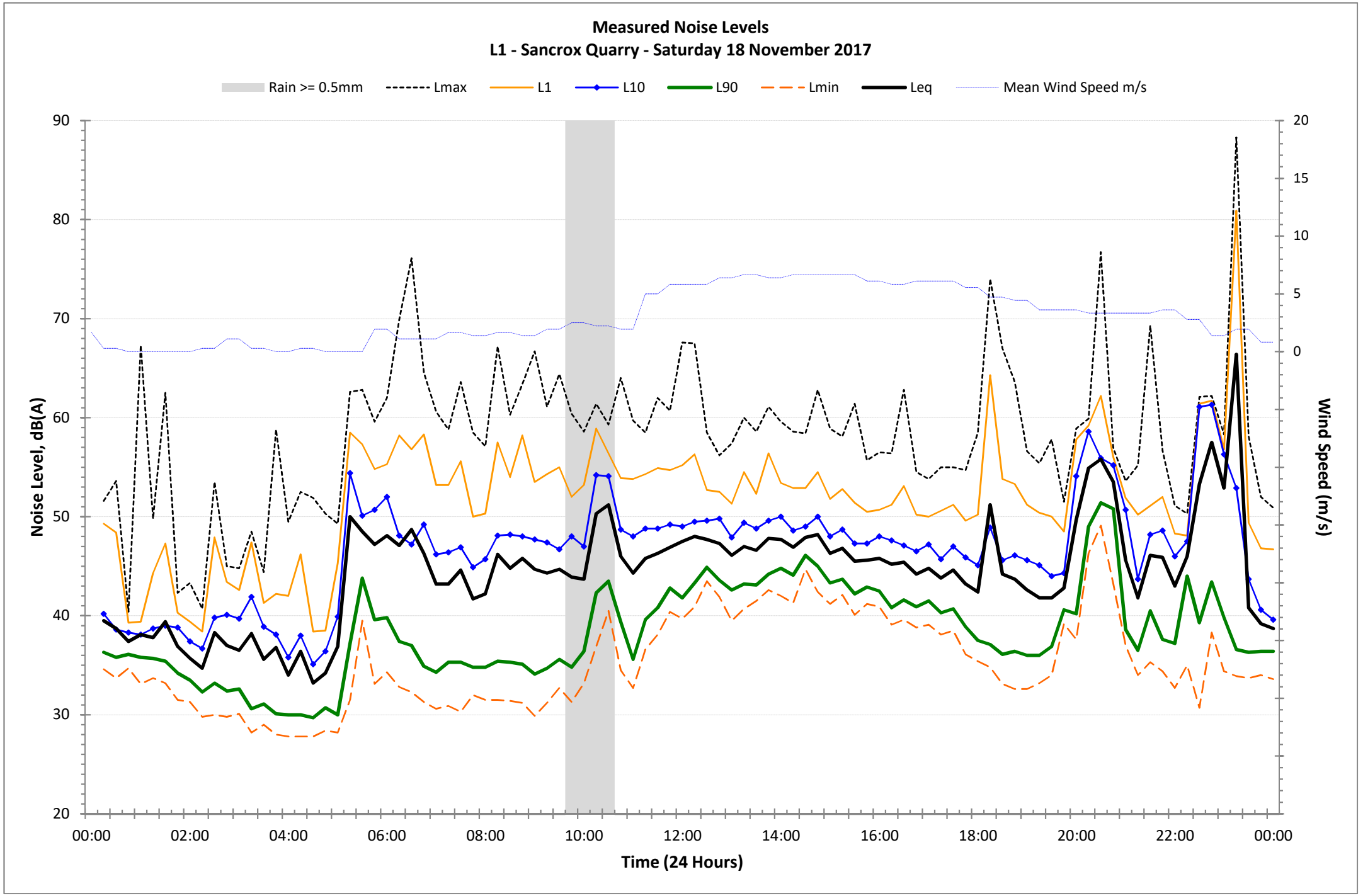
Measured Noise Levels
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Rain >= 0.5mm
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Mean Wind Speed m/s
Noise Level, dB(A)
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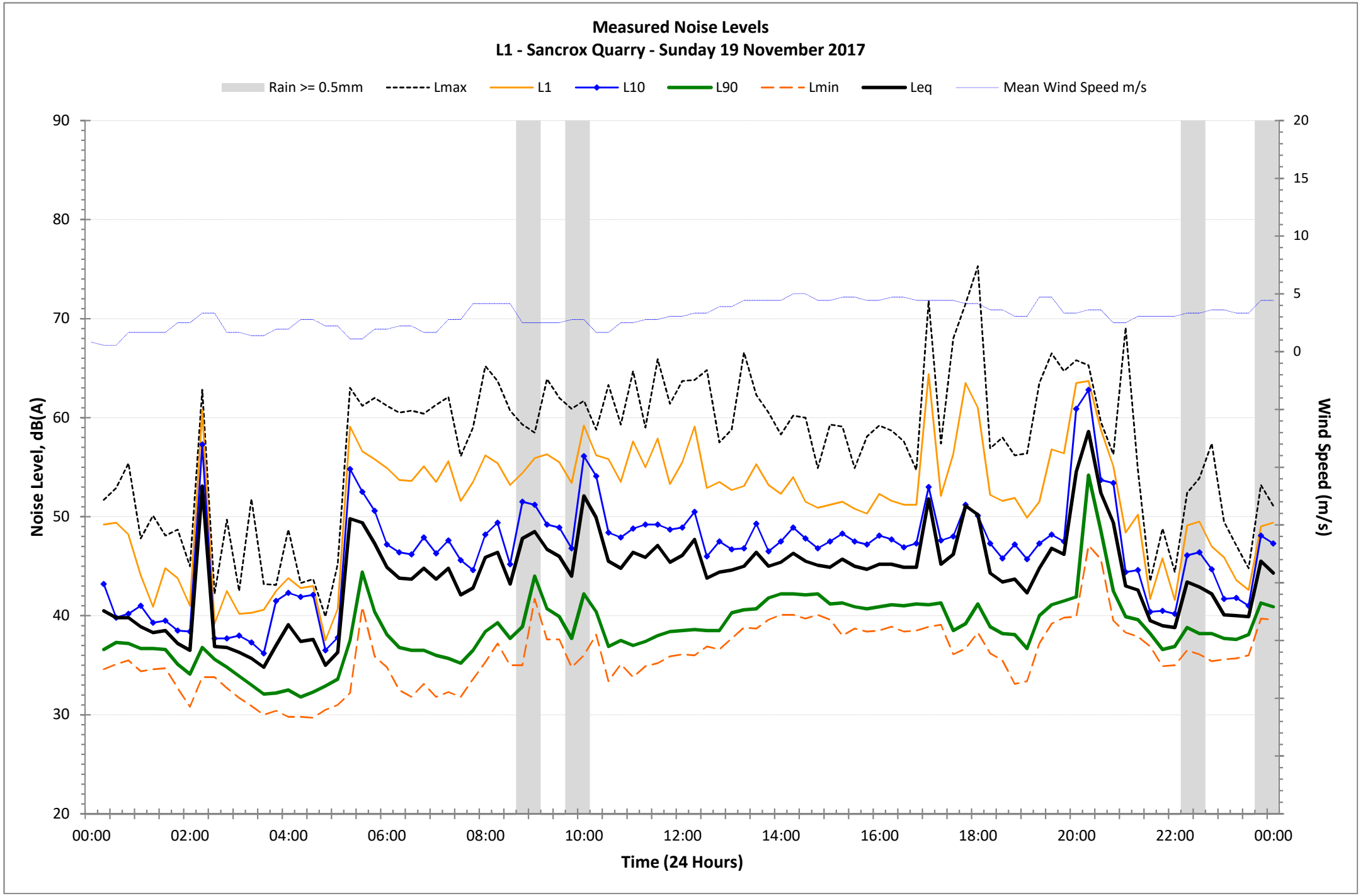
Measured Noise Levels
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Mean Wind Speed m/s
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Wind Speed (m/s)
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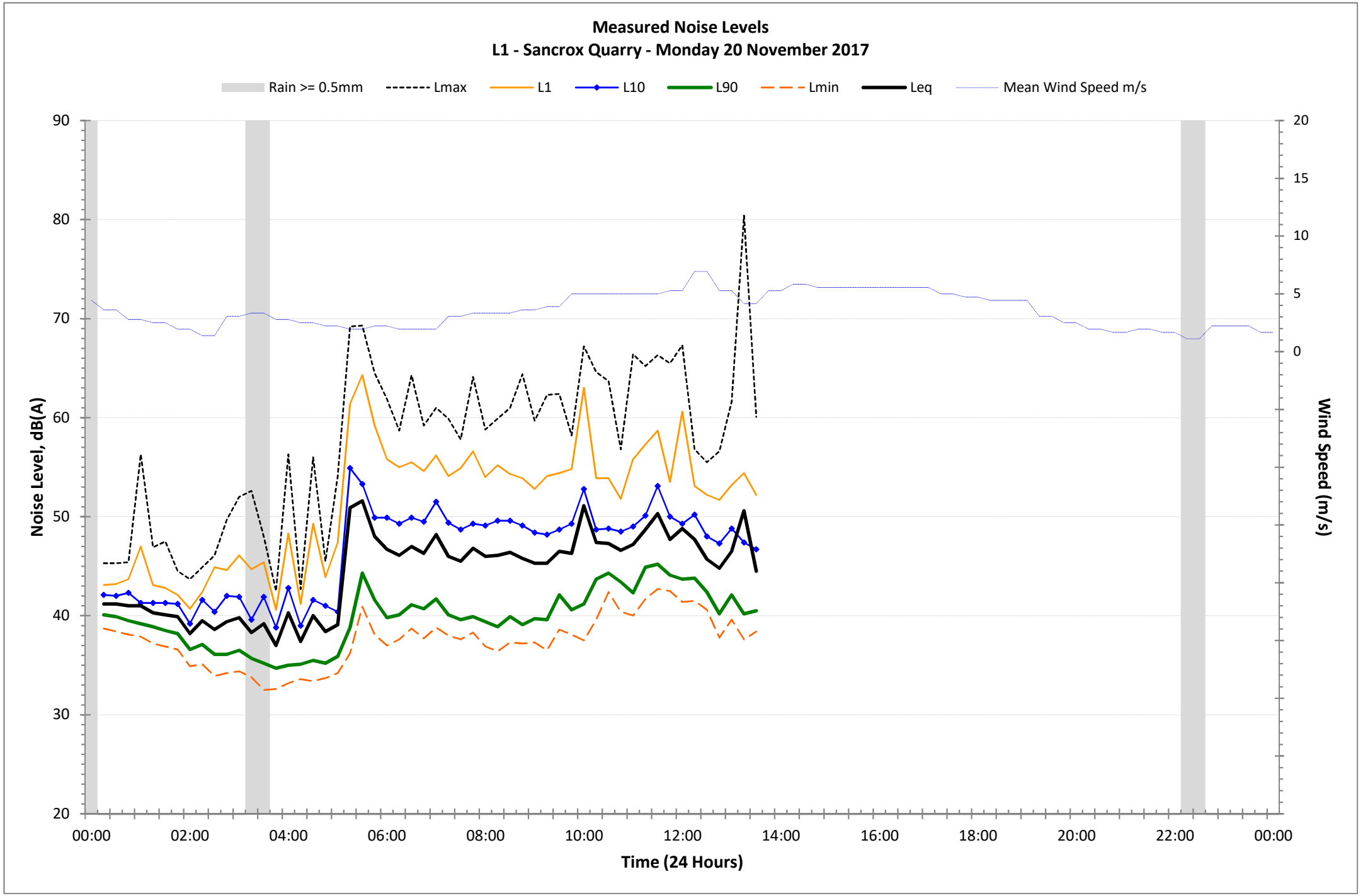
Measured Noise Levels
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Rain >= 0.5mm
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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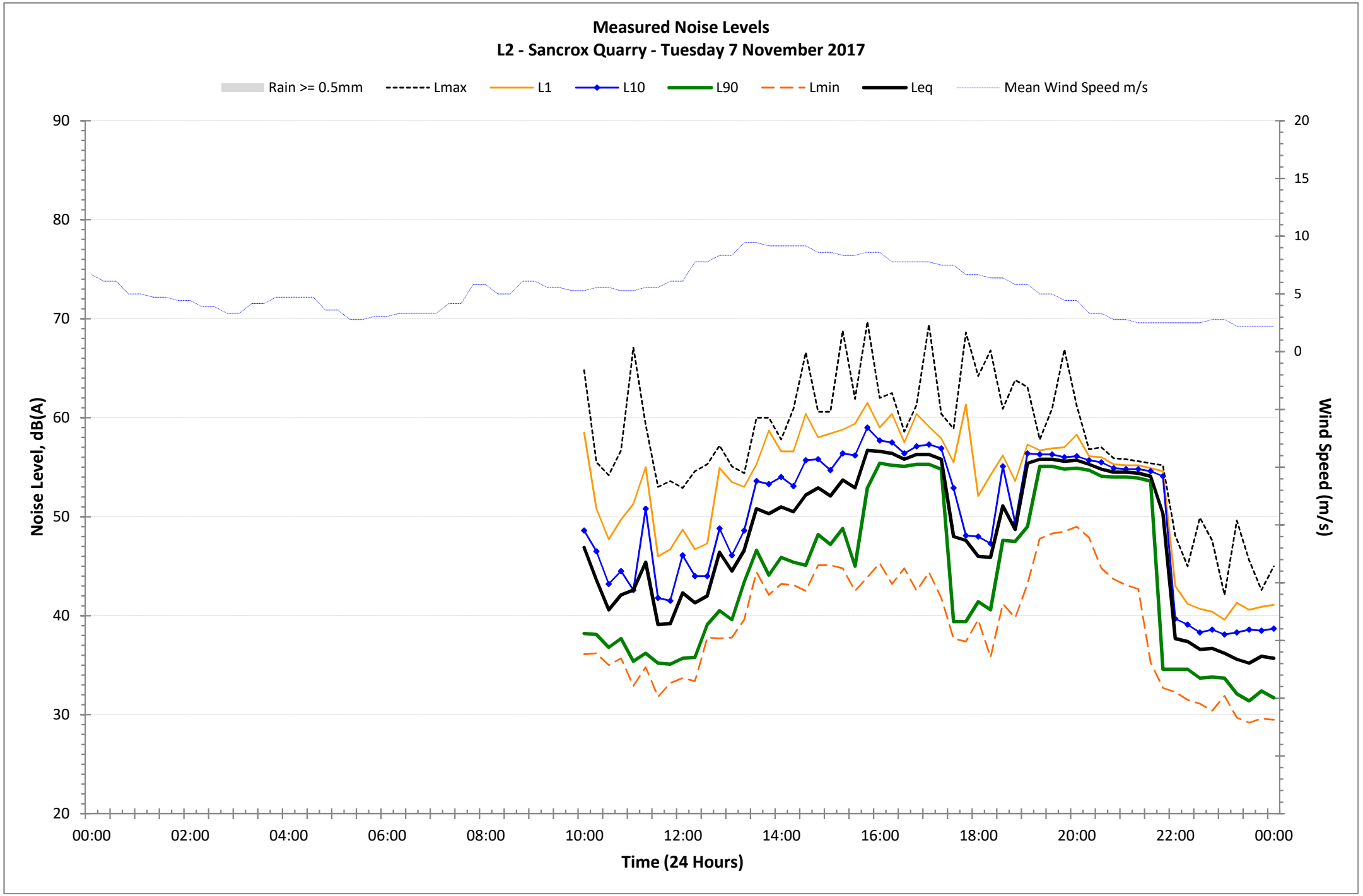
Measured Noise Levels
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Rain >= 0.5mm
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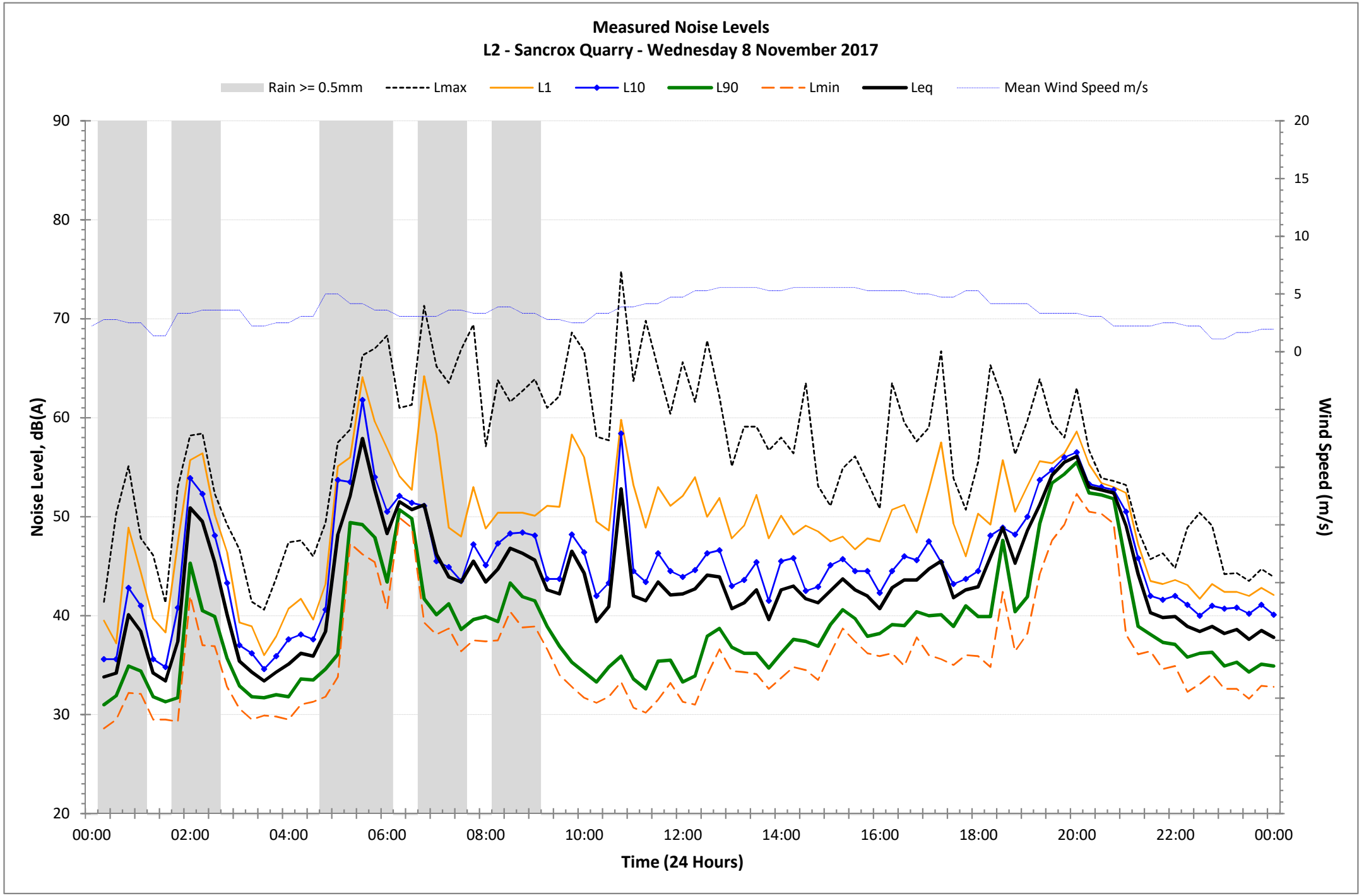
Measured Noise Levels
L2 - Sancrox Quarry - Wednesday 8 November 2017
Rain >= 0.5mm
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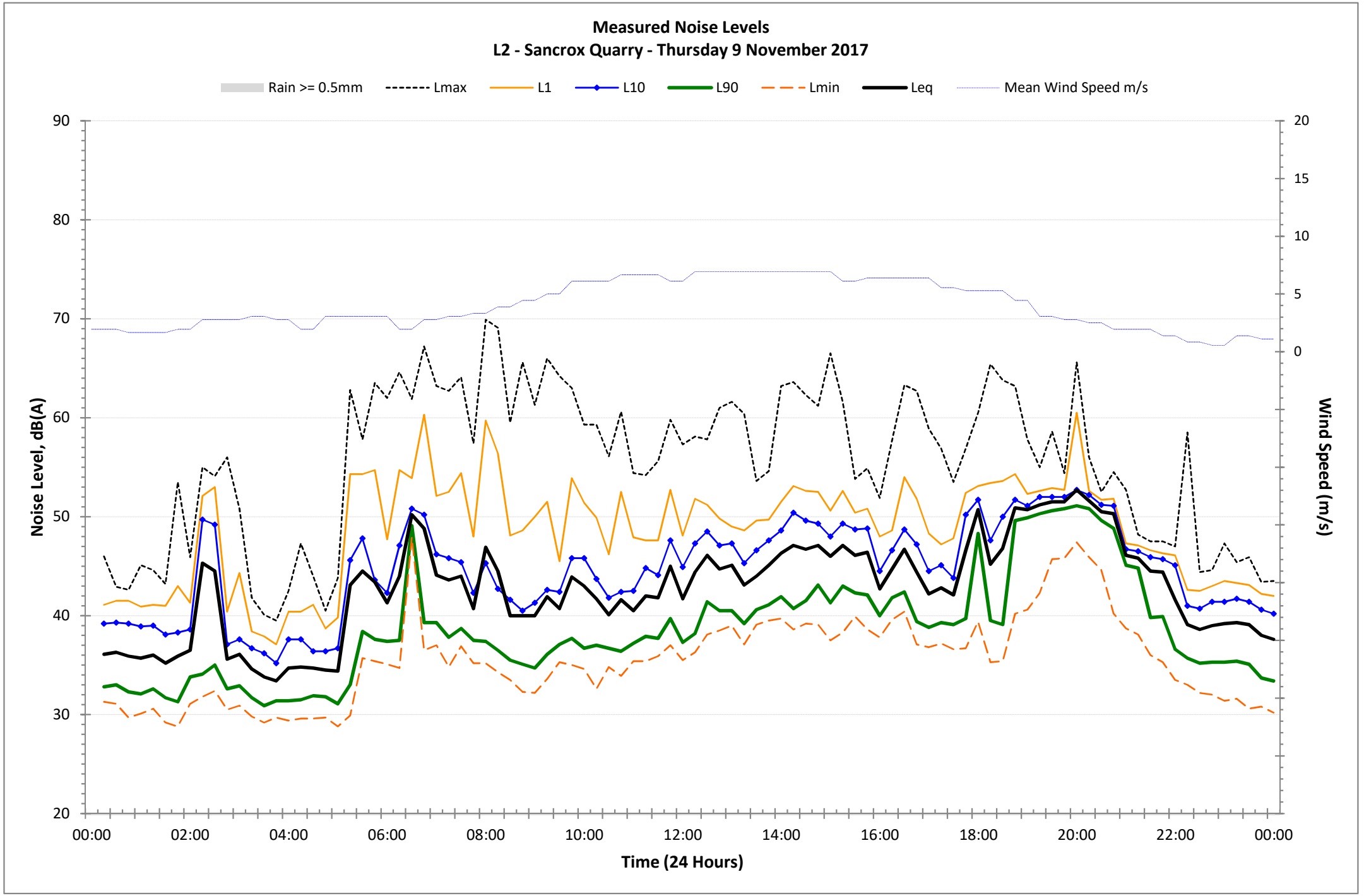
Measured Noise Levels
L2 - Sancrox Quarry - Thursday 9 November 2017
Rain >= 0.5mm
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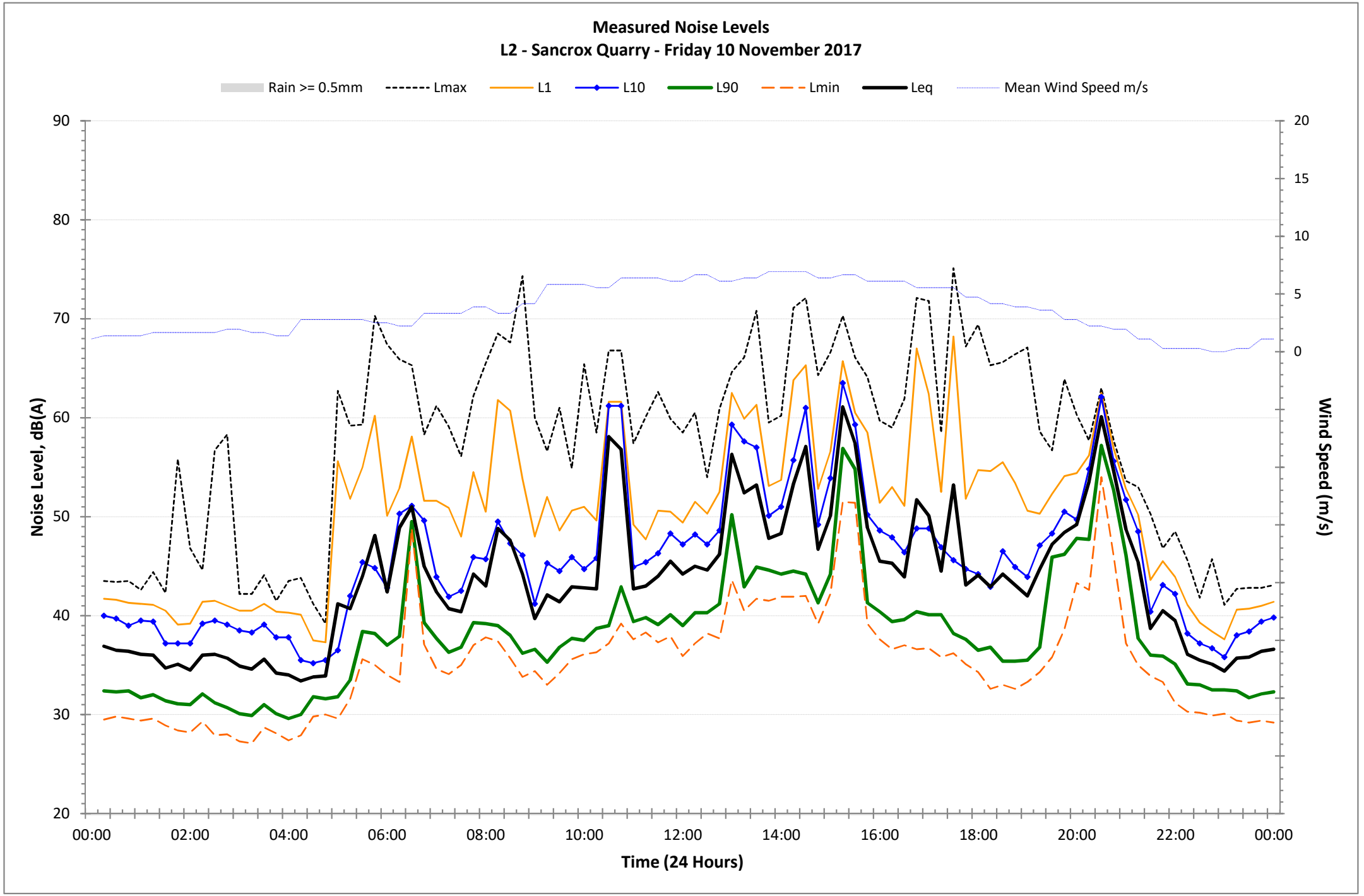
Measured Noise Levels
L2 - Sancrox Quarry - Friday 10 November 2017
Rain >= 0.5mm
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Mean Wind Speed m/s
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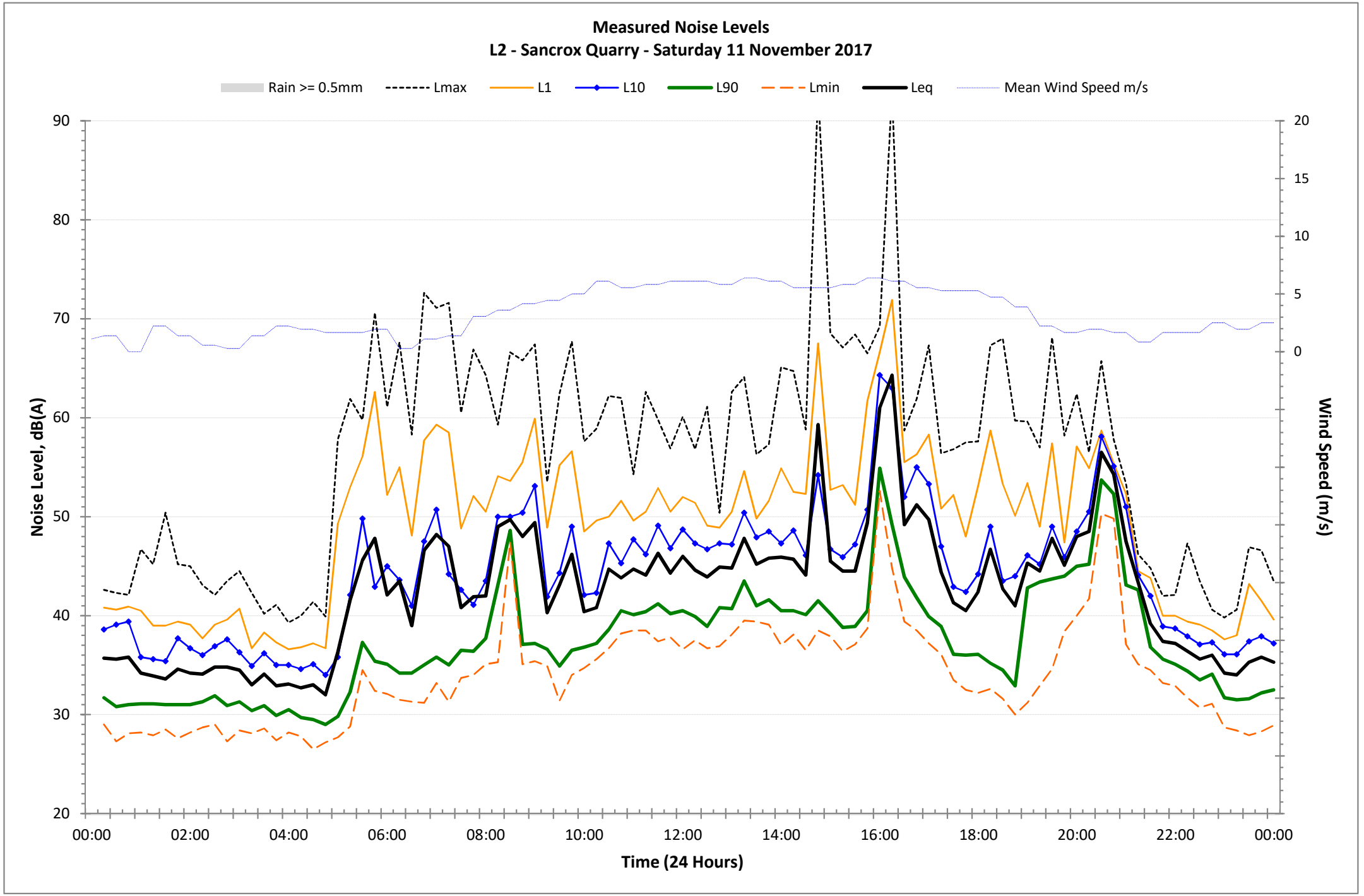
Measured Noise Levels
L2 - Sancrox Quarry - Saturday 11 November 2017
Rain >= 0.5mm
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Mean Wind Speed m/s
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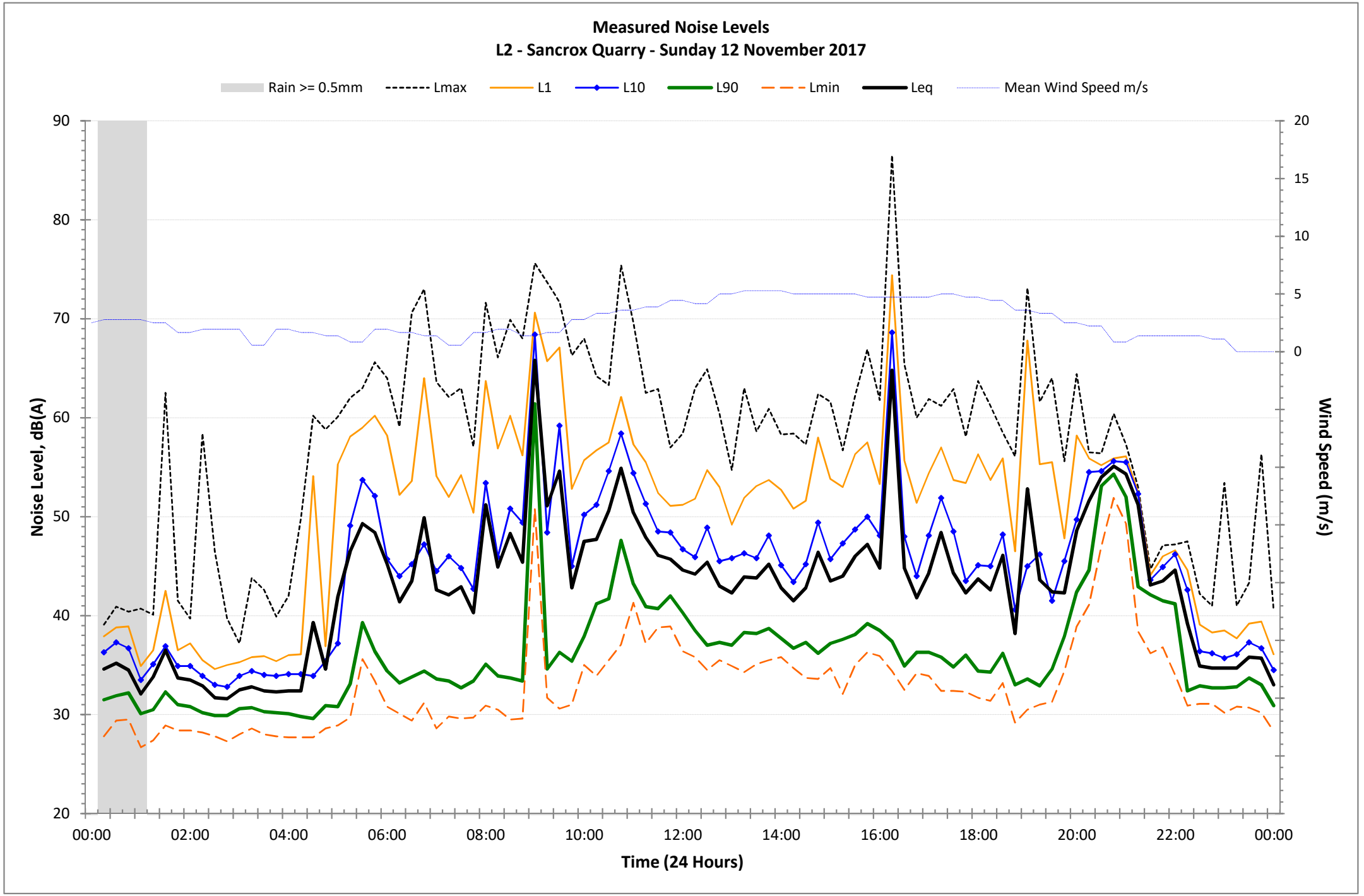
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
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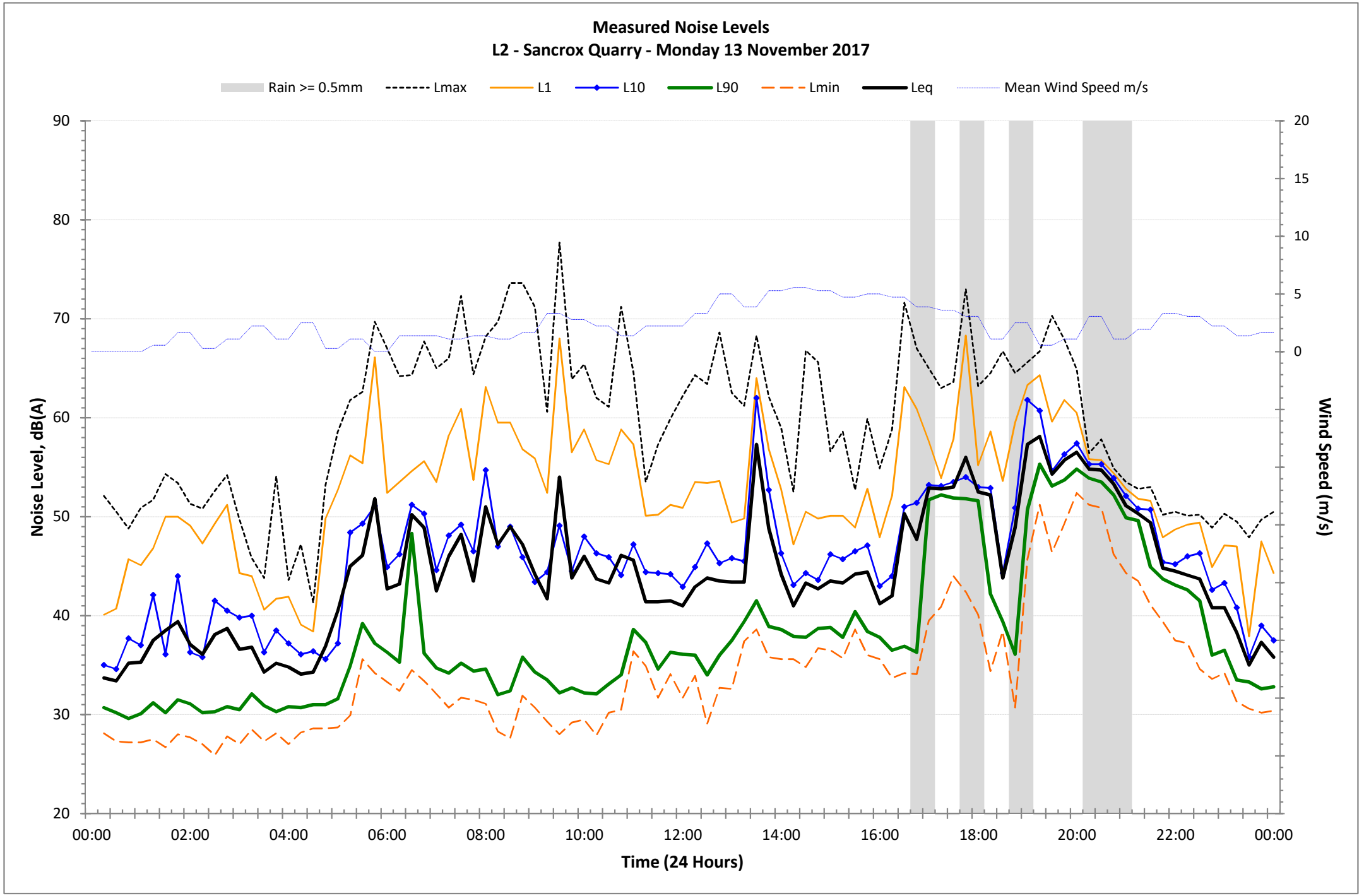
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
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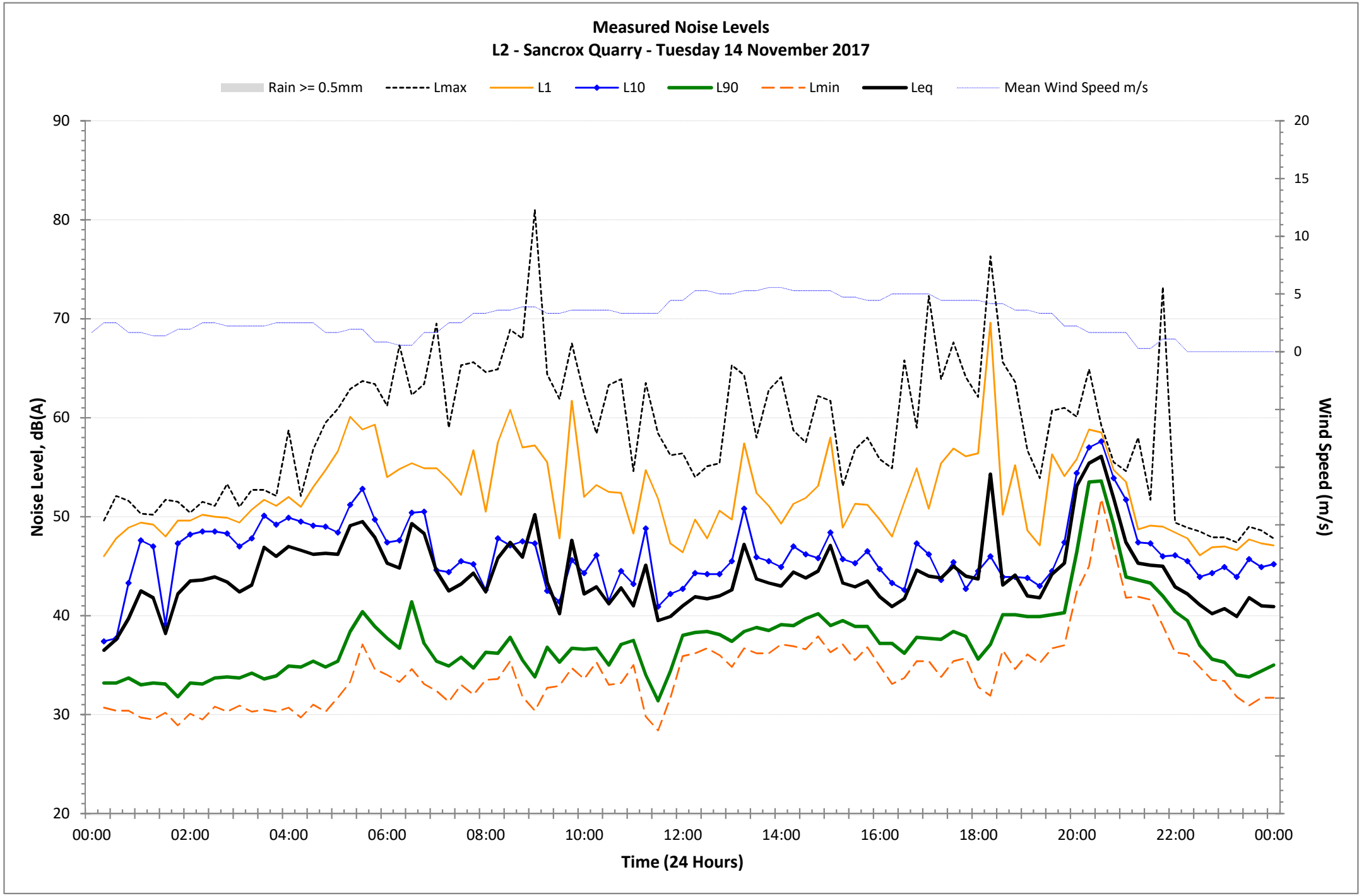
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
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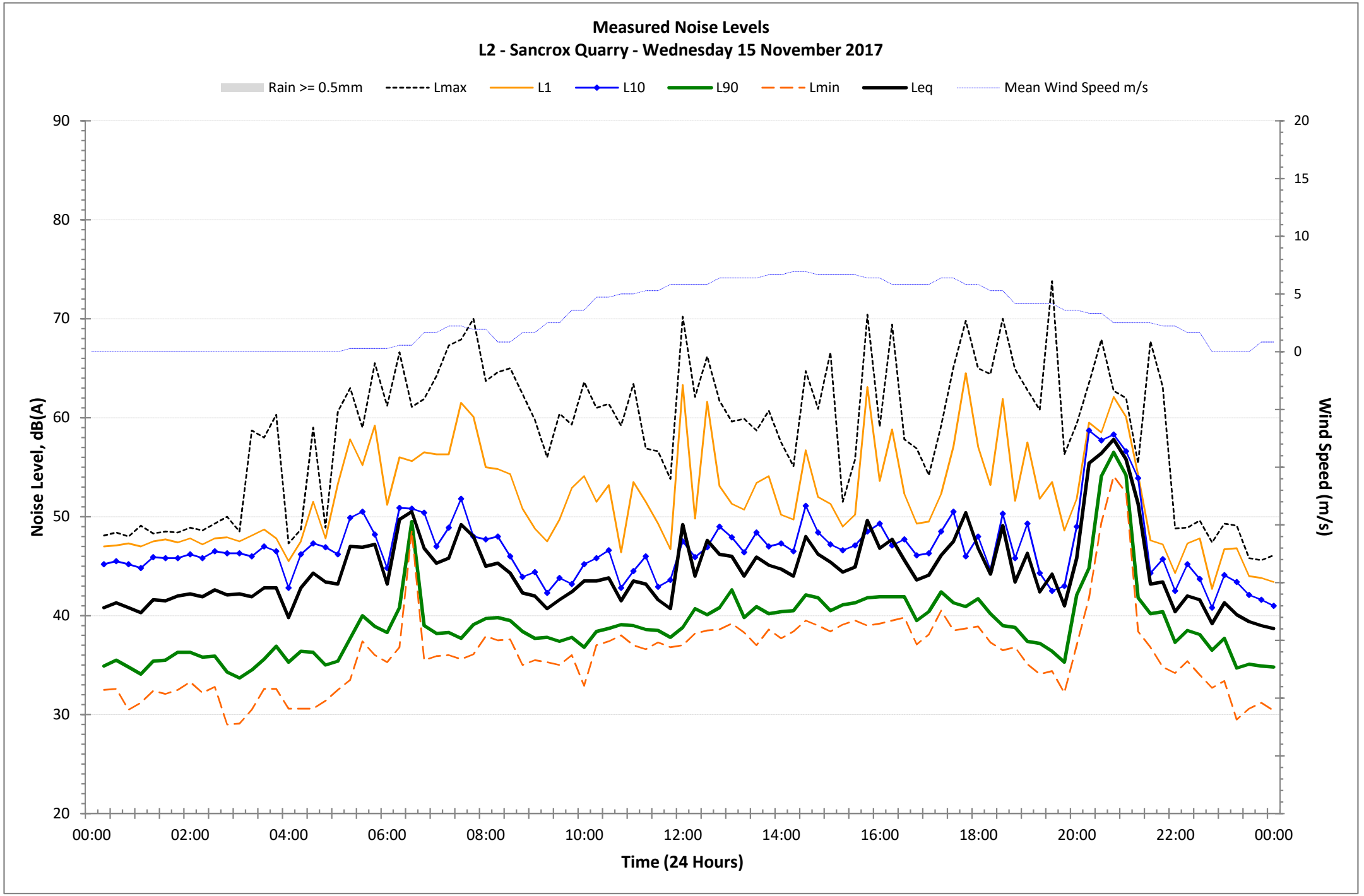
Measured Noise Levels
L2 - Sancrox Quarry - Wednesday 15 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
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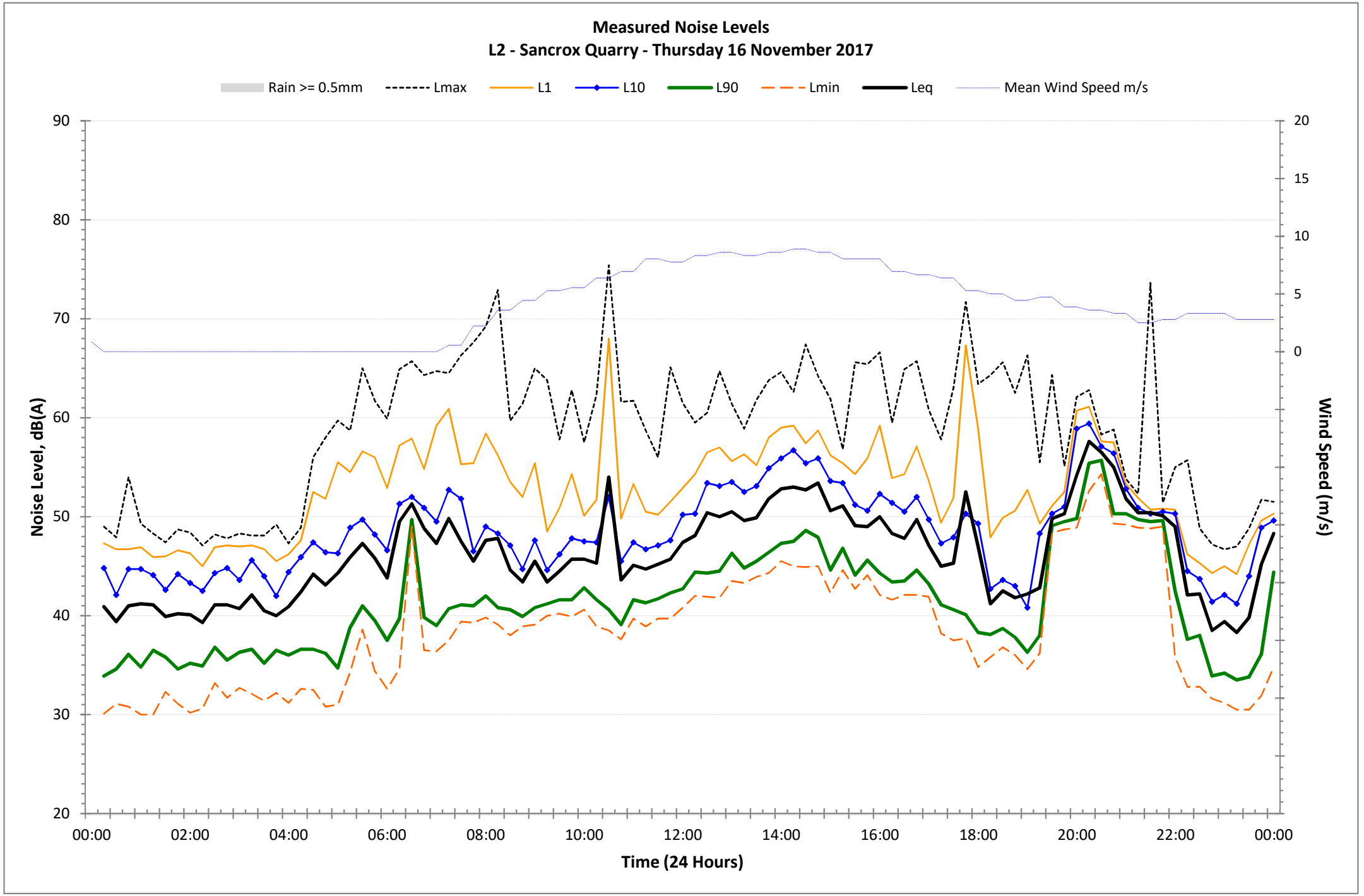
Measured Noise Levels
L2 - Sancrox Quarry - Thursday 16 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
15
10
5
0
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06:00
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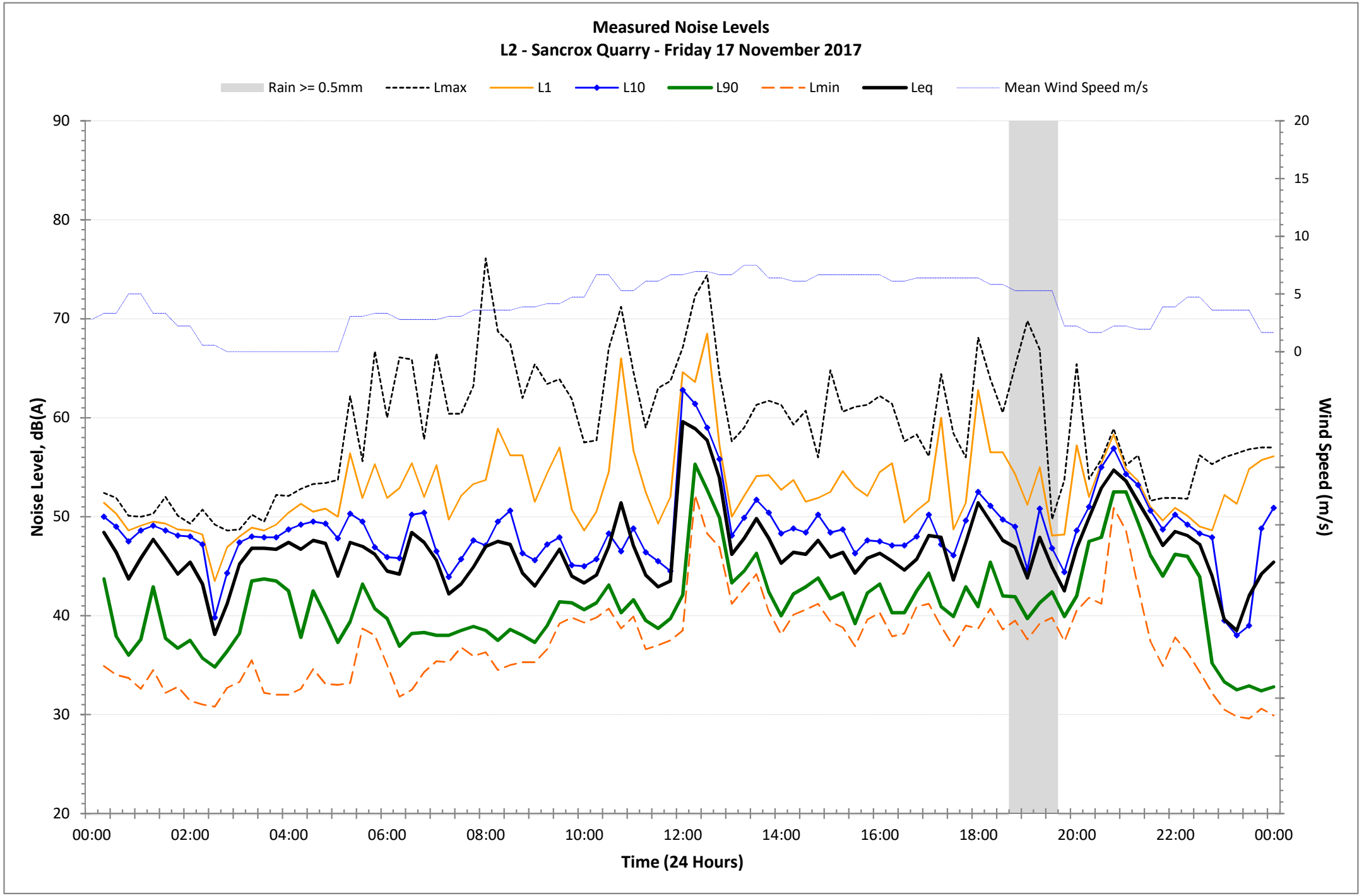
Measured Noise Levels
L2 - Sancrox Quarry - Friday 17 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
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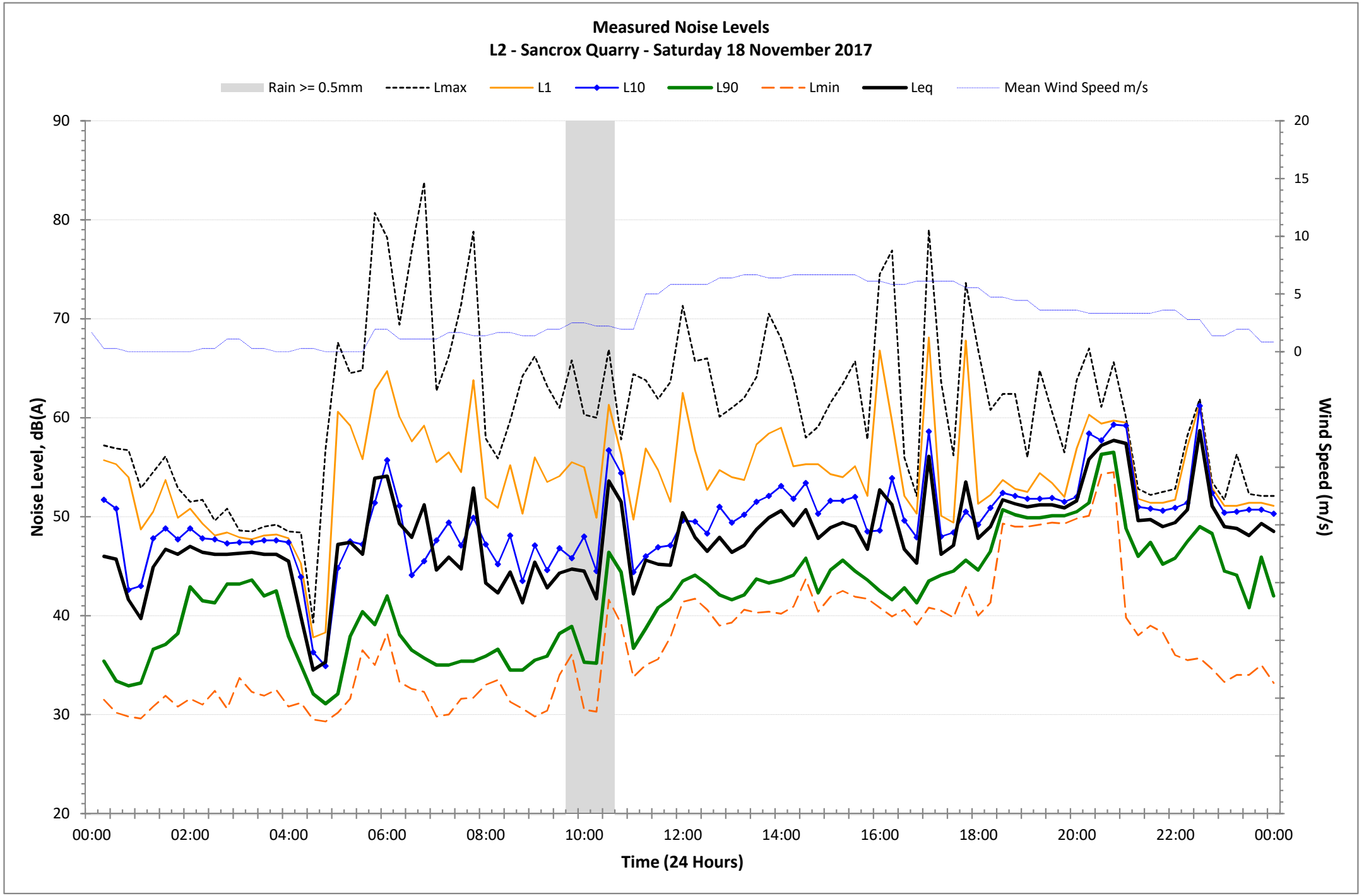
Measured Noise Levels
L2 - Sancrox Quarry - Saturday 18 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
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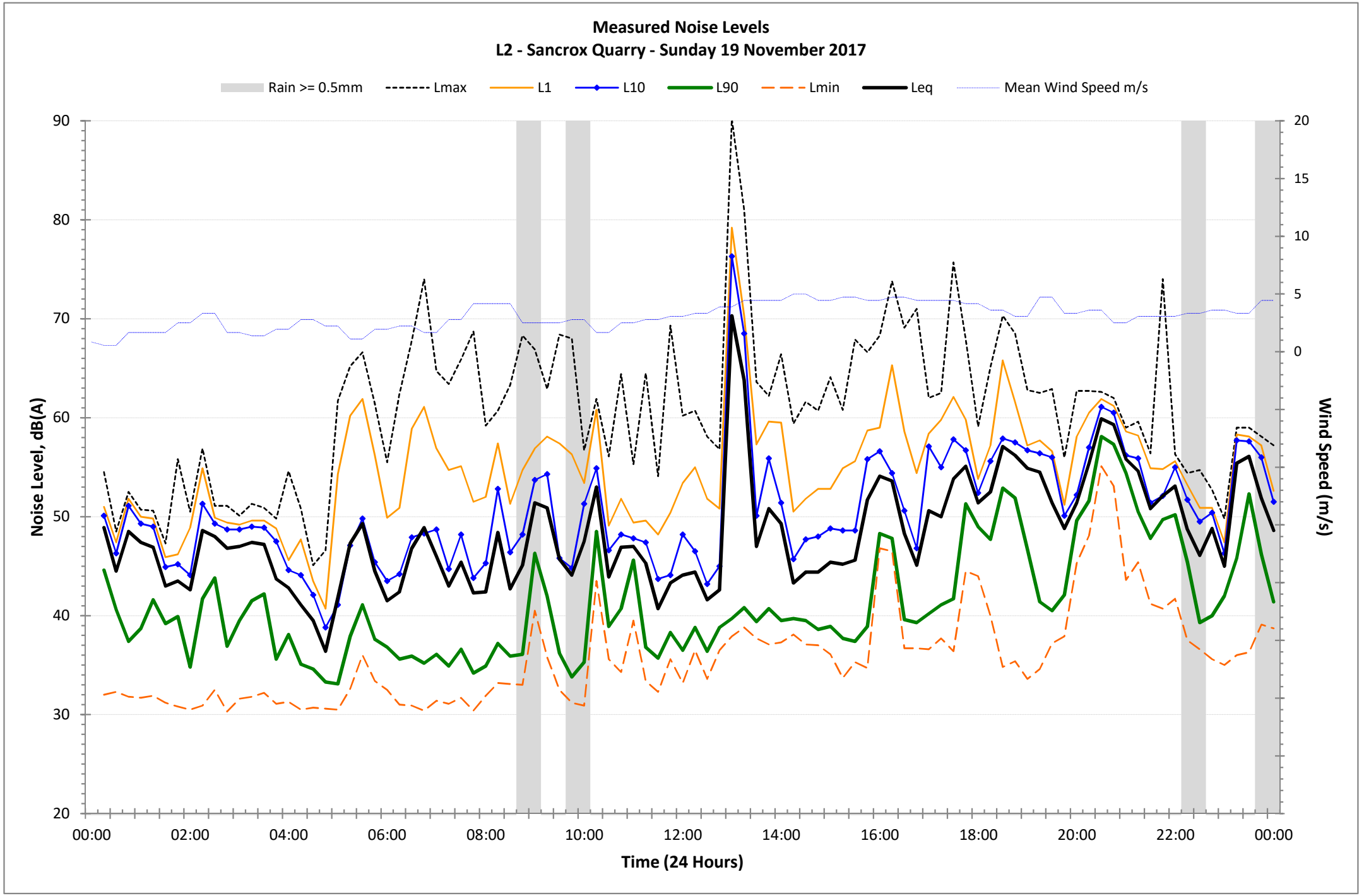
Measured Noise Levels
L2 - Sancrox Quarry - Sunday 19 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
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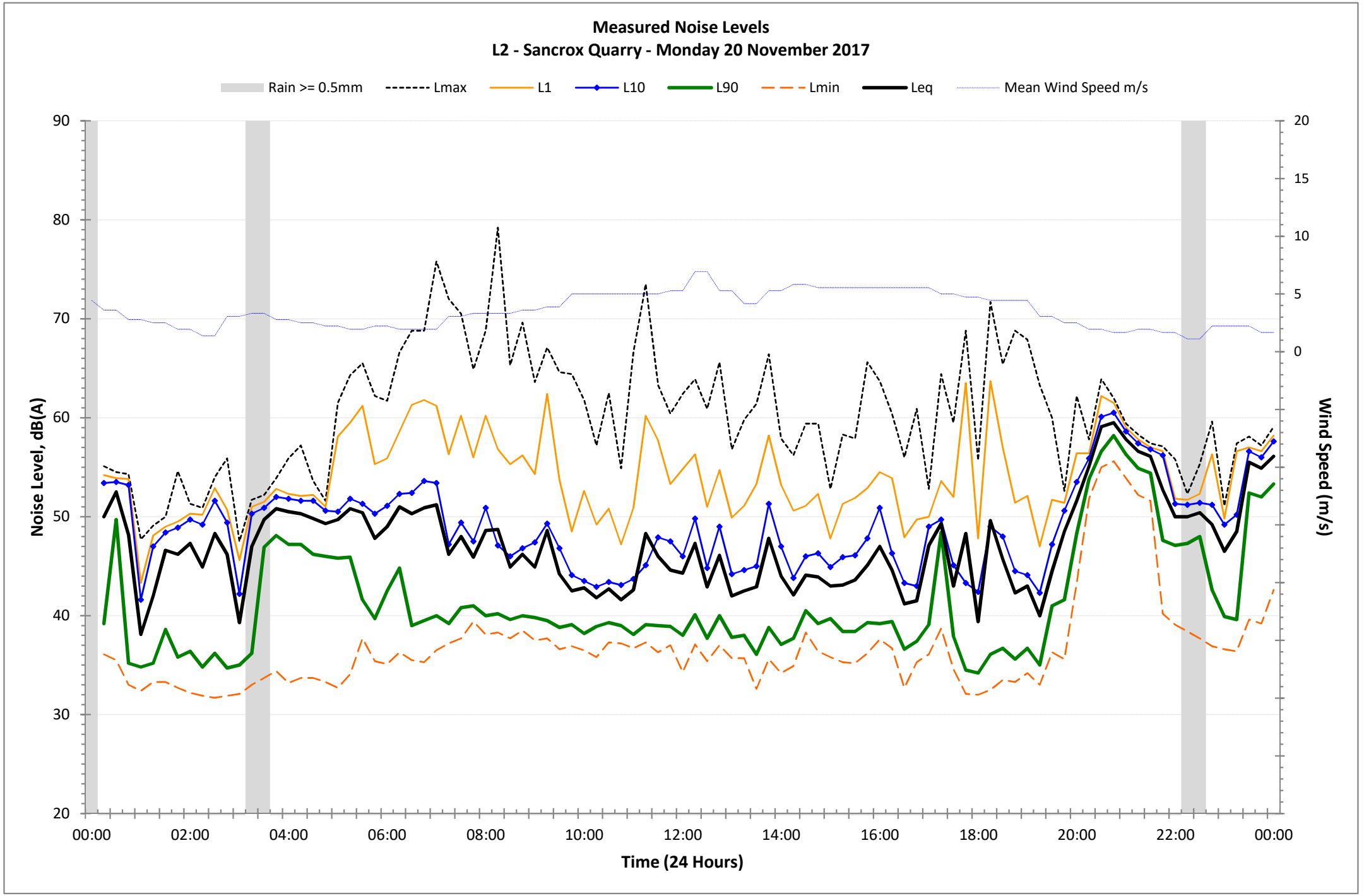
Measured Noise Levels
L2 - Sancrox Quarry - Monday 20 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
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02:00
04:00
06:00
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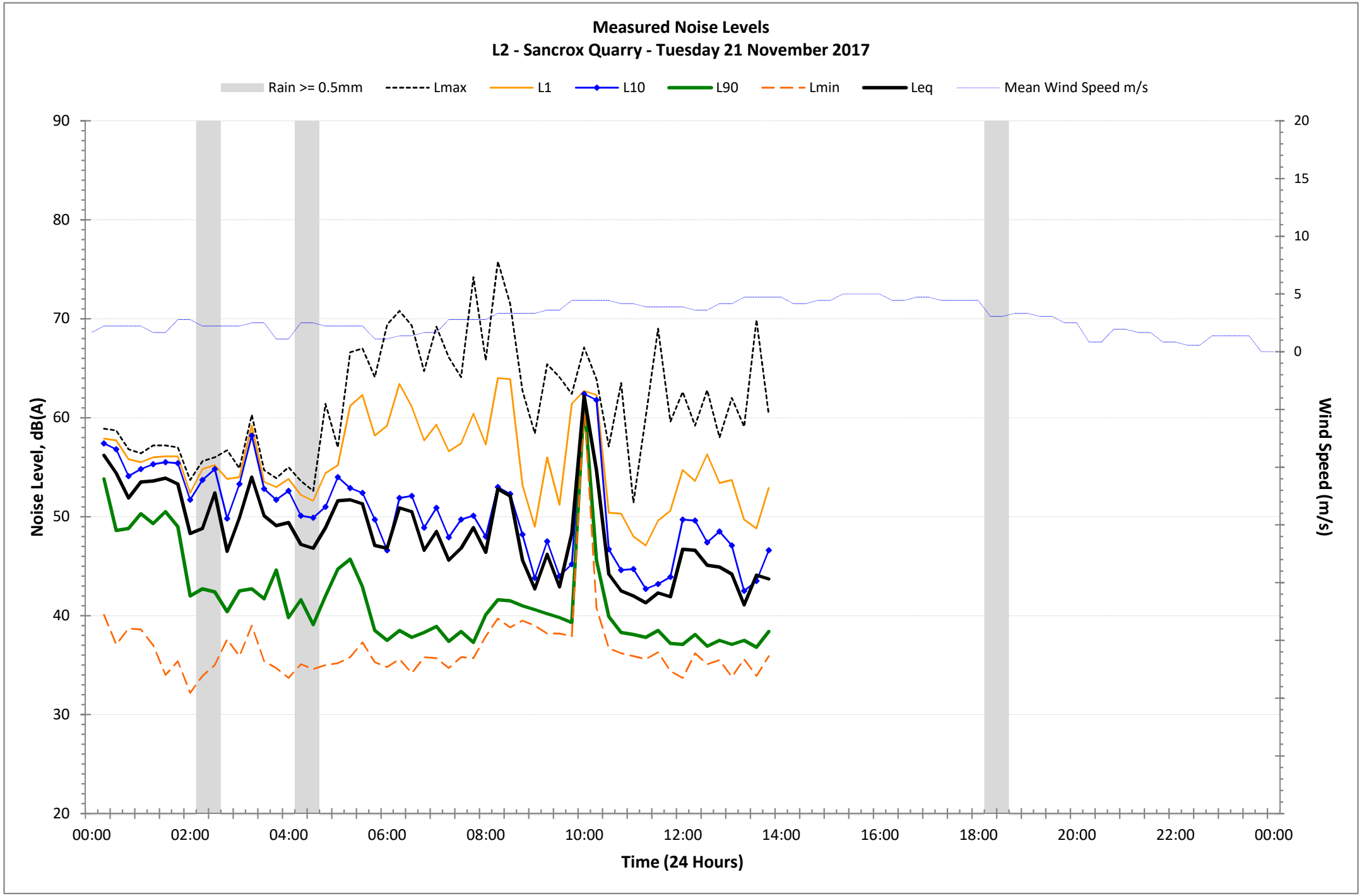
Measured Noise Levels
L2 - Sancrox Quarry - Tuesday 21 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
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06:00
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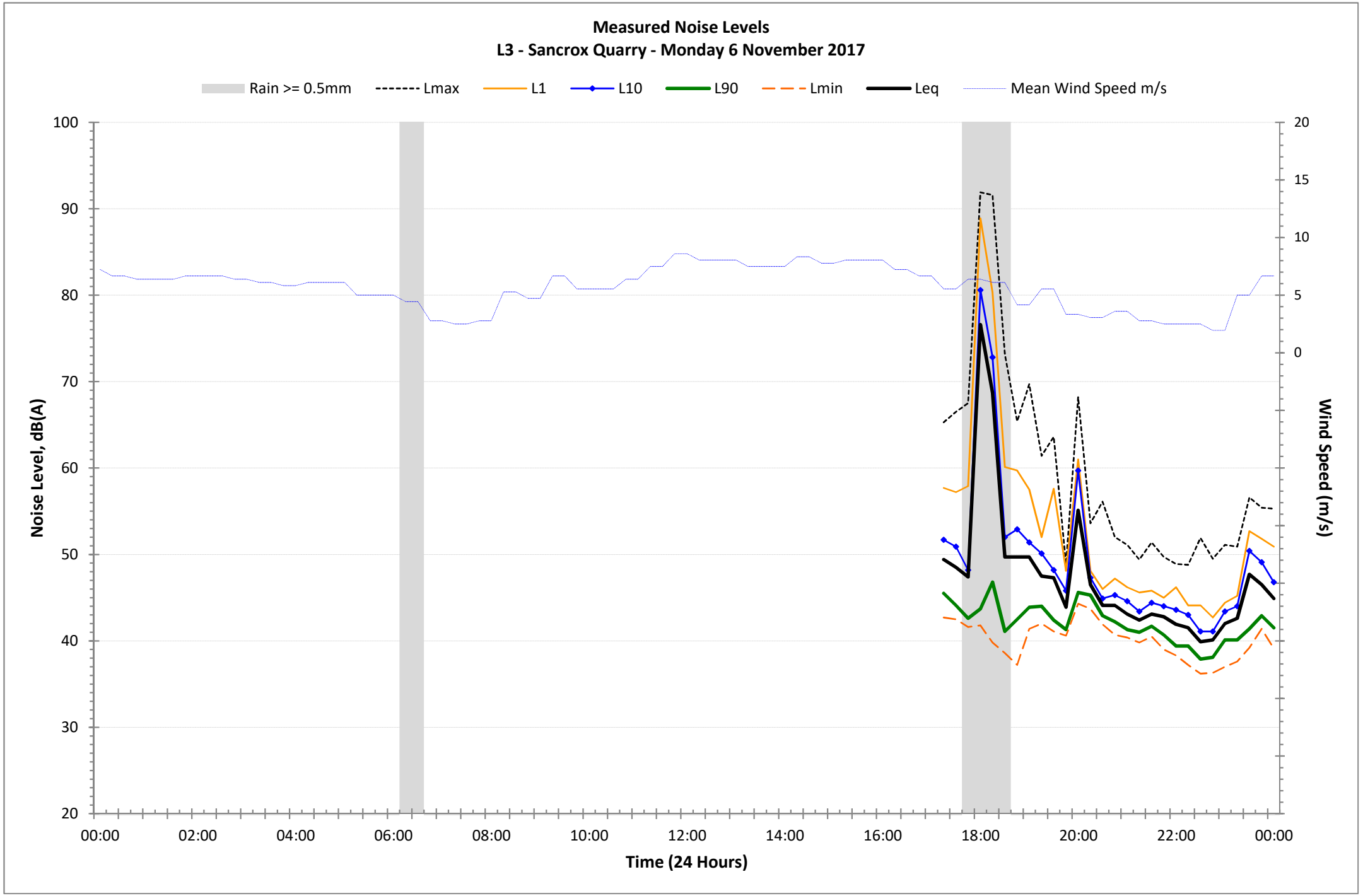
Measured Noise Levels
L3 - Sancrox Quarry - Monday 6 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
100
90
80
70
60
50
40
30
20
20
15
10
5
0
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02:00
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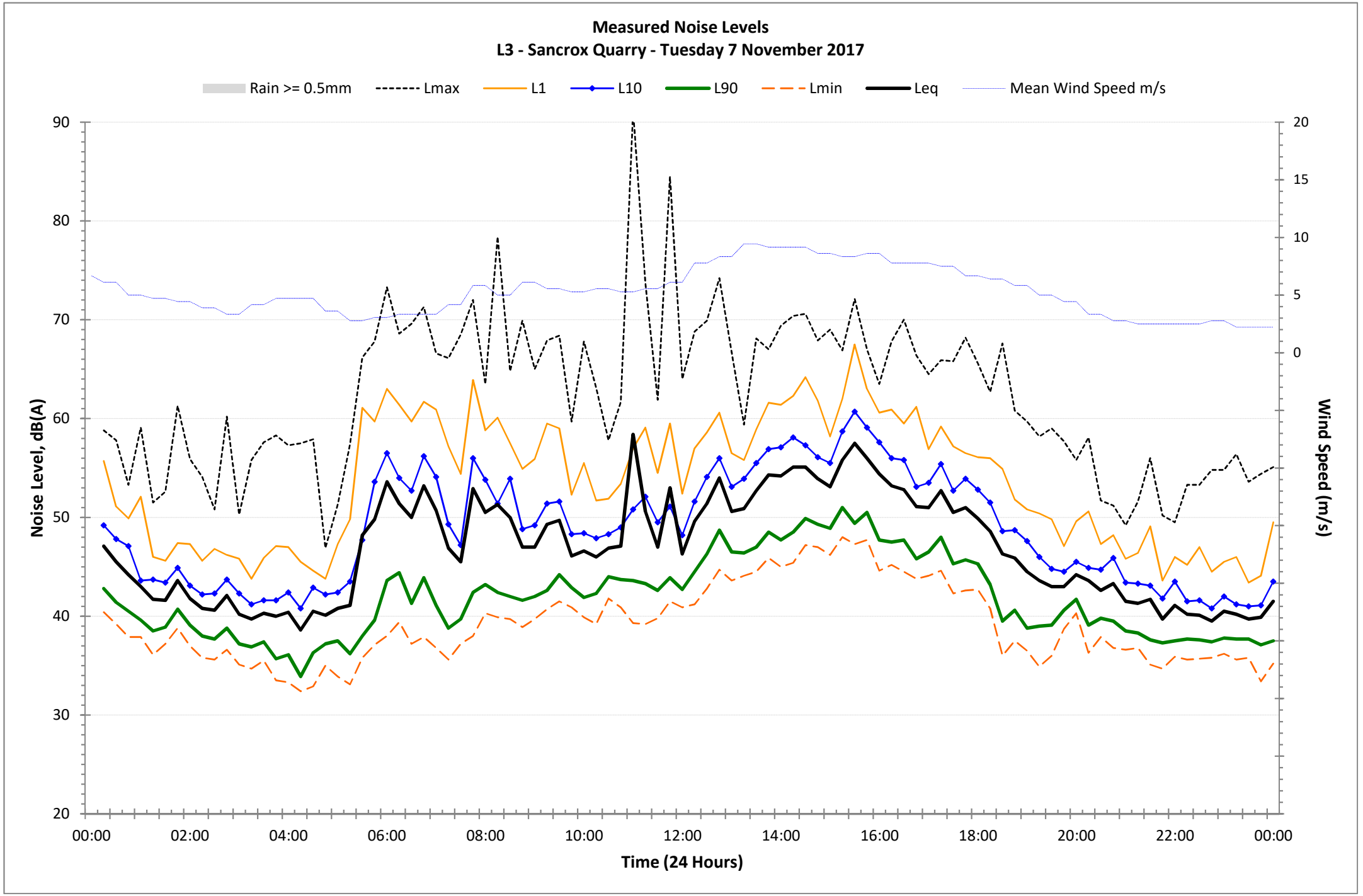
Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 7 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
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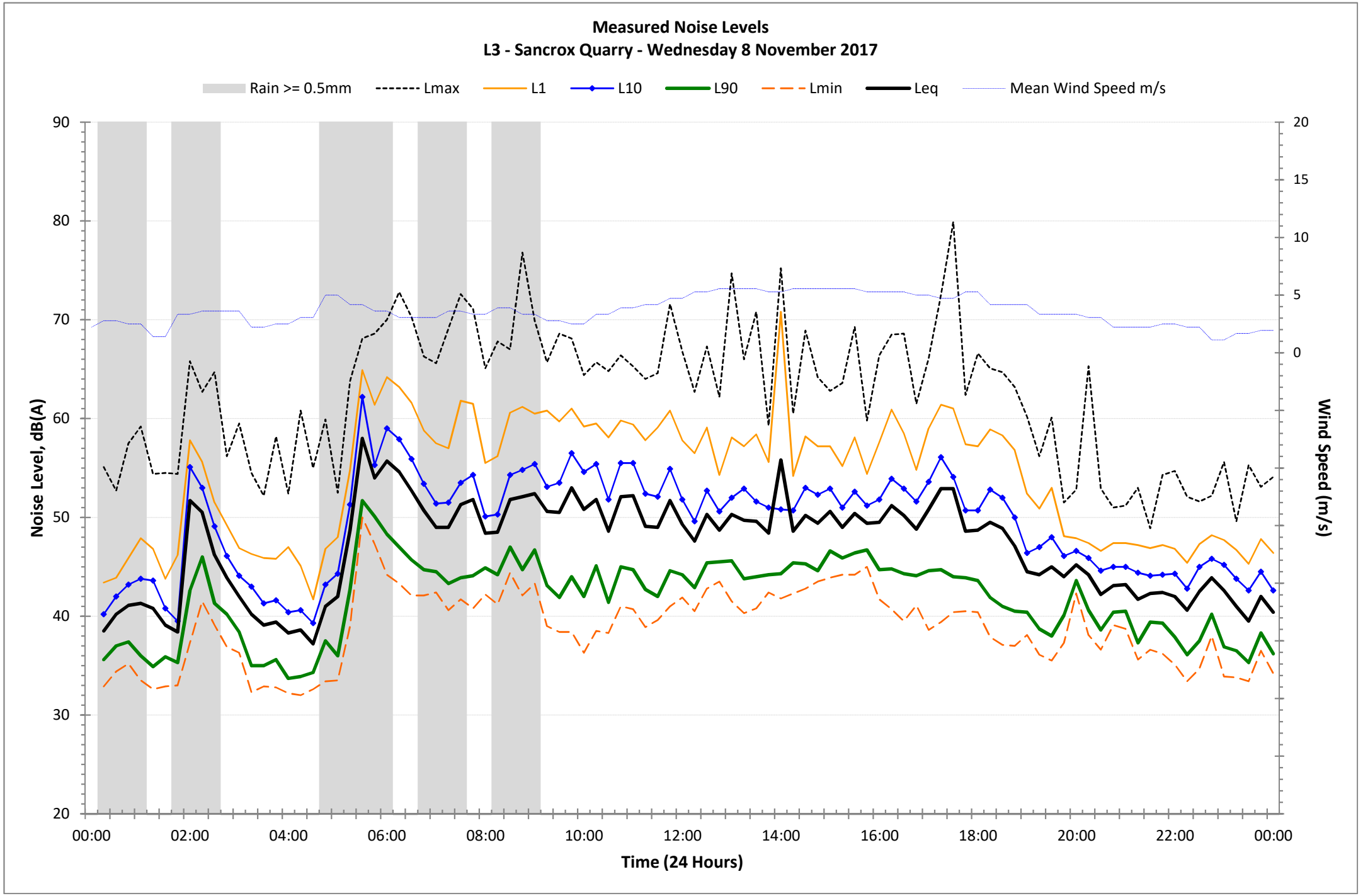
Measured Noise Levels
L3 - Sancrox Quarry - Wednesday 8 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
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10
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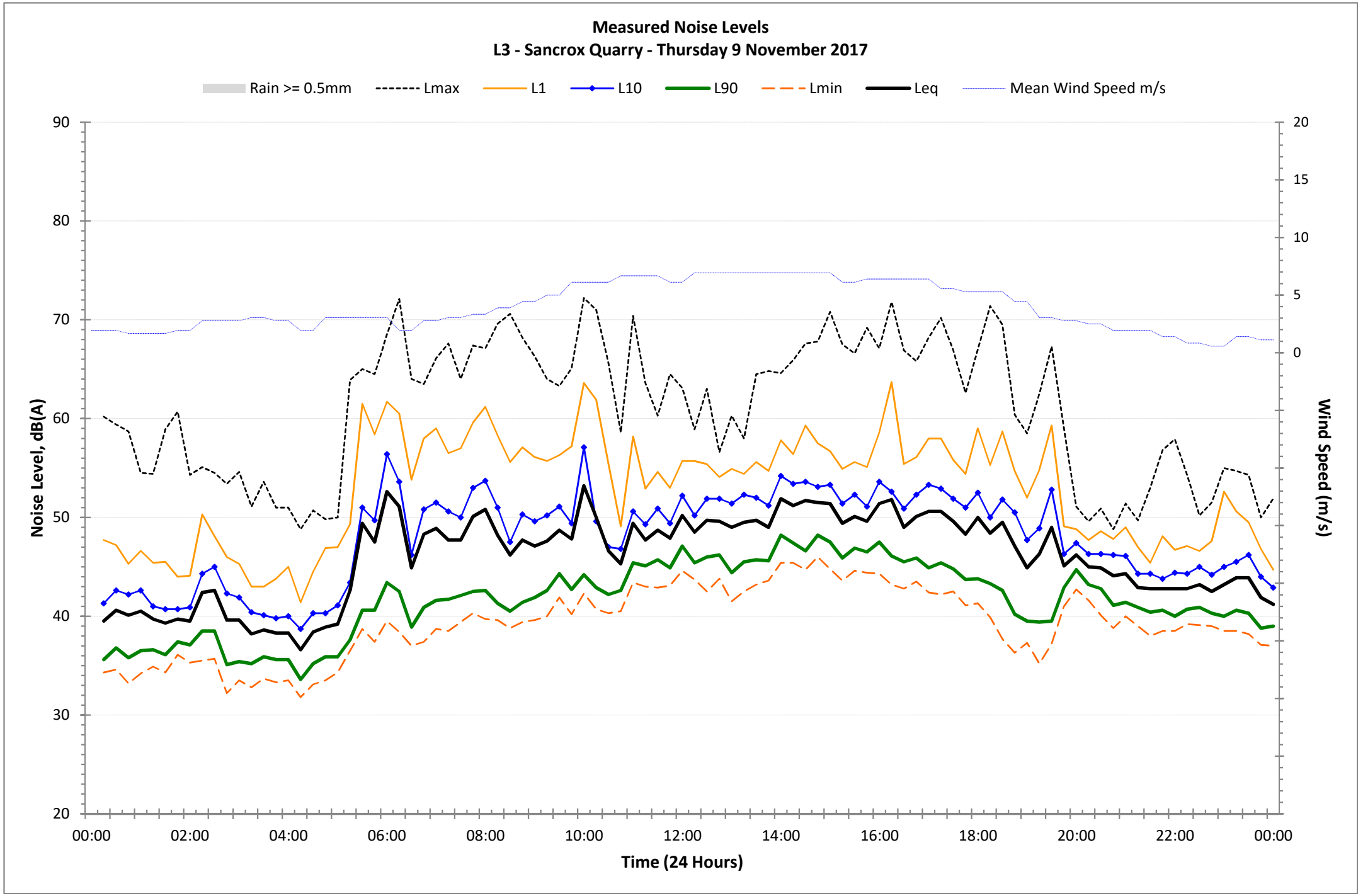
Measured Noise Levels
L3 - Sancrox Quarry - Thursday 9 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
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18:00
20:00
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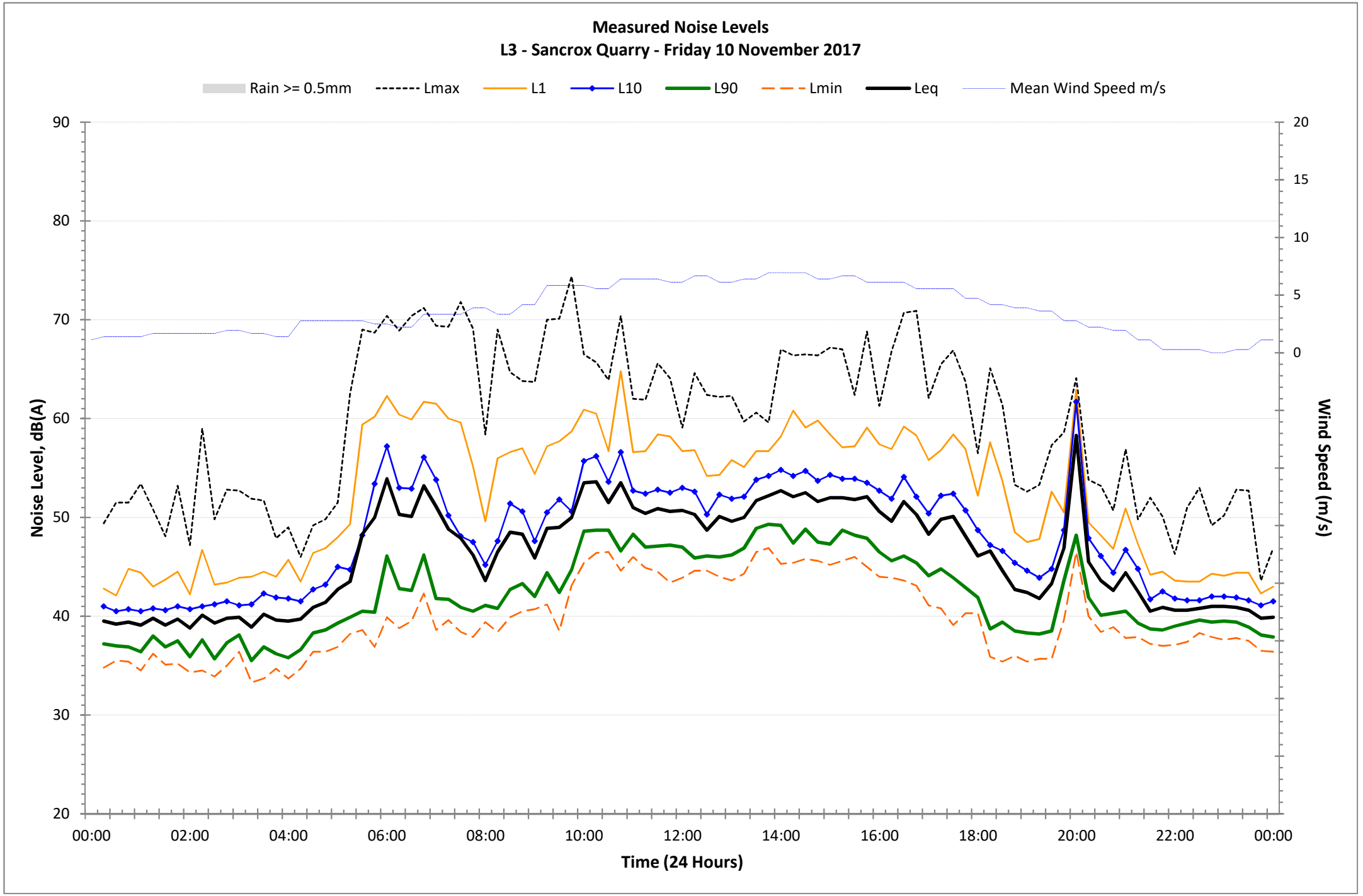
Measured Noise Levels
L3 - Sancrox Quarry - Friday 10 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
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18:00
20:00
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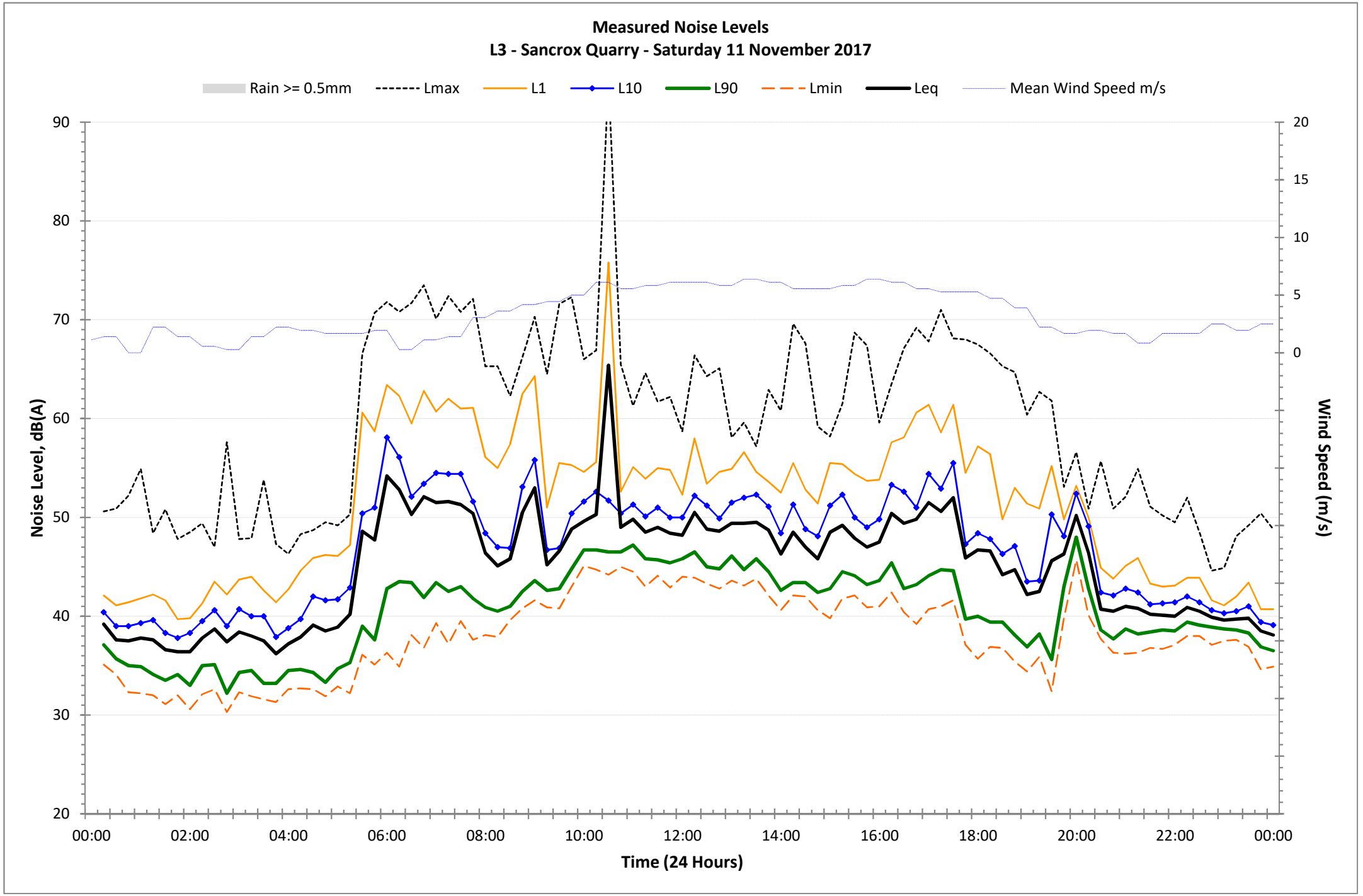
Measured Noise Levels
L3 - Sancrox Quarry - Saturday 11 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
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10:00
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16:00
18:00
20:00
22:00
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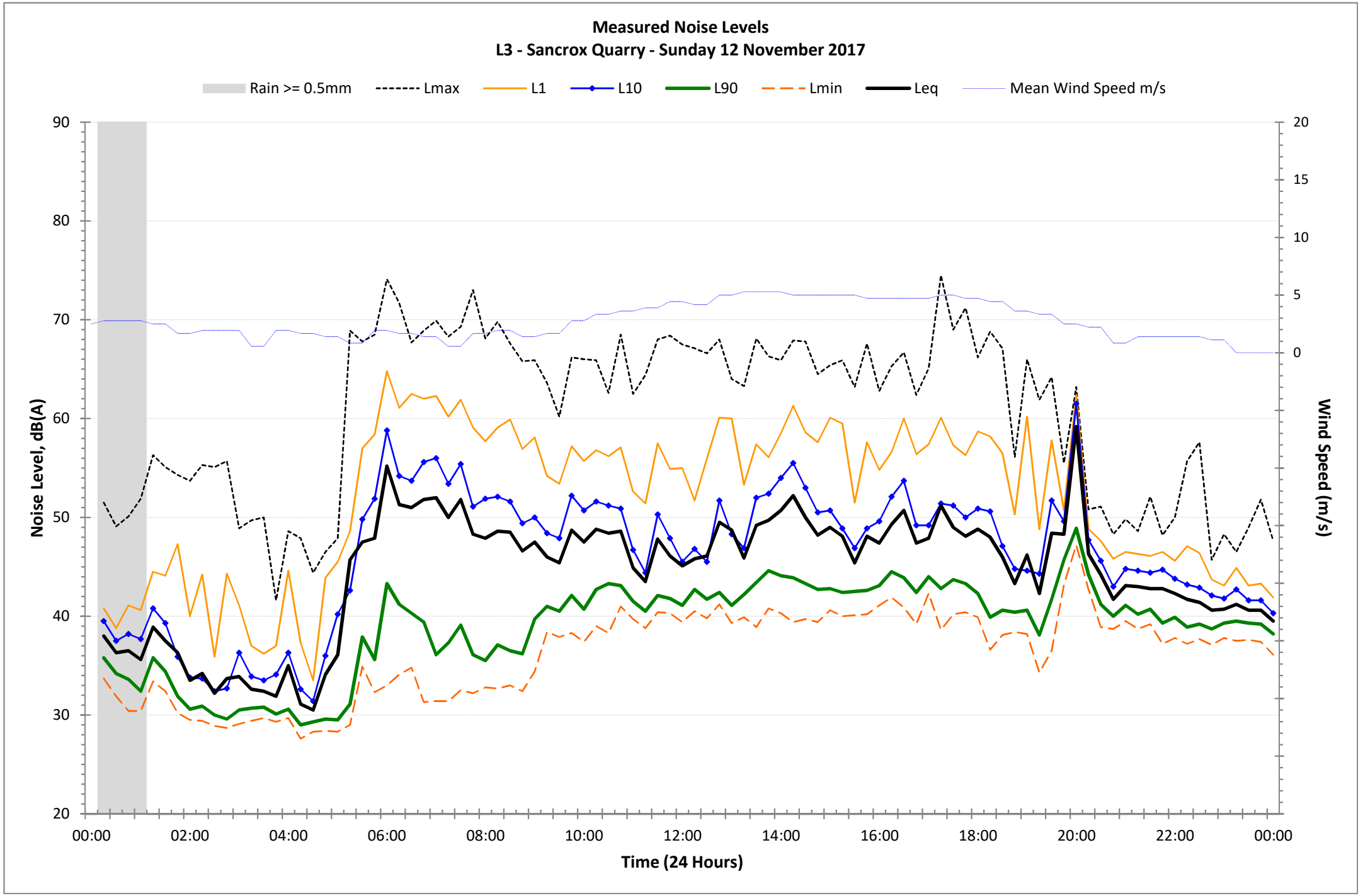
Measured Noise Levels
L3 - Sancrox Quarry - Sunday 12 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
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10:00
12:00
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16:00
18:00
20:00
22:00
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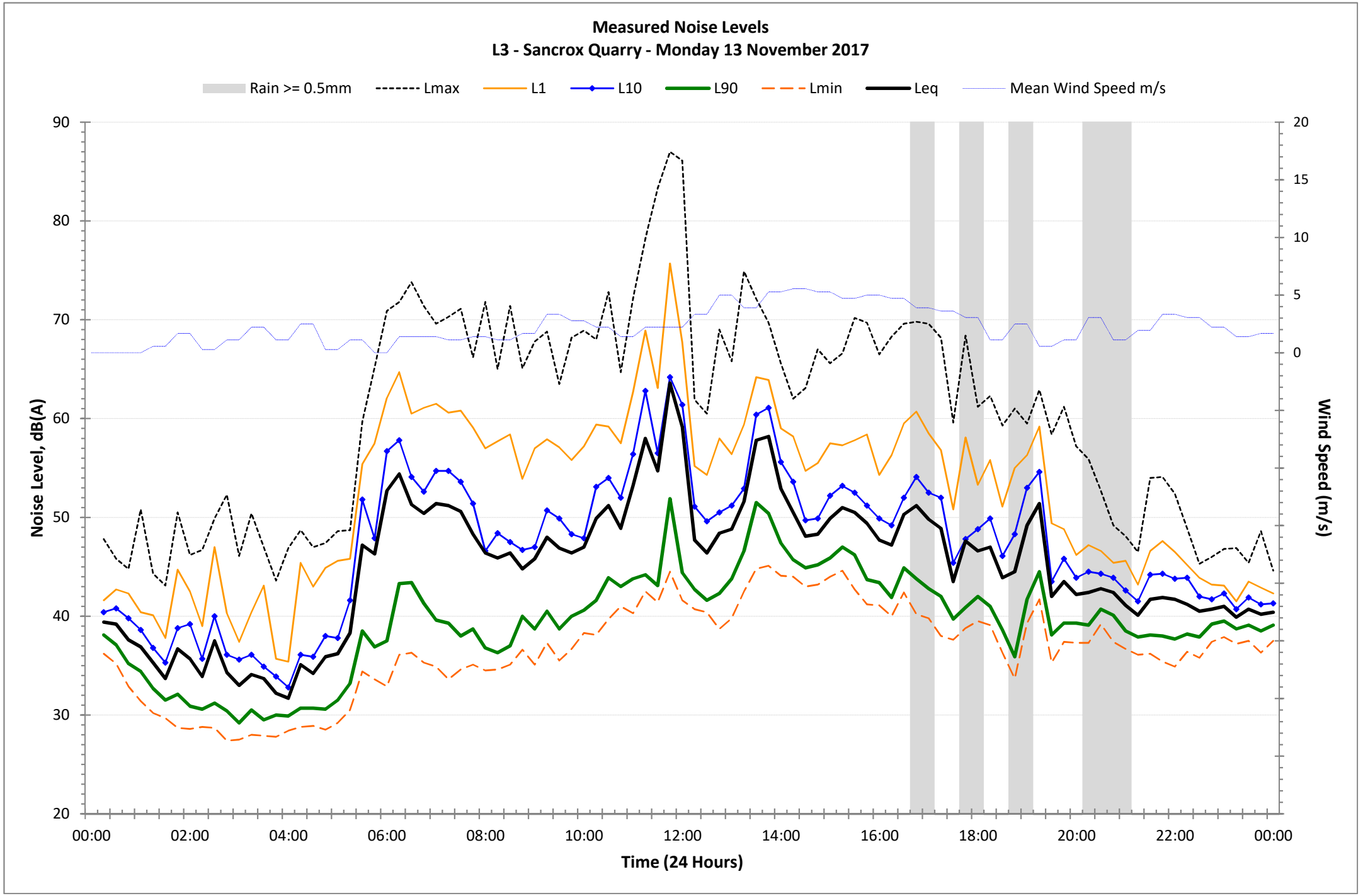
Measured Noise Levels
L3 - Sancrox Quarry - Monday 13 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
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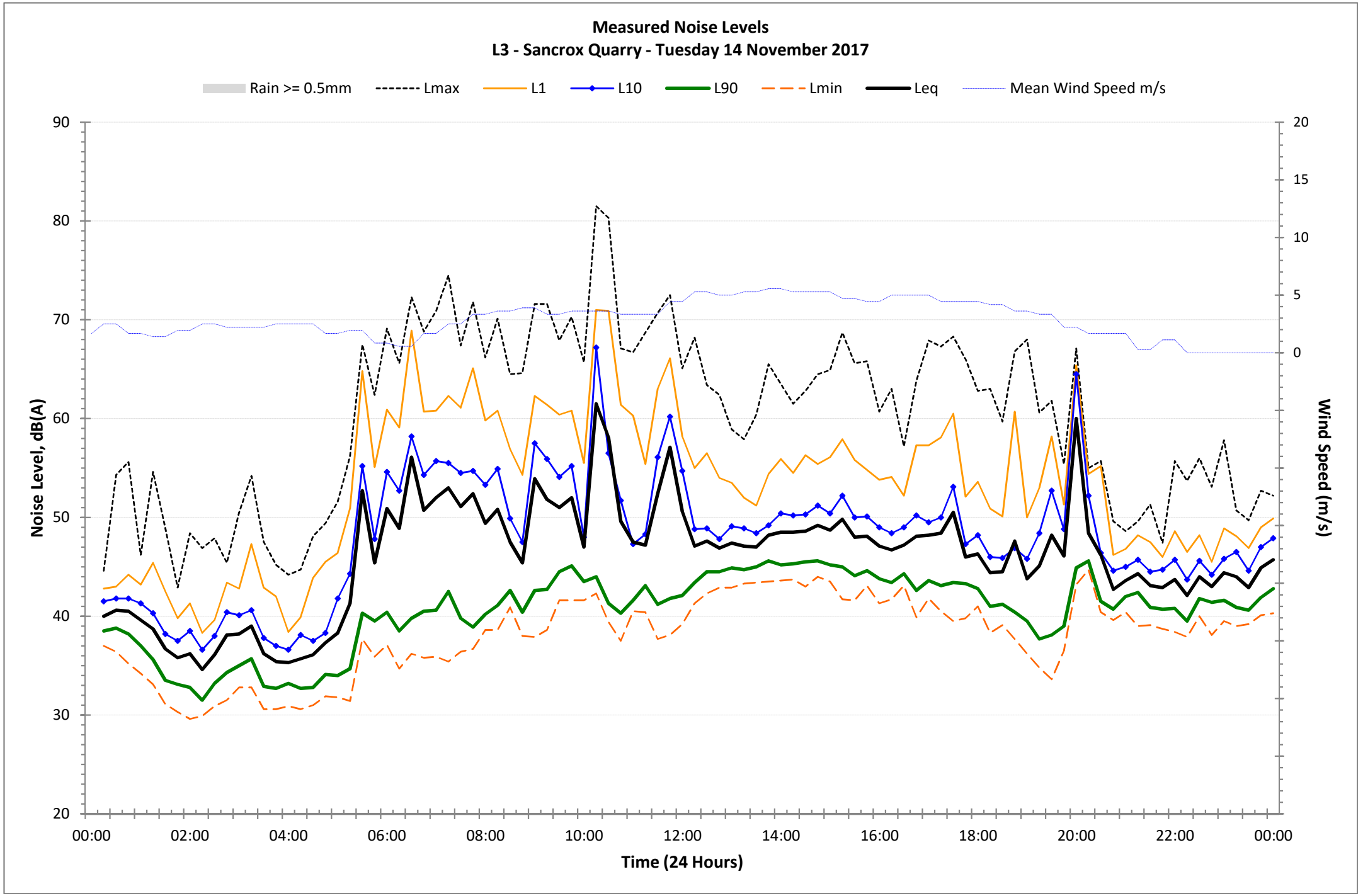
Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 14 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
04:00
06:00
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20:00
22:00
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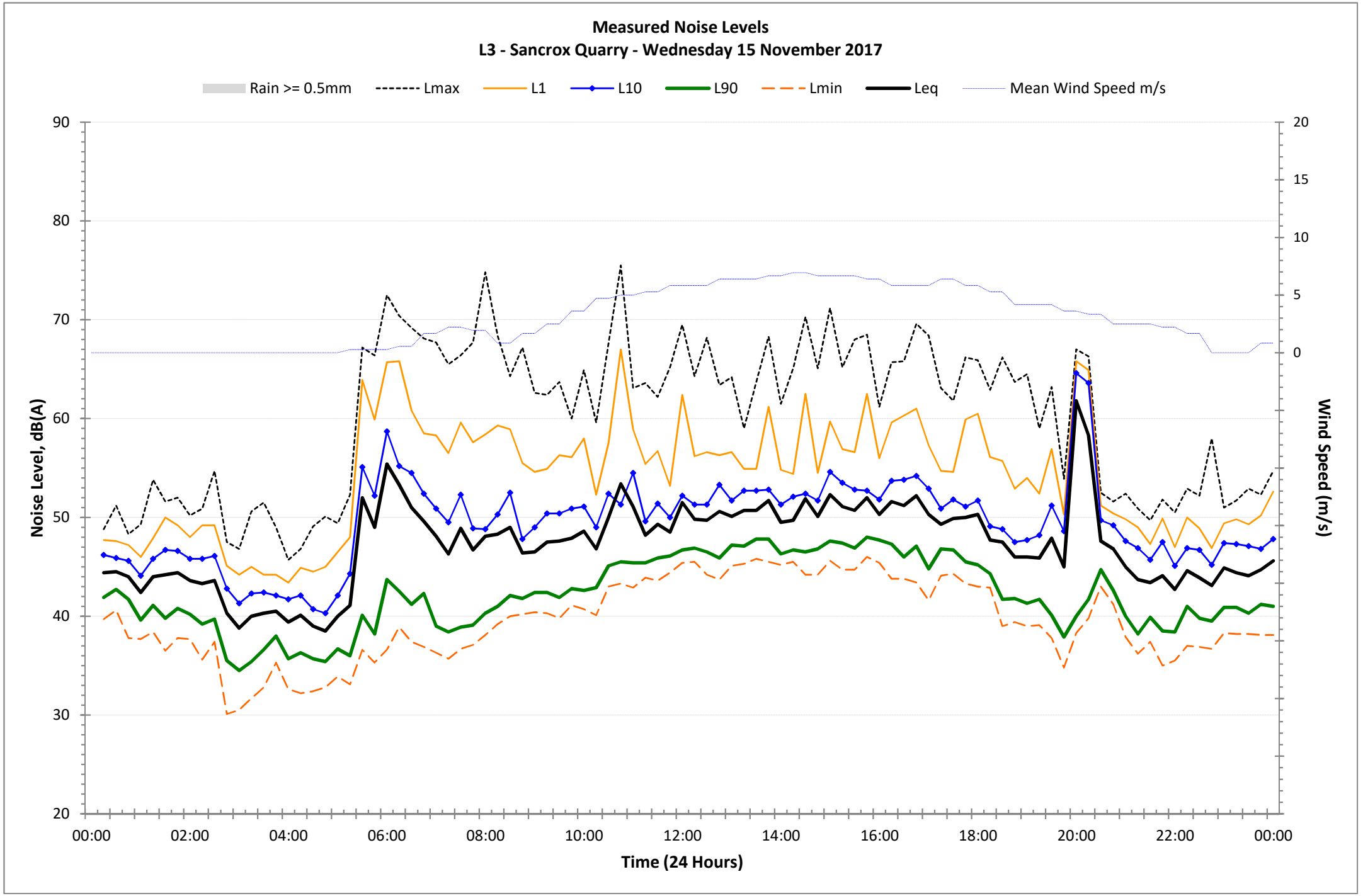
Measured Noise Levels
L3 - Sancrox Quarry - Wednesday 15 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
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06:00
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20:00
22:00
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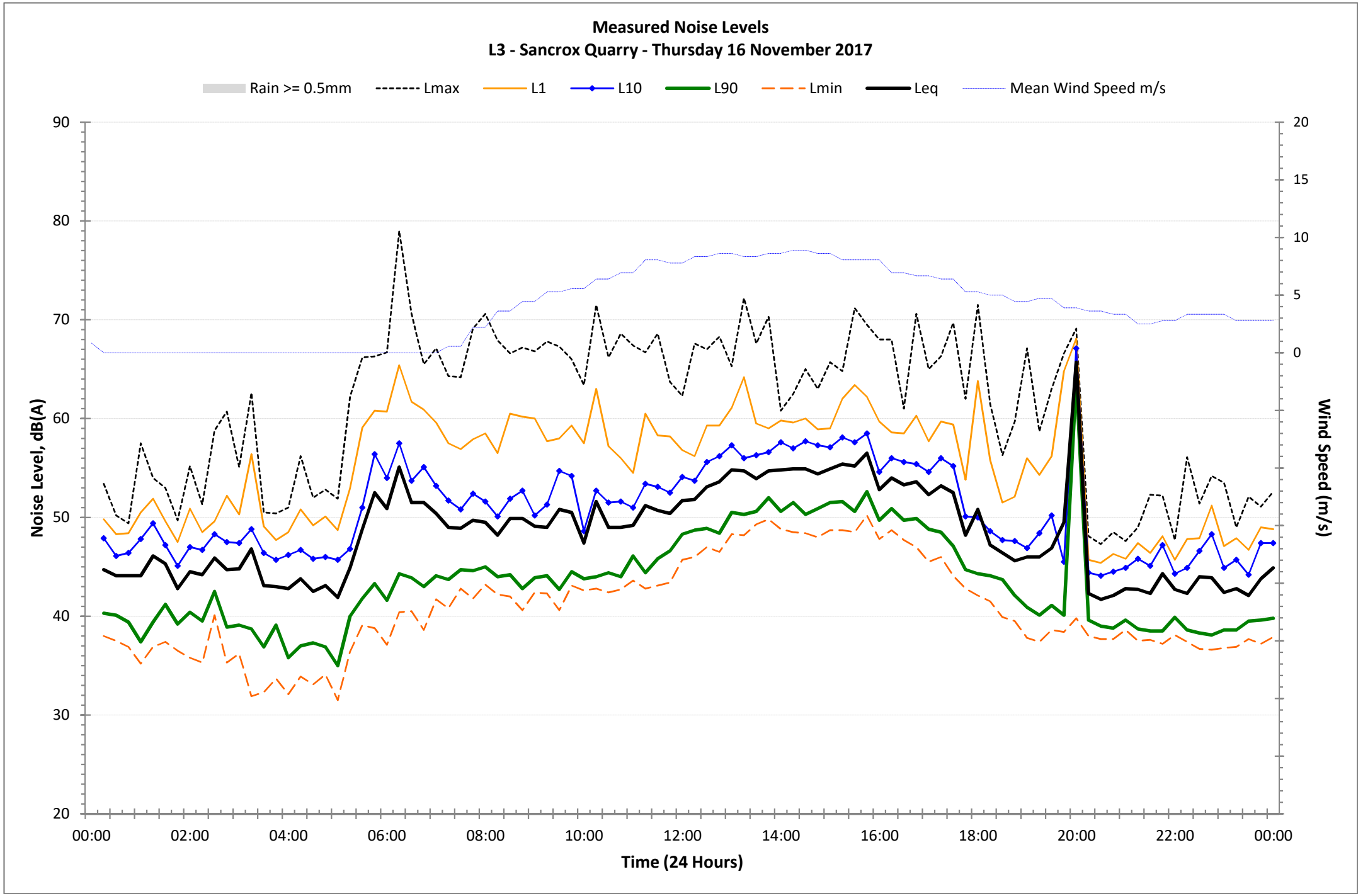
Measured Noise Levels
L3 - Sancrox Quarry - Thursday 16 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
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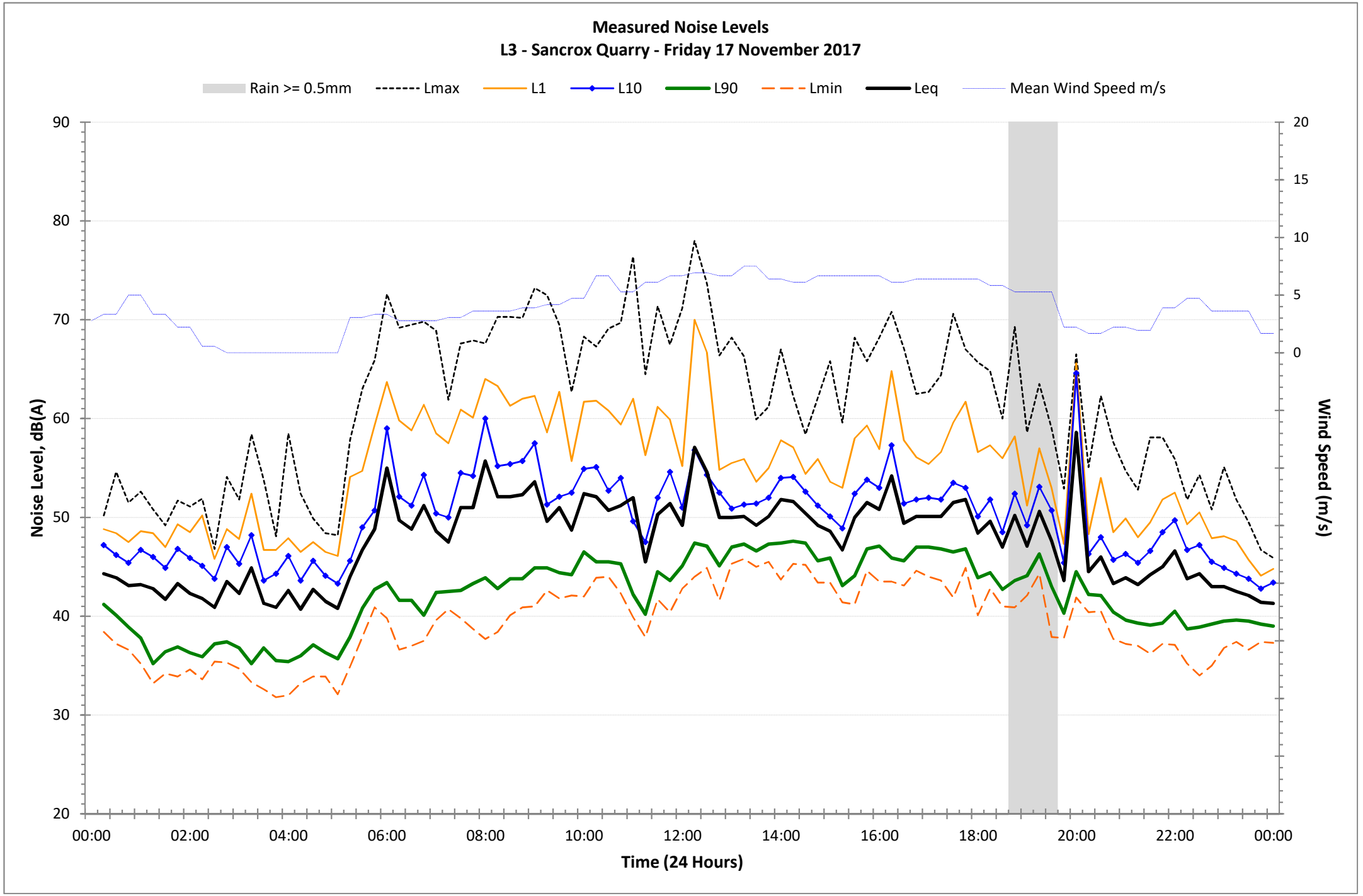
Measured Noise Levels
L3 - Sancrox Quarry - Friday 17 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
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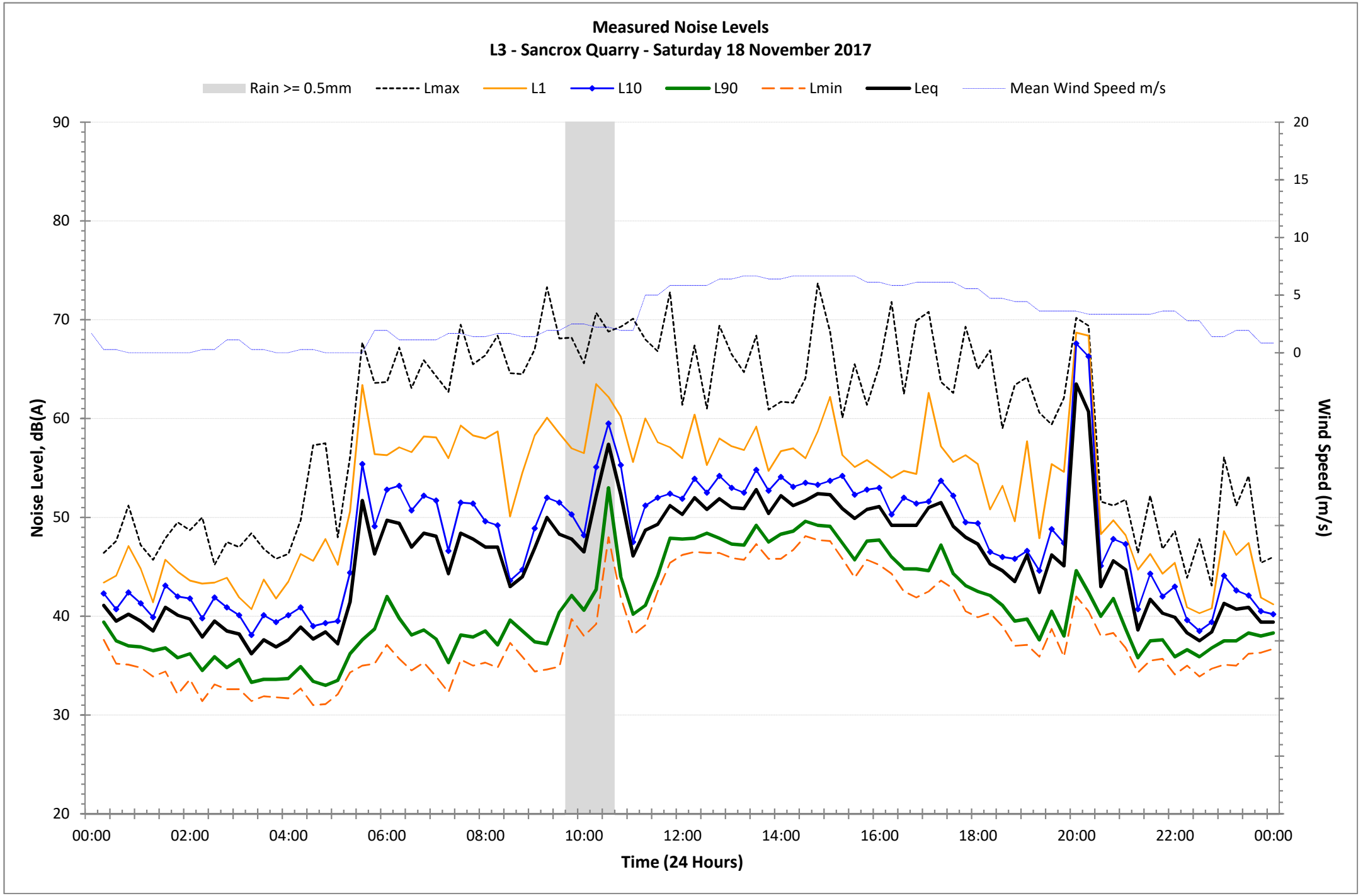
Measured Noise Levels
L3 - Sancrox Quarry - Saturday 18 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
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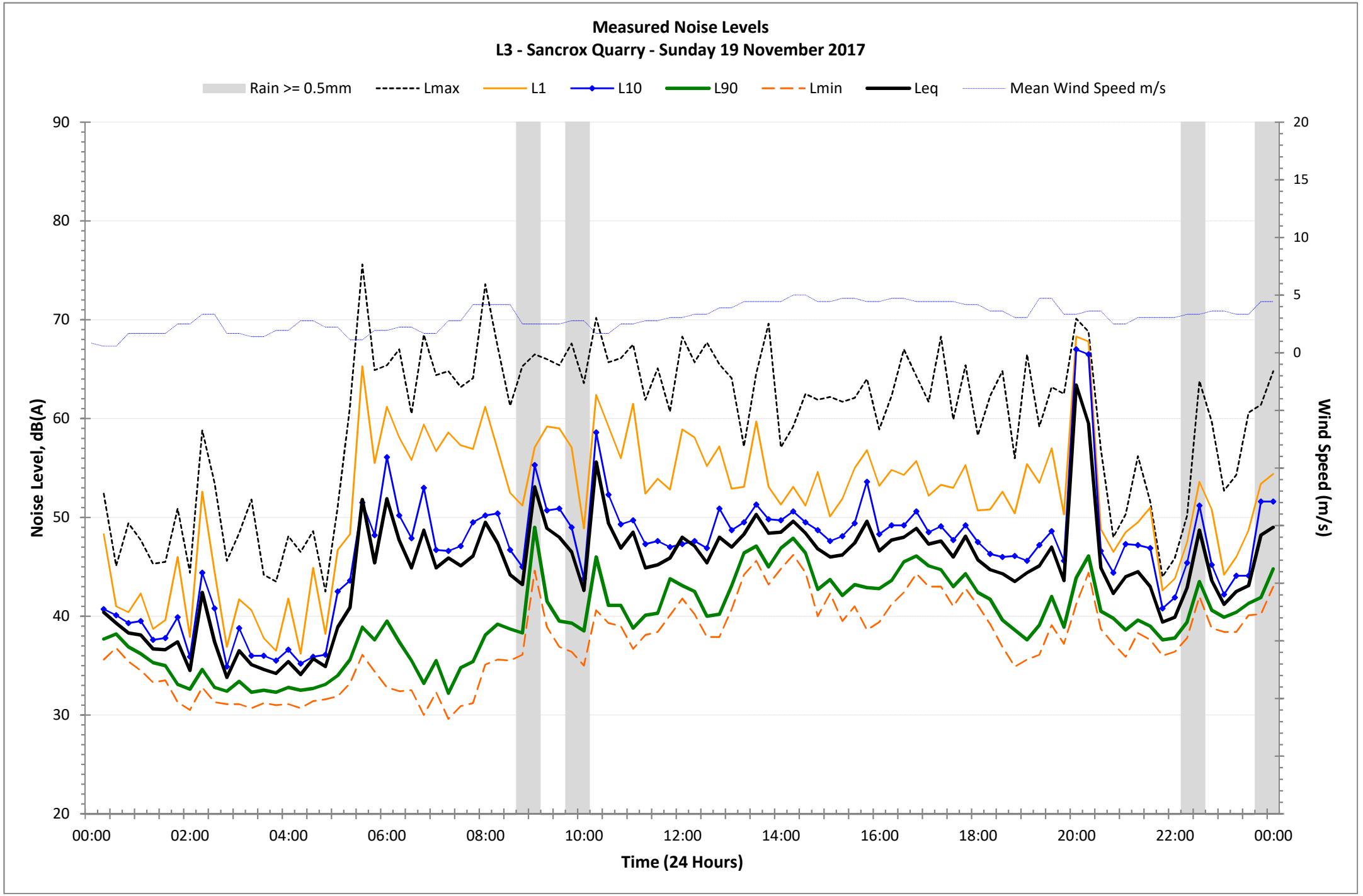
Measured Noise Levels
L3 - Sancrox Quarry - Sunday 19 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
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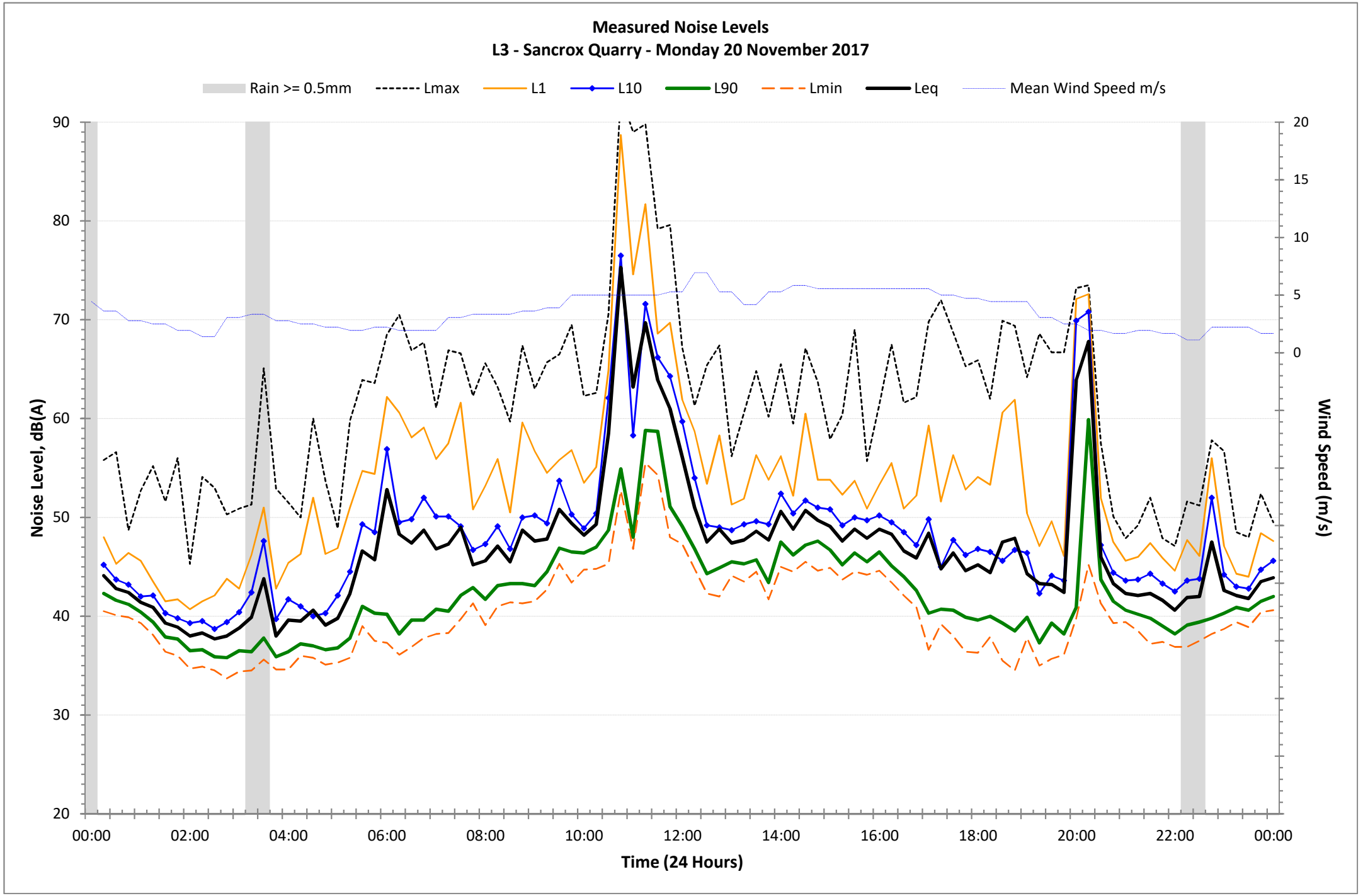
Measured Noise Levels
L3 - Sancrox Quarry - Monday 20 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
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02:00
04:00
06:00
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14:00
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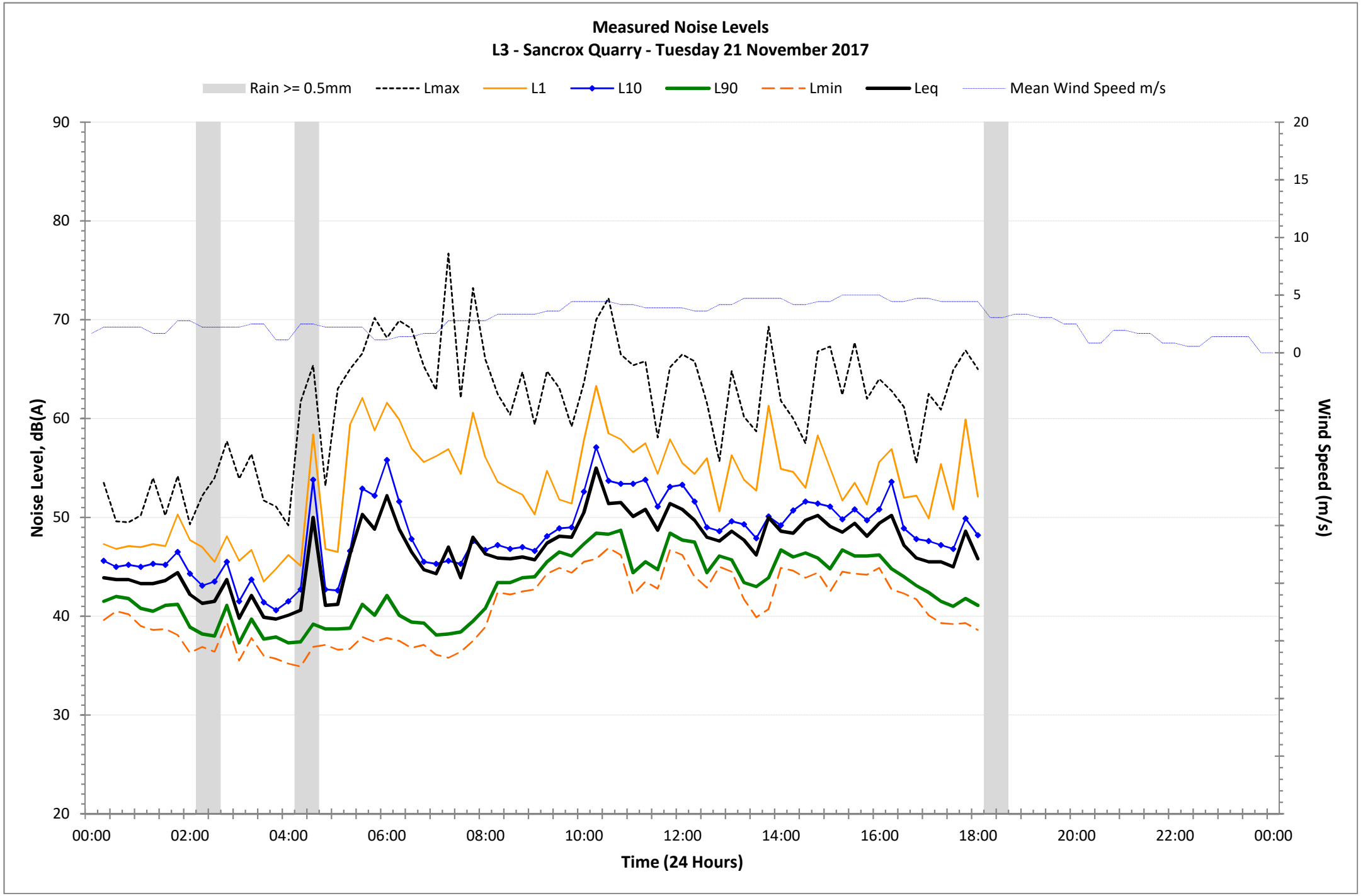
Measured Noise Levels
L3 - Sancrox Quarry - Tuesday 21 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
10
5
0
00:00
02:00
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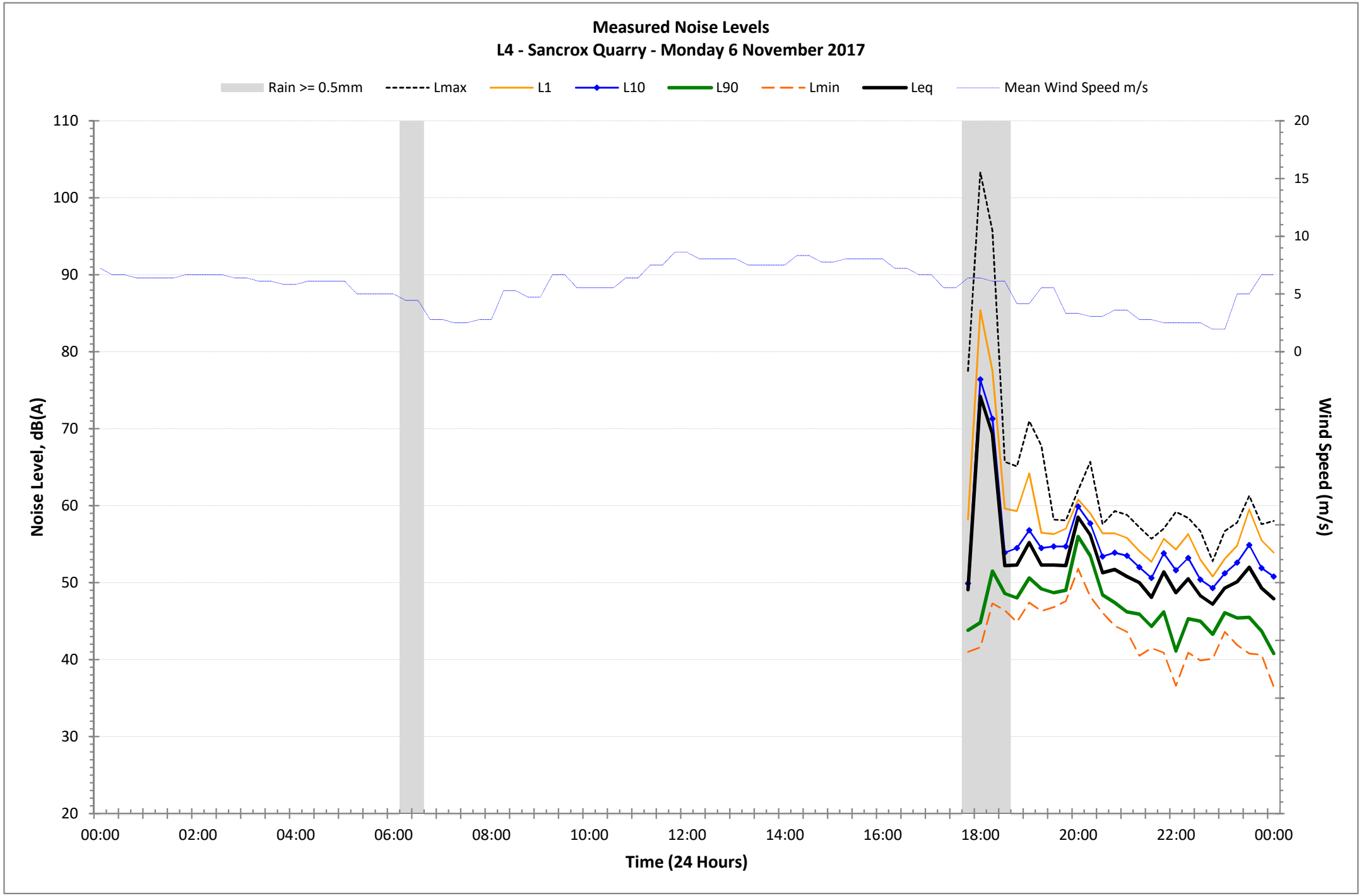
Measured Noise Levels
L4 - Sancrox Quarry - Monday 6 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
110
100
90
80
70
60
50
40
30
20
20
15
10
5
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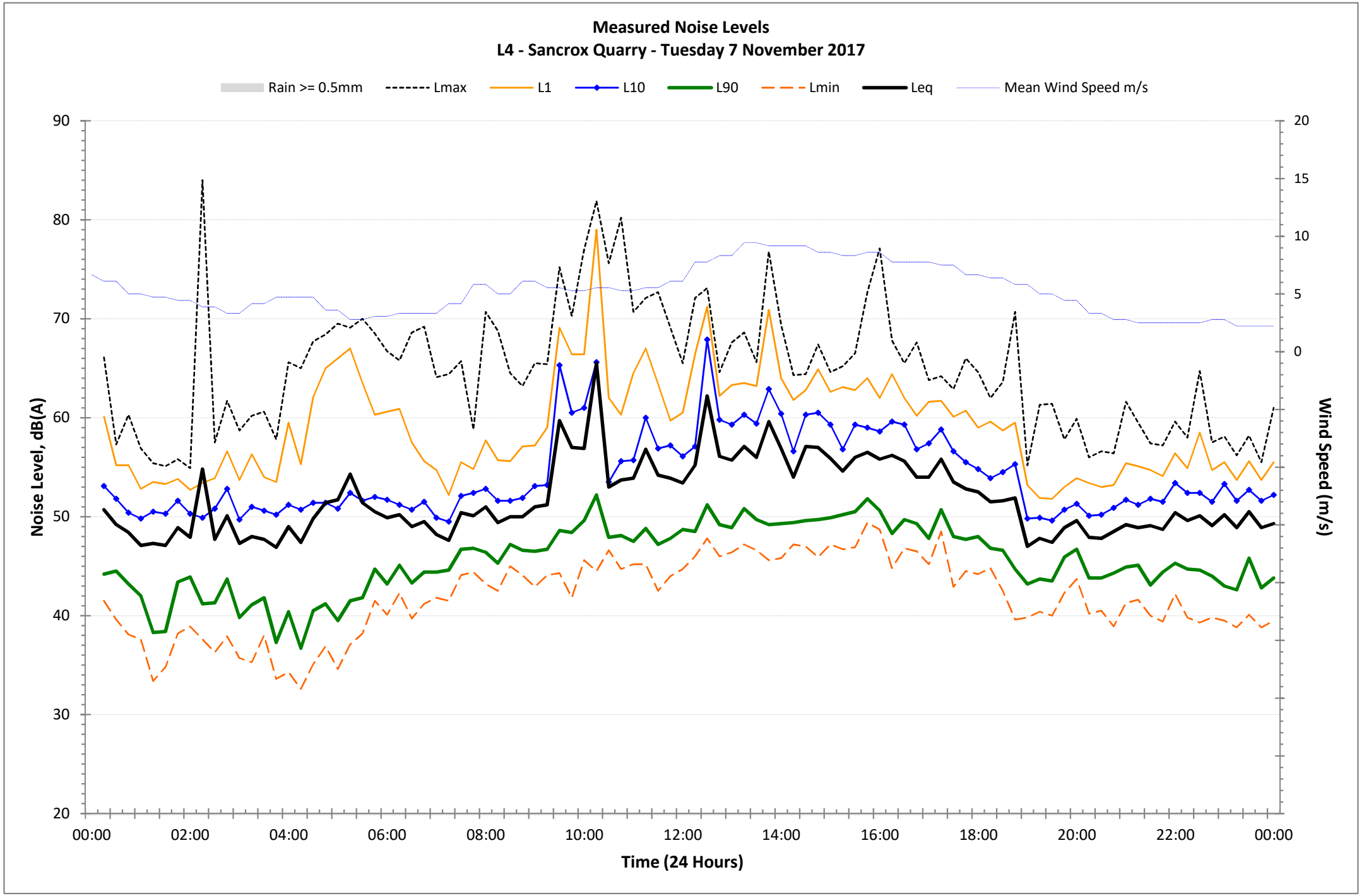
Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 7 November 2017
Rain >= 0.5mm
Lmax
L1
L10
L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
90
80
70
60
50
40
30
20
20
15
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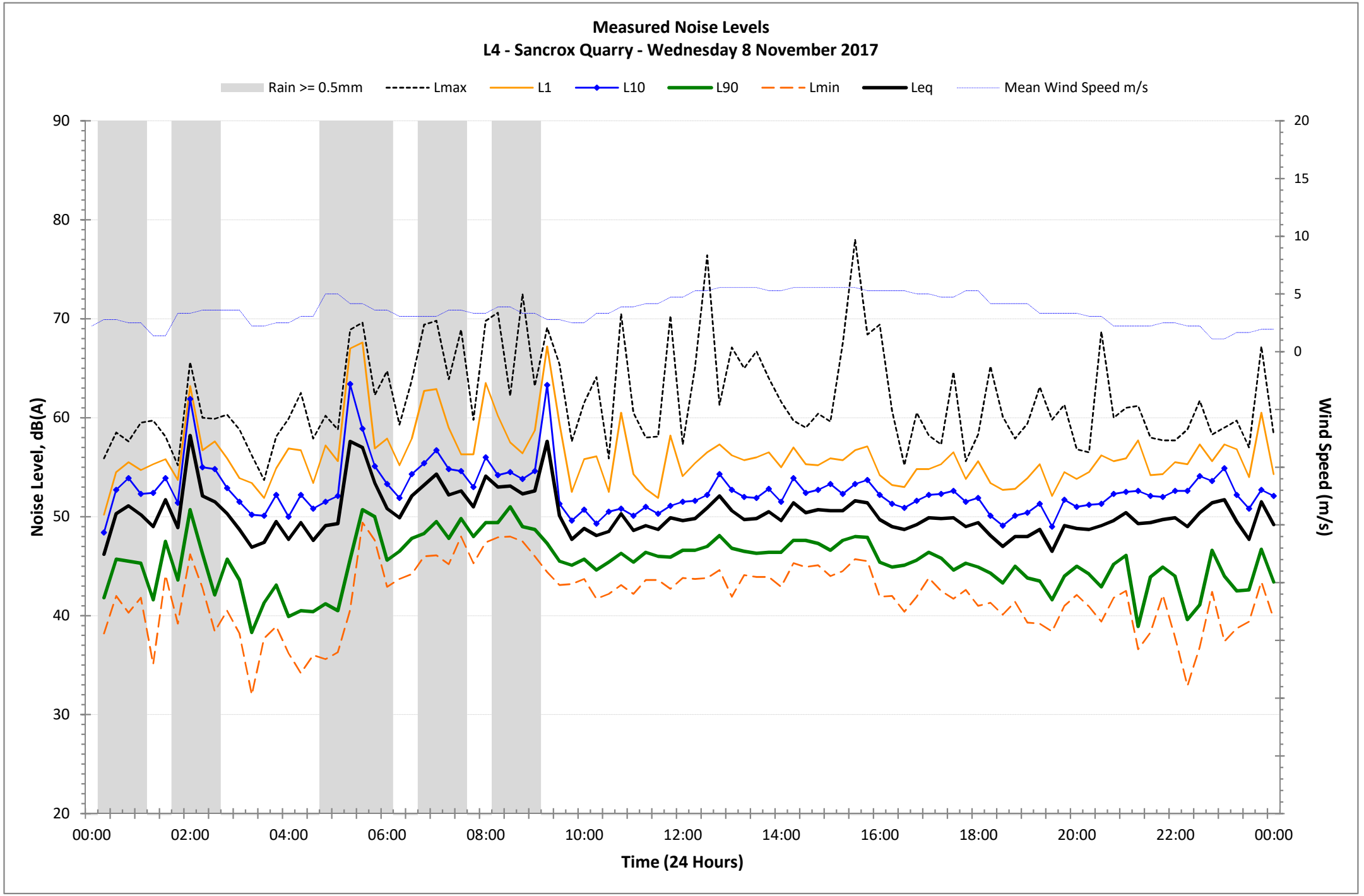
Measured Noise Levels
L4 - Sancrox Quarry - Wednesday 8 November 2017
Rain >= 0.5mm
Lmax
L1
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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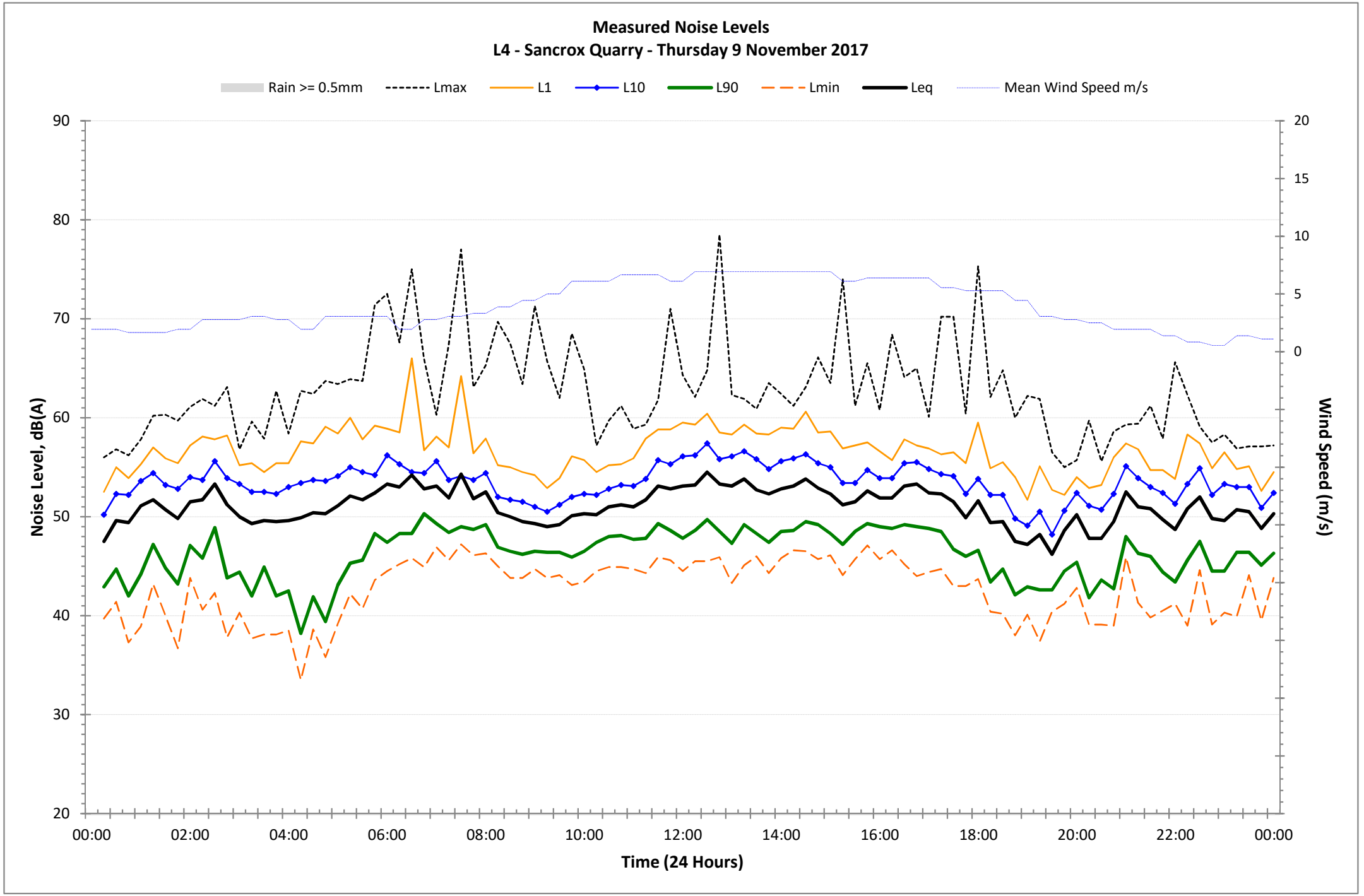
Measured Noise Levels
L4 - Sancrox Quarry - Thursday 9 November 2017
Rain >= 0.5mm
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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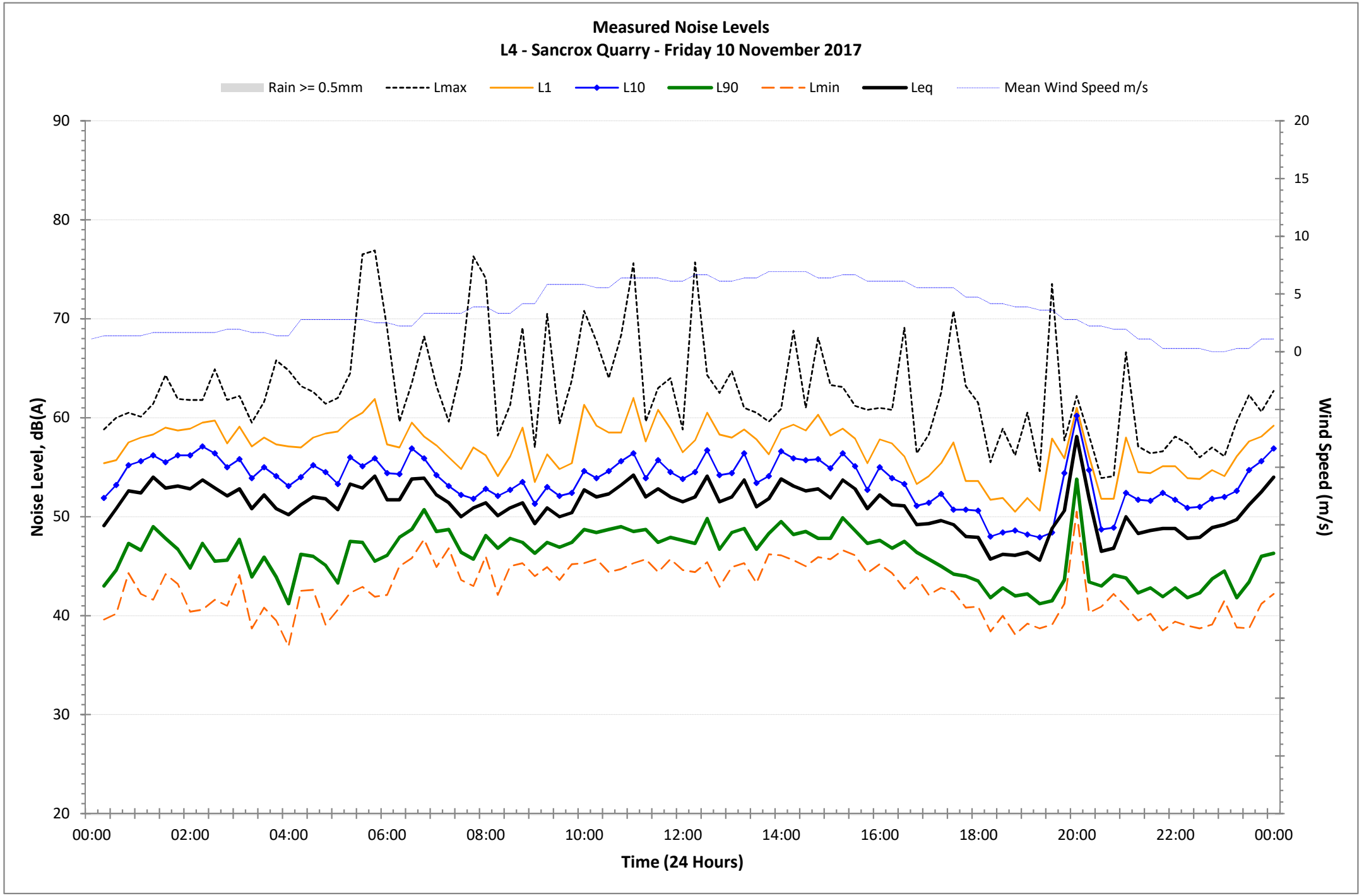
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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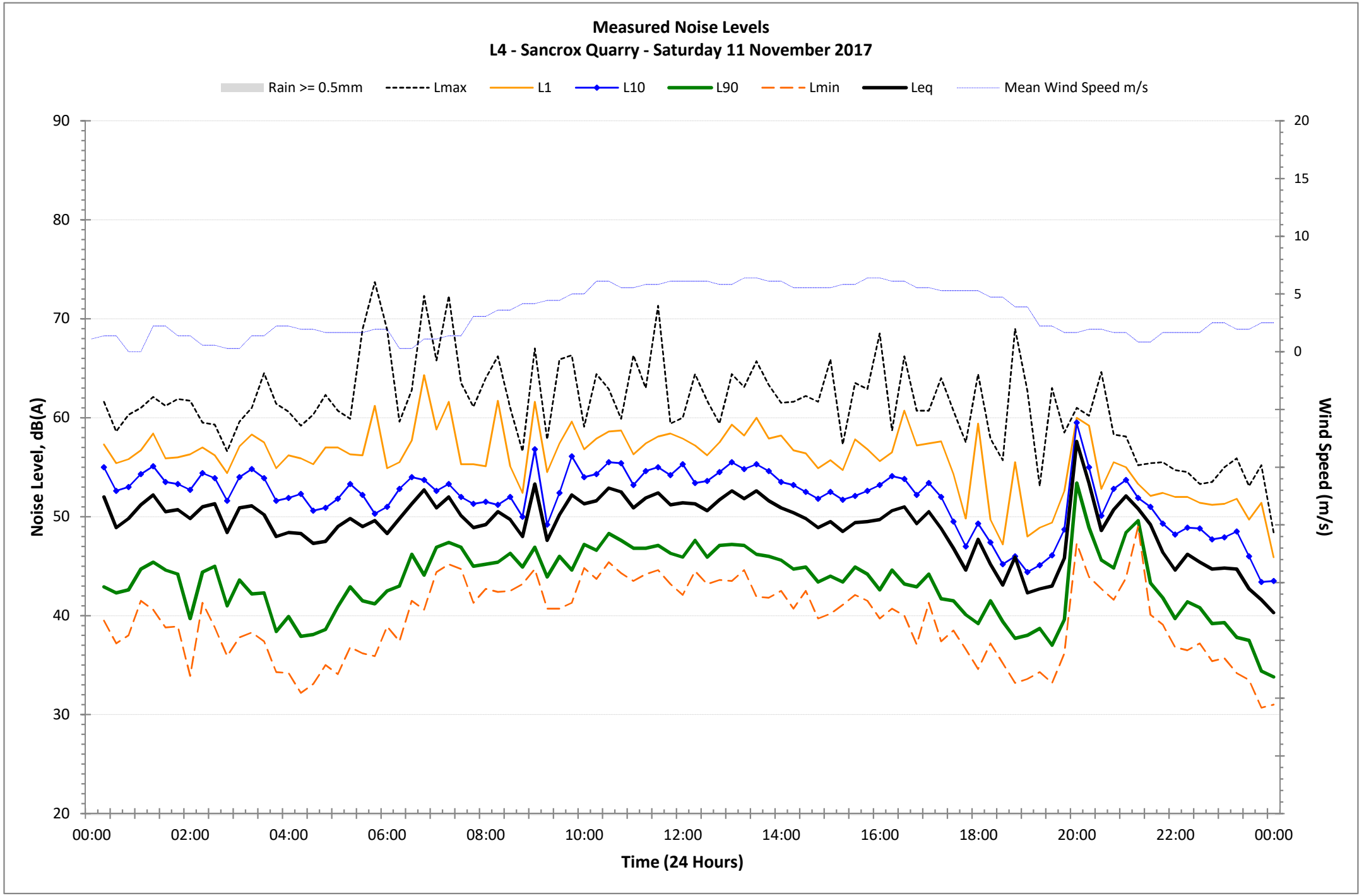
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Rain >= 0.5mm
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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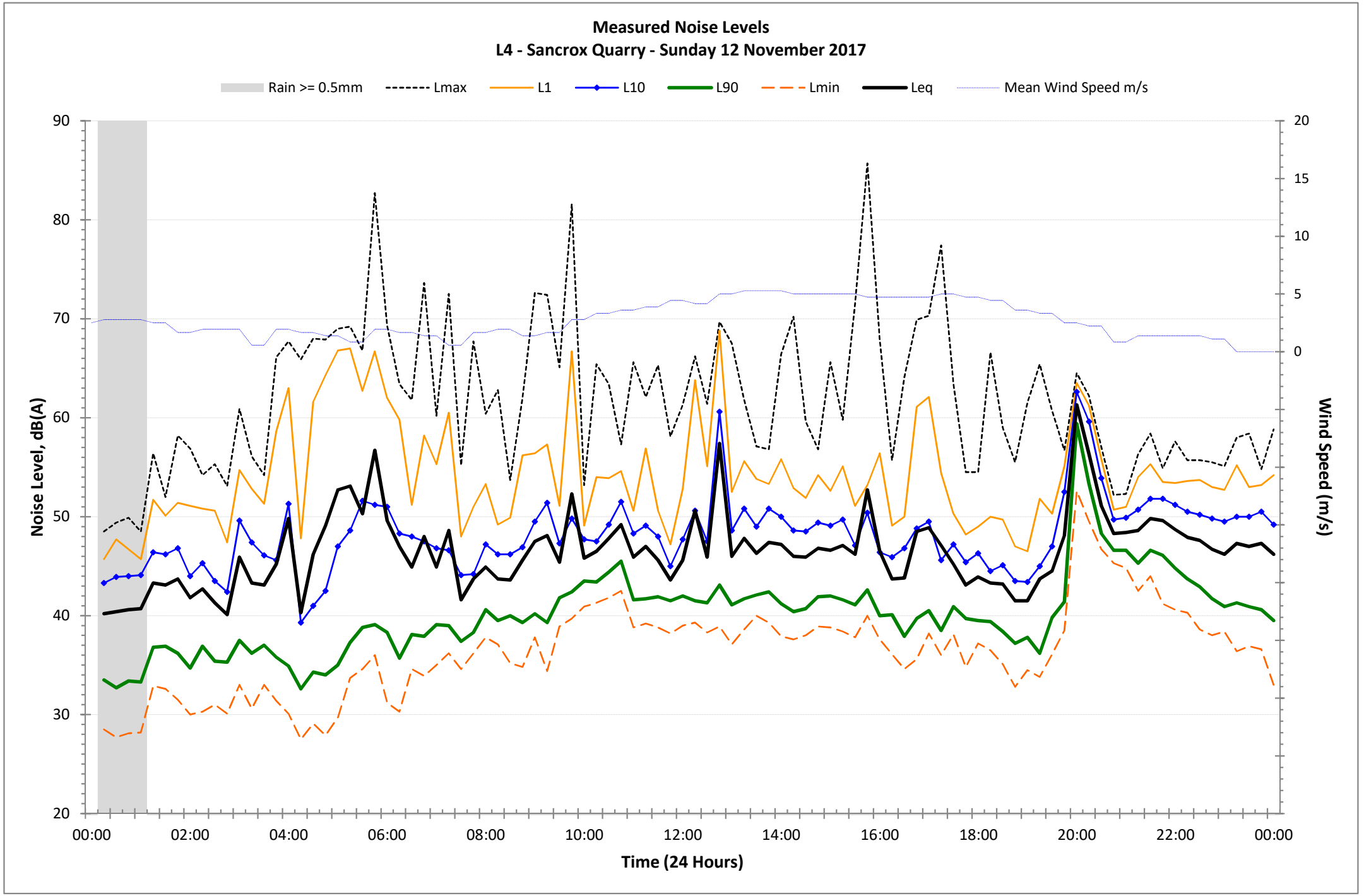
Measured Noise Levels
L4 - Sancrox Quarry - Sunday 12 November 2017
Rain >= 0.5mm
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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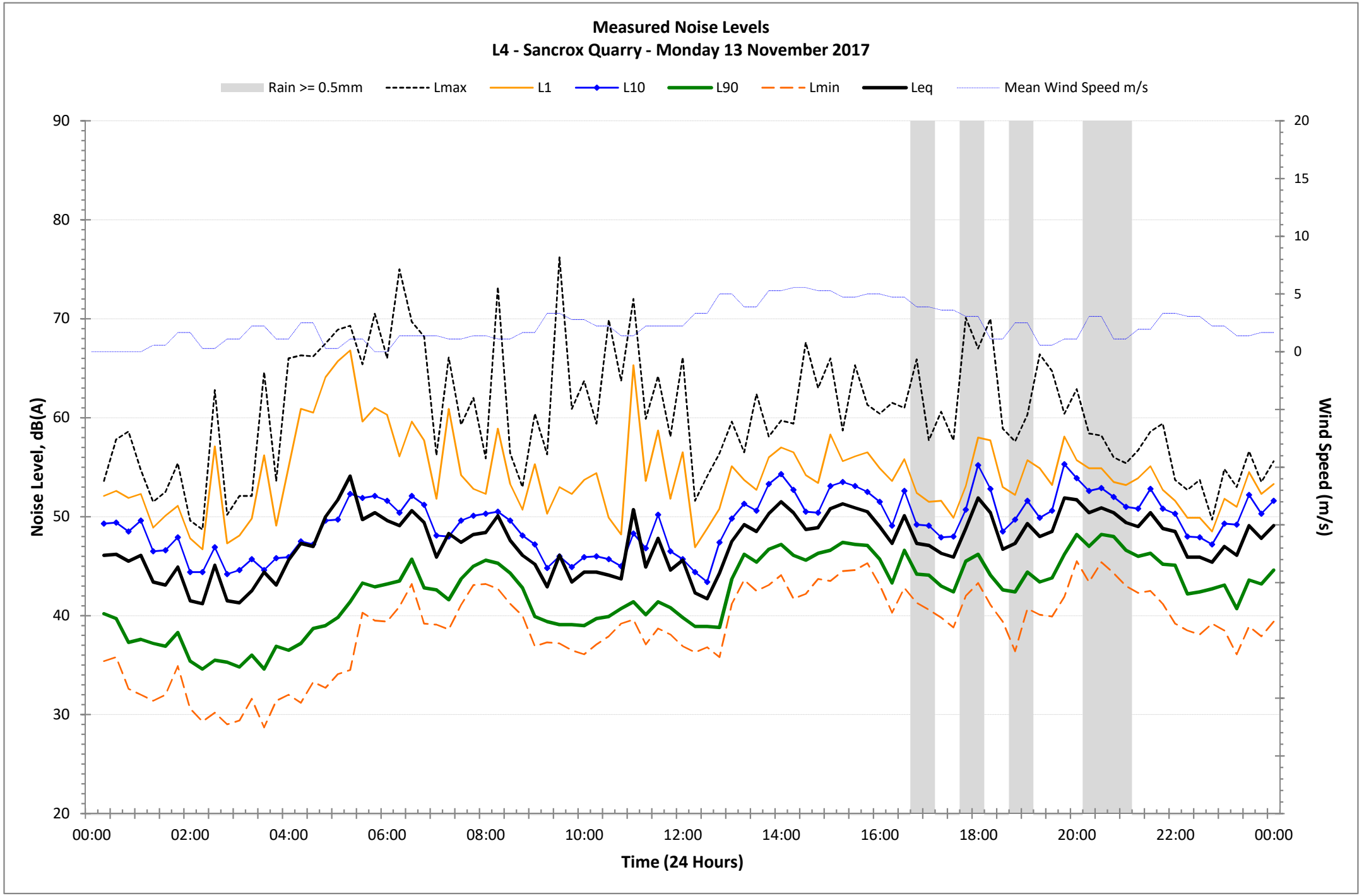
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L4 - Sancrox Quarry - Monday 13 November 2017
Rain >= 0.5mm
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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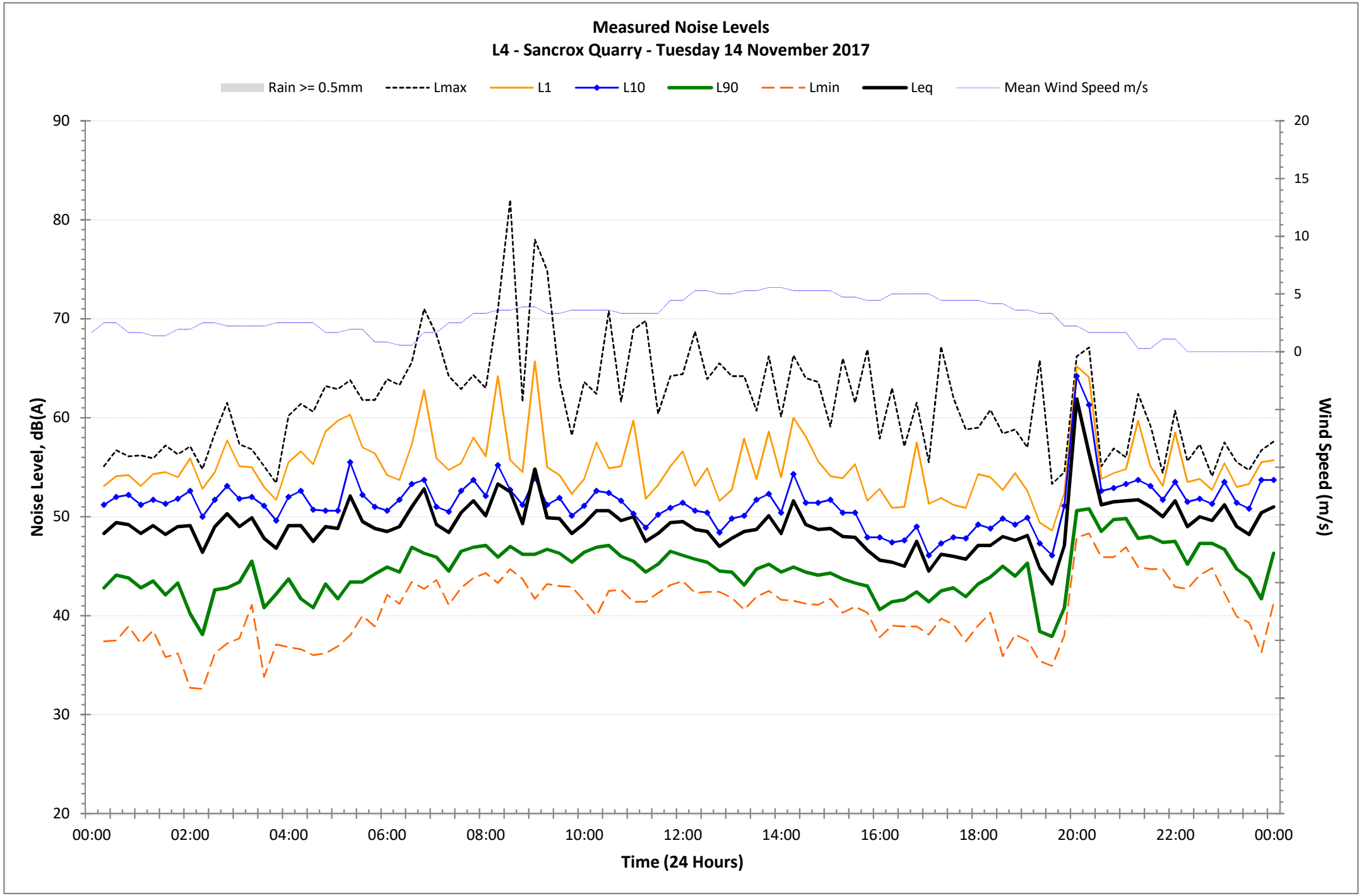
Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 14 November 2017
Rain >= 0.5mm
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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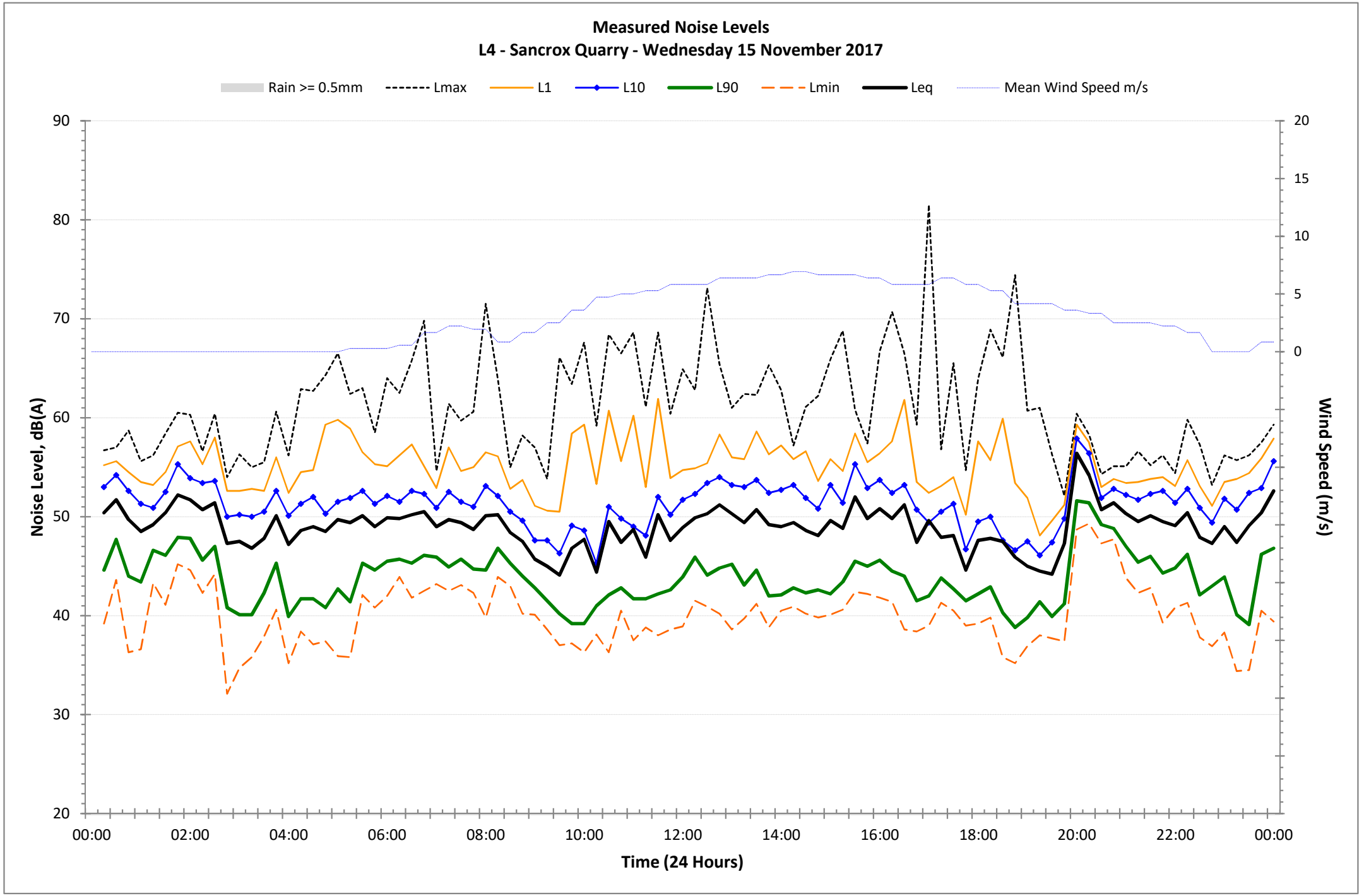
Measured Noise Levels
L4 - Sancrox Quarry - Wednesday 15 November 2017
Rain >= 0.5mm
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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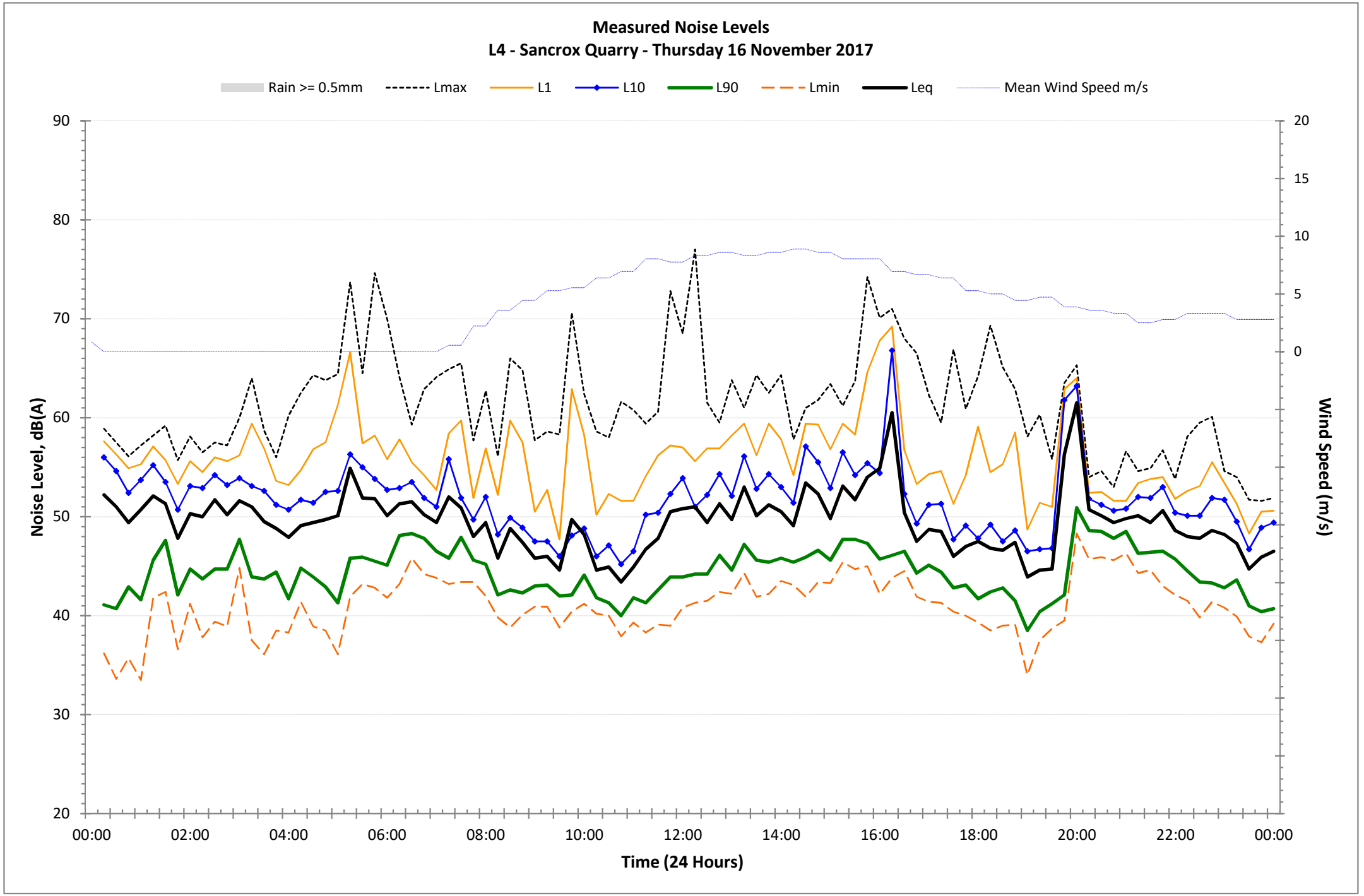
Measured Noise Levels
L4 - Sancrox Quarry - Thursday 16 November 2017
Rain >= 0.5mm
Lmax
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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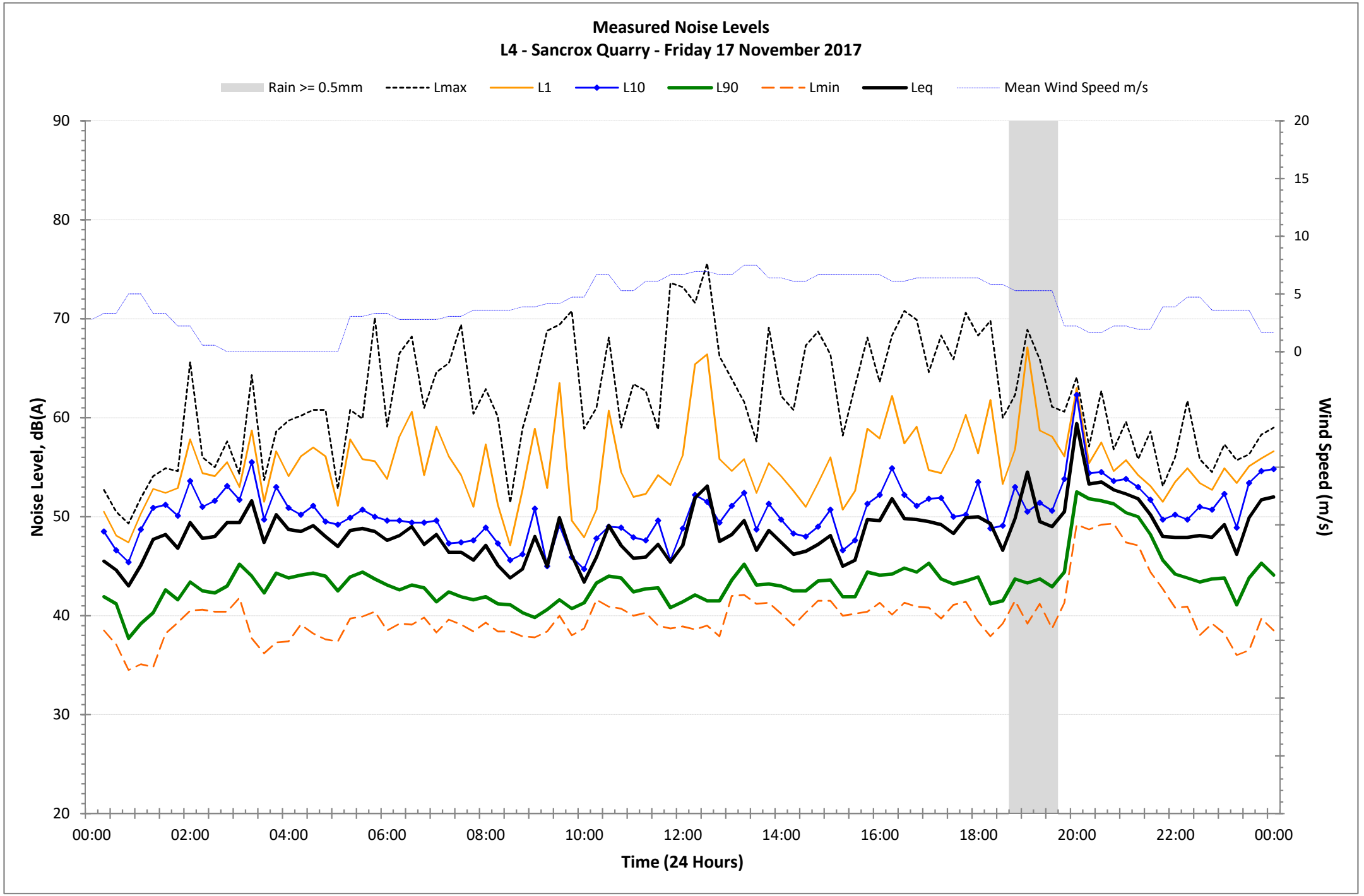
Measured Noise Levels
L4 - Sancrox Quarry - Friday 17 November 2017
Rain >= 0.5mm
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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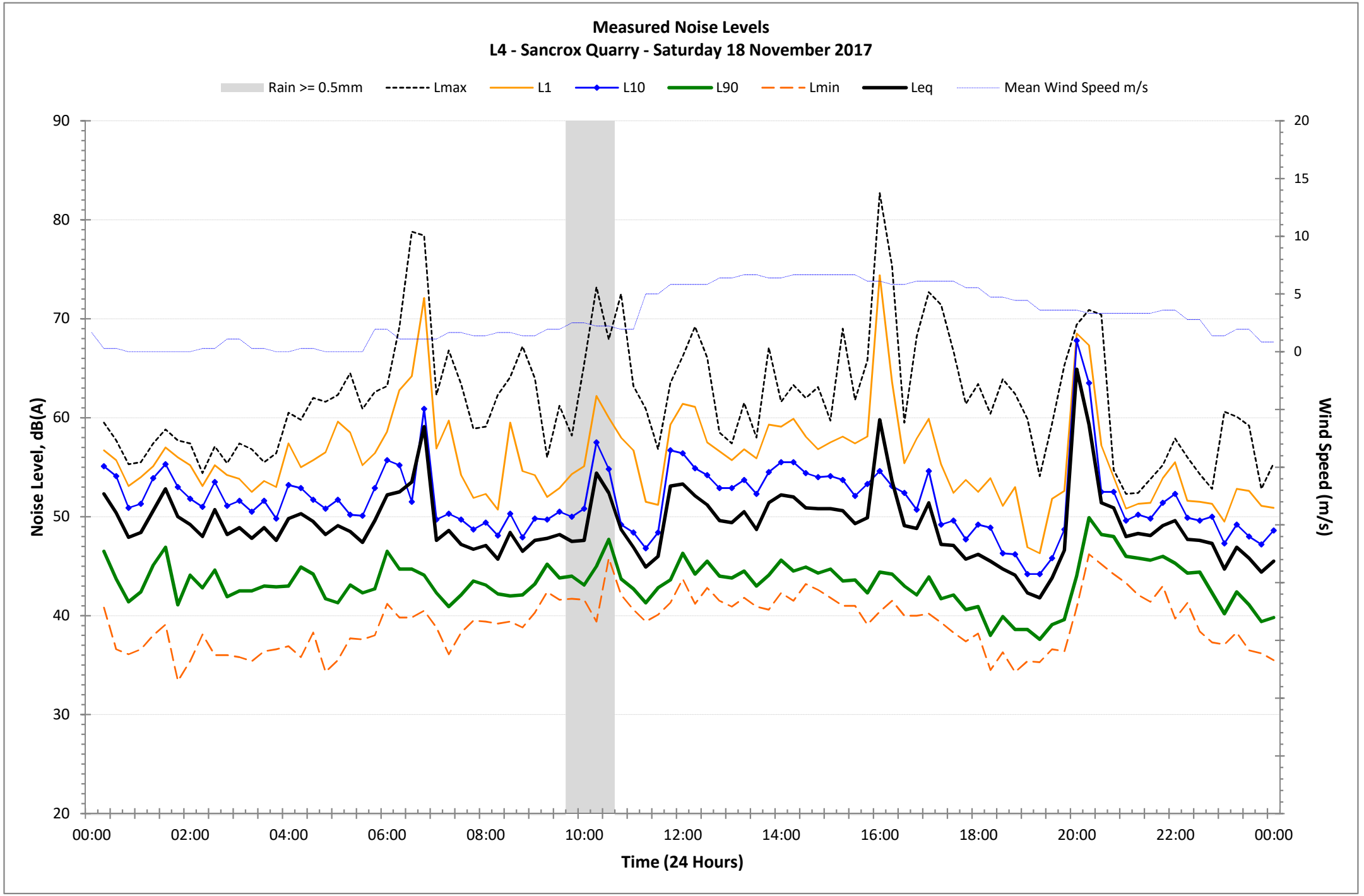
Measured Noise Levels
L4 - Sancrox Quarry - Saturday 18 November 2017
Rain >= 0.5mm
Lmax
L1
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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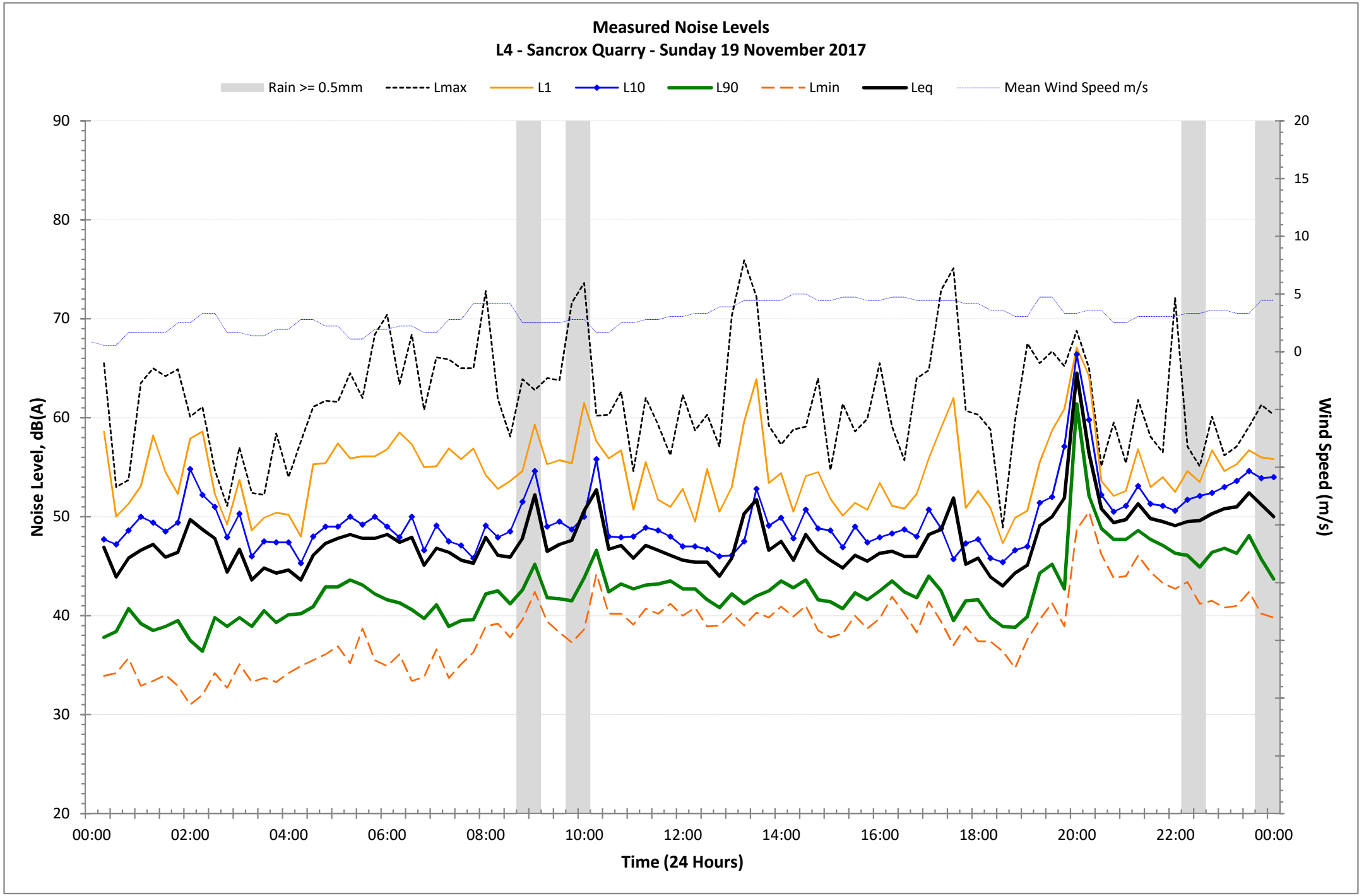
Measured Noise Levels
L4 - Sancrox Quarry - Sunday 19 November 2017
Rain >= 0.5mm
Lmax
L1
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Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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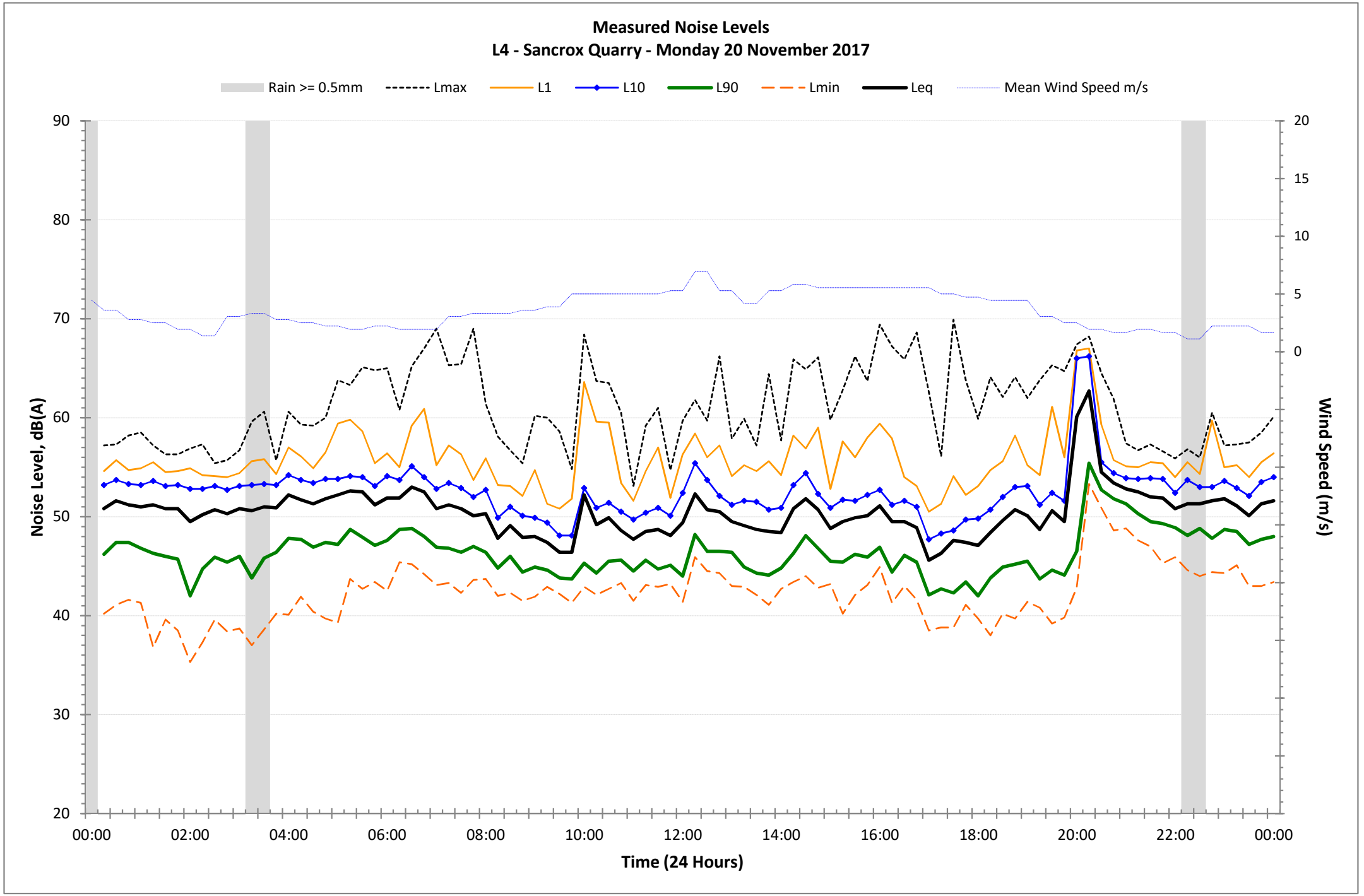
Measured Noise Levels
L4 - Sancrox Quarry - Monday 20 November 2017
Rain >= 0.5mm
Lmax
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Lmin
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Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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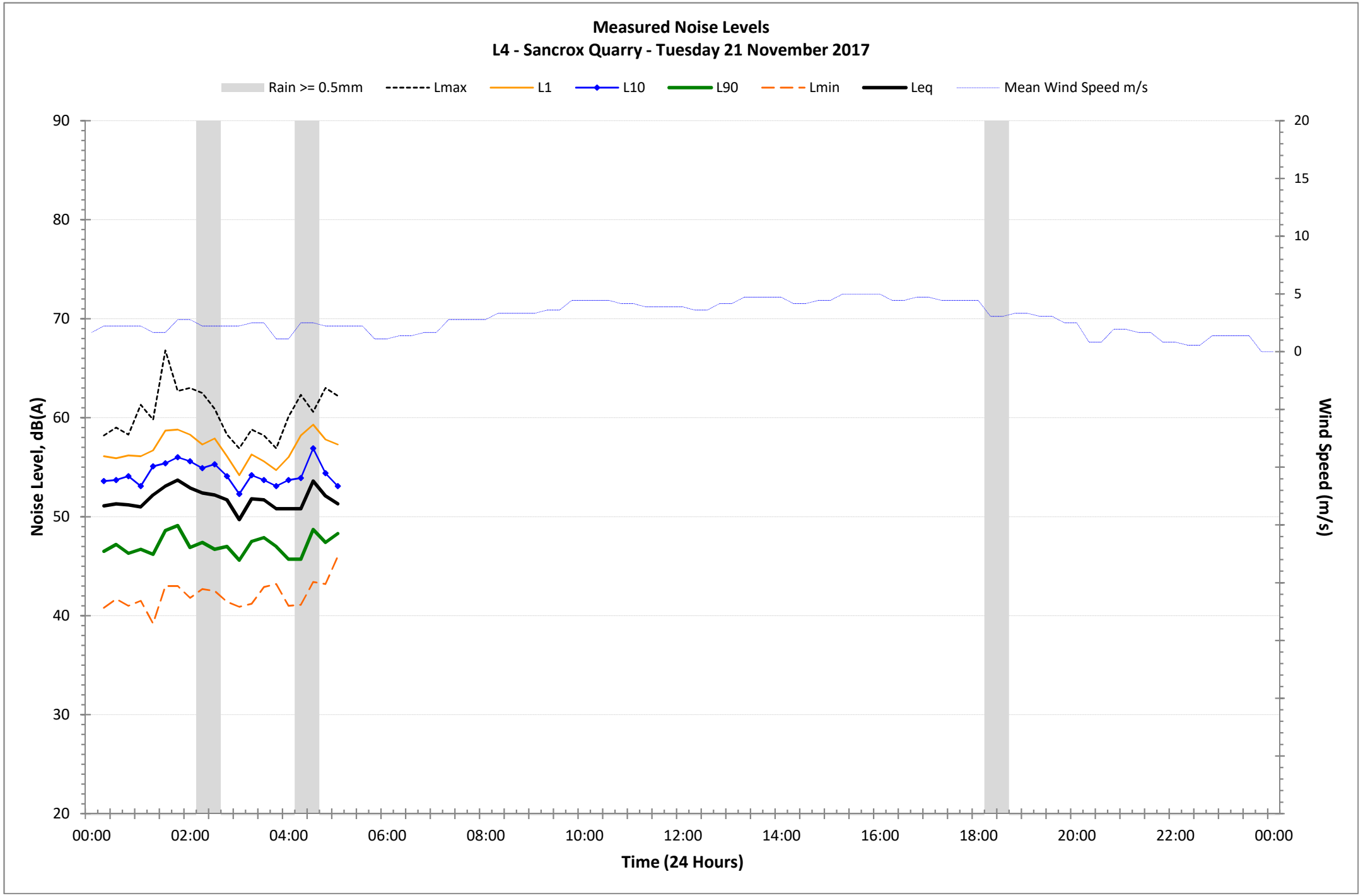
Measured Noise Levels
L4 - Sancrox Quarry - Tuesday 21 November 2017
Rain >= 0.5mm
Lmax
L1
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L90
Lmin
Leq
Mean Wind Speed m/s
Noise Level, dB(A)
Wind Speed (m/s)
Time (24 Hours)
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Annex H

Air Quality And Greenhouse Gas Impact Assessment

Air Quality and Greenhouse Gas Assessment Report

Sancrox Quarry Expansion Project

Hanson Construction Materials Pty Ltd

August 2019

0418291 Final

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Air Quality and Greenhouse Gas Assessment Report

Sancrox Quarry Expansion Project

Approved by:	*Thomas Buchan*
Position:	Project Manager
Signed:	
Date:	*28 August, 2019*
Approved by:	*Murray Curtis*
Position:	Partner Director
Signed:	
Date:	*28 August 2019*

28 August 2019

0418291_Final

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CONTENTS

EXECUTIVE SUMMARY

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by Hanson Construction Materials Pty Ltd (Hanson) to undertake specialist assessments to inform the Environmental Impact Statement (EIS) for the proposed Sancrox Quarry Extension Project (the 'Project').

The Project involves the following:

- *Extending the approved extraction boundary by approximately 52 hectares;*
- *Extending the quarry life by ten years (from 20 to 30 years);*
- *Increasing the production limit from 455,000 tonnes per annum (tpa) to 750,000 tpa;*
- *Constructing and operating a concrete batching plant producing 20,000m^3 per annum;*
- *Constructing and operating a concrete recycling facility processing 20,000 tpa;*
- *Increasing truck movements and equipment loading to 24 hours per day, 7 days per week;*
- *Increasing quarry operations to 24 hours per day, 7 days per week;*
- *Transporting material off-site via public roads; and*
- *Constructing and operating an asphalt plant producing 50,000 tpa.*

This Air Quality and GHG Assessment has been prepared in accordance with the latest version of Secretary's Environmental Assessment Requirements (SEARs) for the preparation of an EIS for the Sancrox Quarry Extension Project (Department of Planning and Environment, 2017) *and forms the air quality assessment for the EIS to be submitted to the NSW Department of Planning and Environment (DP&E). The following scope of works has been undertaken:*

- *Assessment of potential for ambient air quality impacts and greenhouse gas emissions from construction and operation of the Proposed Project;*
- *Provision of mitigation measures to minimise impacts to the surrounding land use; and*
- *Recommendations for ambient monitoring to ensure compliance with legislation.*

It should be noted that the estimation of GHG emissions from the Project was limited to Scope 1 and Scope 2 emissions.

The Project has the potential for ambient air quality impacts and greenhouse gas emissions from the construction and operation of the following:

Quarry, including:	*Concrete Batching Plant, including:*	*Concrete Recycling Plant, including:*	*Asphalt Plant, including:*
• *Drilling;* • *Blasting;* • *Product handling;* • *Rock processing;* • *Wheel generated dust; and* • *Wind generated dust.*	• *Dry product delivery;* • *Product storage;* • *Product transfer;* • *Pneumatic unloading of moist product;* • *Weight hopper and mixer unloading; and* • *Wheel generated dust.*	• *Product delivery;* • *Product storage;* • *Product handling;* • *Crushing, using primary crusher; and* • *Wheel generated dust.*	• *Bitumen delivery and storage;* • *High quality aggregate delivery and storage;* • *Dryer emissions;* • *Truck load out; and* • *Wheel generated dust.*

The primary emissions from the sources considered in this assessment are TSP, PM_{10}, $PM_{2.5}$ and deposited dust. Concrete batching and asphalt plants however have the potential to emit additional species. All potential species emitted to atmosphere from these sources were identified through consideration of published emission factor databases for these sources.

The criteria for all the emitted species were established through consideration of the following legislation and guidelines:

- *POEO Clean Air Regulation 2010* (New South Wales Government, 2017)*;*
- *Approved Methods for the Assessment of Air Pollutants in NSW* (State of NSW and Environment Protection Authority, 2016)*;*
- *National Environment Protection Measures* (Australian Government, 2016)*;*
- *Other international legislations:*
  - *Ontario Regulation 419/06: Air Pollution – Local Air Quality* (Government of Ontario, 2017)*;*
- *Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments* (NSW Government, 2018)*; and*
- *Protocol for Environmental Management: Mining and Extractive Industries* (Environment Protection Authority Victoria, 2007).

Initially, a screening assessment was undertaken for the species other than particulate matter, using the 'UK Air emissions risk assessment for your environmental permit' guidance (UK Guidance). The species that could not be screened out using the criteria provided in the UK Guidance were further considered through the use of atmospheric dispersion modelling.

Atmospheric dispersion modelling was undertaken using the California Puff (CALPUFF) dispersion model for the latest five year period (2012 to 2016 inclusive). The dispersion modelling was completed using site-specific meteorology predicted using a two-step process:

- *Prognostic modelling using TAPM (developed by CSIRO); and*
- *Diagnostic modelling using CALMET (the meteorological pre-processor for the CALPUFF dispersion model).*

The configuration of the emission sources within the CALPUFF dispersion model comprised a combination of volume, point and road sources.

The assessment of ambient air quality impacts identified that:

- *The cumulative annual mean concentrations of PM_{10} are below the Approved Methods criterion at all sensitive receptors;*
- *Contemporaneous analysis identified that the cumulative (background plus project contribution) PM_{10} 24-hour average predicted concentrations indicate exceedances of the Approved Methods Criterion at 13 sensitive receptors.*
    - *Where exceedance of the Approved Methods Criterion occurs, a State Significant extractive development may be assessed against the criteria contained in the Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments* (NSW Government, 2018). *Impacts predicted for the Project demonstrate an acceptable level of PM_{10} 24 hour concentrations under the Policy;*
- *The cumulative annual mean concentrations of $PM_{2.5}$ are below the Approved Methods criterion at all sensitive receptors;*
- *Contemporaneous analysis of the $PM_{2.5}$ 24-hour average predicted concentrations are below the Approved Methods Criterion at all sensitive receptors;*
- *The predicted concentrations for all other species are below the adopted criteria at all sensitive receptor locations.*

The Project over its entire life cycle is estimated to release approximately 48.4 million tonnes of CO_2-e into the atmosphere with scope 1 and scope 2 emissions accounting for 74% and 26% respectively of the total emissions. The main GHG emission sources over the life of the project representing 99% of all emissions are:

- *Operations – Diesel for transport related purposes (38%)*

- *Operations – Electricity (26%)*
- *Operations – LNG (16%)*
- *Construction – Vegetation clearing (12%)*
- *Operations – Diesel for stationary energy purposes (6%)*

Peak Scope 1 and Scope 2 emissions from the Project (approximately 0.0054 Mt CO_2-e during Year 7/Year8) represent approximately 0.0010% of Australia's commitment for annual emissions under the Kyoto Protocol (550.2 Mt CO2-e/annum for 2016-17). In comparison to the 2015 GHG emissions in NSW, the project emissions account for approximately 0.0041%. When compared to the 2015 GHG emission levels from all Mining sources in Australia (74.5 Mt CO_2-e), the Project accounts to 0.0073%.

This air quality impact assessment considered all reasonable and feasible mitigation measures to minimise the emissions from the proposed activities at the site, including:

- *Roads, which are likely to remain unchanged throughout the Project stages and to be frequently used by machinery, will be sealed using asphalt and swept daily to minimise wheel-generated dust emissions;*
- *Full dust extraction system for drilling;*
- *Utilisation of water sprays during truck rear dumping;*
- *The use of mobile sprinkler systems during the operation of FELs;*
- *Dust suppression measures such as water sprays in place at the crushers and screeners;*
- *Water sprays used on all conveyor transfer points;*
- *The conveyor loading to be enclosed by a shroud;*
- *Level 2 watering (more than 2 litres/m^2/hour) applied to unsealed roads to minimise impact from hauling;*
- *Water sprays to be utilised to minimise wind erosion from stockpiles during wind speeds of over 5.4 metres per second;*
- *The dry product delivered to the concrete batching, concrete recycling and asphalt plants to be stored in aggregate storage bins enclosed on three sides. The walls to extend one metre above the height of the maximum quantity of raw material, and two metre beyond the front of the stockpile. The aggregate storage bins to be fitted with water sprays to keep the stored material damp at all times;*
- *Cement and cement supplement to be delivered to the concrete batching plant in the agitator trucks and pneumatically fed to the bottom-loaded silos;*

- *Concrete batching loading point to be totally enclosed with all particulate matter emissions generated by the facility captured by one bag filter located above the pan mixer;*

- *Concrete recycling facility outloading to be directly to processed material storage bins enclosed on three sides. The walls to extend one metre above the height of the maximum quantity of raw material, and two metre beyond the front of the stockpile. The recycled concrete storage bins to be fitted with water sprays to keep the stored material damp at all times;*

- *Vapour balancing system to be installed for the delivery of bitumen at the asphalt plant;*

- *Asphalt plant will be totally enclosed. All particulate matter emissions generated at the plant will be captured by one fabric filter associated with the natural-gas fired dryer; and*

- *Vapour recovery system to be employed for transfer of asphalt to trucks.*

It is recommended that the Site additionally employs real-time ambient air quality monitoring system. This will allow staff to identify when additional mitigation measures are to be implemented to minimise impact from the onsite activities on days when the background concentrations of PM_{10} and $PM_{2.5}$ exceed the criteria set by the Approved Methods.

1 INTRODUCTION

1.1 BACKGROUND

Environmental Resources Management Australia Pty Ltd (ERM) has been commissioned by Hanson Construction Materials Pty Ltd (Hanson) to undertake specialist assessments to inform the Environmental Impact Statement (EIS) for the proposed Sancrox Quarry Extension Project (the 'Proposed Project'). The site is located on Lot 2 DP 574308, Lot 353 DP 754434, Lot 1 DP 704890 and Lot 1 DP 720807, Sancrox Road, Sancrox, 8km west of Port Macquarie, within the Port Macquarie Hastings Council (PMHC) Local Government Area (LGA) on the Mid North Coast of New South Wales (NSW).

Current operations at the site primarily include the extraction and crushing of high quality aggregate materials (rhyolite) for concrete and asphalt, sealing aggregates, road bases and select fill to both the private and government sectors. Current extraction rate at the site is 455,000 tonnes per annum (tpa), which has been approved for a period of up to five years to service planned upgrades to the Pacific Highway.

The Project involves the following:

- Extending the approved extraction boundary by approximately 52 hectares;
- Extending the quarry life by ten years (from 20 to 30 years);
- Increasing the production limit from 455,000 tpa to 750,000 tpa;
- Constructing and operating a concrete batching plant producing 20,000m^3 per annum;
- Constructing and operating a concrete recycling facility processing 20,000 tpa;
- Increasing truck movements and equipment loading to 24 hours per day, 7 days per week;
- Increasing quarry operations to 24 hours per day, 7 days per week;
- Transporting material off-site via public roads; and
- Constructing and operating an asphalt plant producing 50,000 tpa.

This report forms the Air Quality and Greenhouse Gas (GHG) Assessment for the EIS to be submitted to the NSW Department of Planning and Environment (DP&E).

1.2 SECRETARY ENVIRONMENTAL ASSESSMENT REQUIREMENTS (SEARS)

This Air Quality and GHG Assessment has been prepared in accordance with the latest version of SEARs for the preparation of an EIS for the Sancrox Quarry Extension Project (Department of Planning and Environment, 2017). In relation to air quality the following has been required:

- *A detailed assessment of potential construction and operational impacts, in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (State of NSW and Environment Protection Authority, 2016), *and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}, and having regard to the Voluntary Land Acquisition and Mitigation Policy* (NSW Government, 2018);

- *An assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products;*

- *Reasonable and feasible mitigation measures to minimise dust and emissions; and*

- *Monitoring and management measures, in particular, real-time air quality monitoring.*

1.3 SCOPE OF WORKS

To address the SEARs for the preparation of an EIS for the Sancrox Quarry Extension Project (Department of Planning and Environment, 2017), ERM undertook the following scope of works:

The scope of works for the Air Quality Assessment is as follows:

- Assessment of potential for ambient air quality impacts and greenhouse gas emissions from construction and operation of the Proposed Project;

- Provision of mitigation measures to minimise impacts to the surrounding land use; and

- Recommendations for ambient monitoring to ensure compliance with legislations.

It should be noted that as the SEARs provide no specific guidance in relation to reporting of GHG emissions for EIS purposes, the estimation of GHG emissions from the Project was limited to Scope 1 (direct emissions) and Scope 2 (emissions associated with production of electricity consumed) emissions, in line with the requirements of National Greenhouse and Energy Reporting Act 2007 (Commonwealth of Australia, 2007) (please refer to *Section 5* of the Assessment for details).

2 SITE AND PROCESS DESCRIPTION

2.1 SITE LOCATION

The Proposed Project is located on Sancrox Road, Sancrox, approximately 8km west of Port Macquarie, within the PMHC LGA on the NSW Mid North Coast (refer *Figure 2.1*) (the site). Access to the site is gained via a sealed road which runs off Sancrox Road located to the southeast of the site. The total area of the Project is approximately 52 hectares. The closest residences to the site are located approximately 50m to the western boundary and 130 metres to the northern boundary of the Site.

2.1.1 Site Layout

The building west of the main access road serves as the site office and staff amenities block. A workshop and materials storage shed is located next to the site office. The weighbridge is also located on the access road near the site office.

The processing plant is proposed to be relocated approximately 300 metres south-west of the current location. A new stockpile area is proposed to be located to the west of the new processing plant location. A concrete recycling facility is proposed to be located immediately west of the new processing plant location and immediately east of the new stockpile area. Concrete batching facility is proposed to be located to the north of the old processing plant location, and asphalt plant is proposed to be located to the east of the new processing plant location.

It is proposed that roads, which are likely to remain unchanged throughout the stages of the Project and to be frequently used by machinery, are sealed using asphalt and swept daily to minimise wheel-generated dust emissions. *Figure 2.2* presents the site layout and outlines both sealed and unsealed roads.

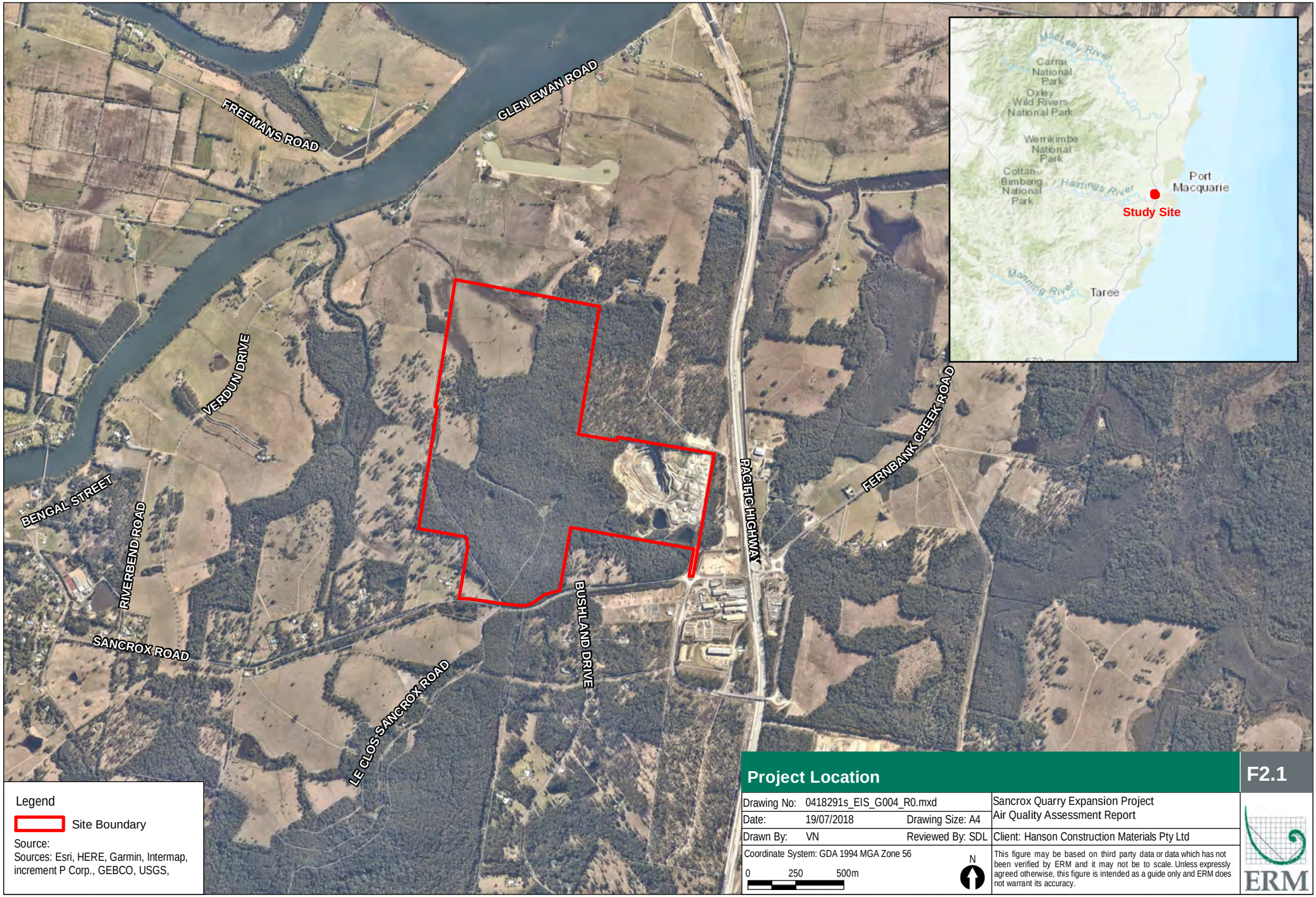
2.1.2 Quarry Staging

It is proposed that the quarry operations are expanded in five stages over a 10 year period. The five stages of the quarry expansion are provided in *Figure 2.3*, and may be described as follows:

- Stage 1 will involve the expansion of the western side of the quarry into the uncleared area, to a limit of RL-14.;
- Stage 2 will further expand the existing pit to the west to the previous extraction limit of RL-14;
- Stage 3 works include the widening and deepening of the benches towards the western extraction boundary. The quarry pit floor will be lowered from RL – 14 (AHD) to RL - 40m (AHD);

- Stage 4 works involve additional expansion of operations through the western side of the quarry to the approved boundary, and to the extraction depth proposed within Stage 3 works (i.e. RL-40); and

- Stage 5 will expand the quarry along the southern extraction boundary to a depth of RL-40.



Legend

Site Boundary

Source:
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS,

Project Location

F2.1

Drawing No:	0418291s_EIS_G004_R0.mxd		Sancrox Quarry Expansion Project Air Quality Assessment Report
Date:	19/07/2018	Drawing Size: A4	
Drawn By:	VN	Reviewed By: SDL	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 250 500m

N

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Site Layout

F 2.2

Drawing No:	0418291m_HRA_G001_R1.mxd		Sancrox Quarry Expansion Project
Date:	19/07/2018	Drawing Size: A4	
Drawn By:	LT	Reviewed By: ME	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

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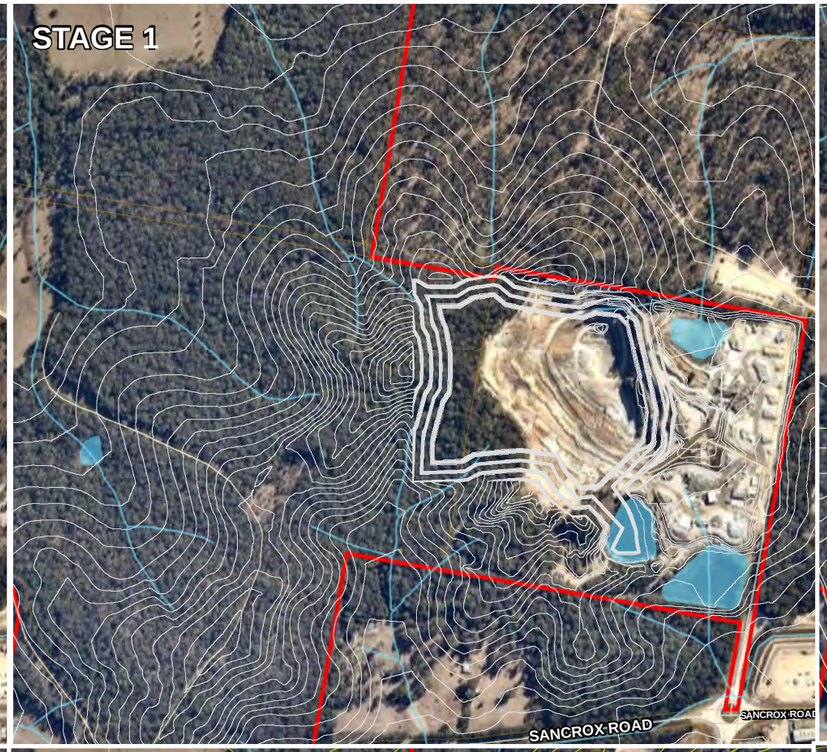

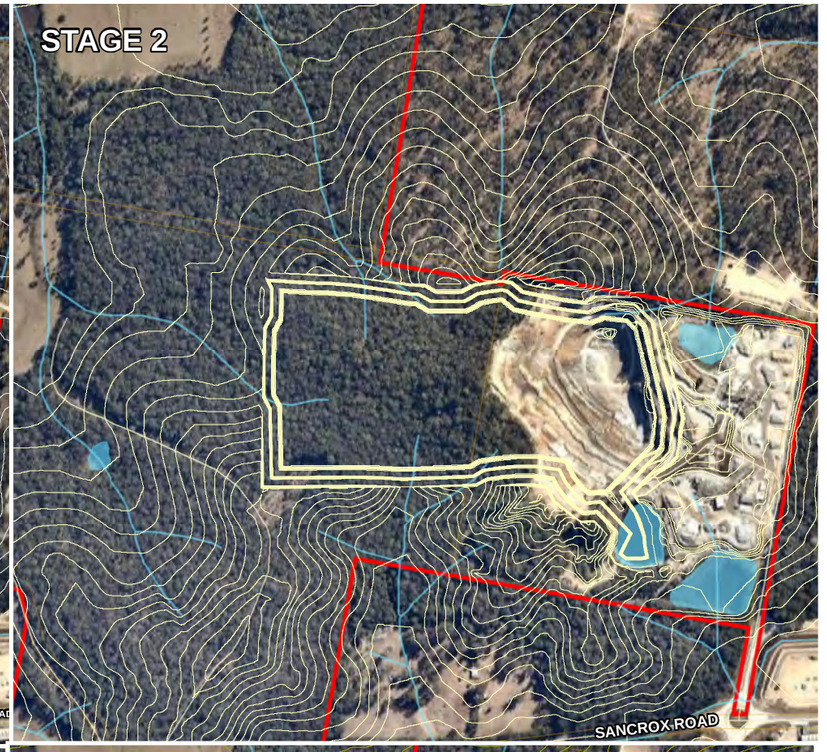

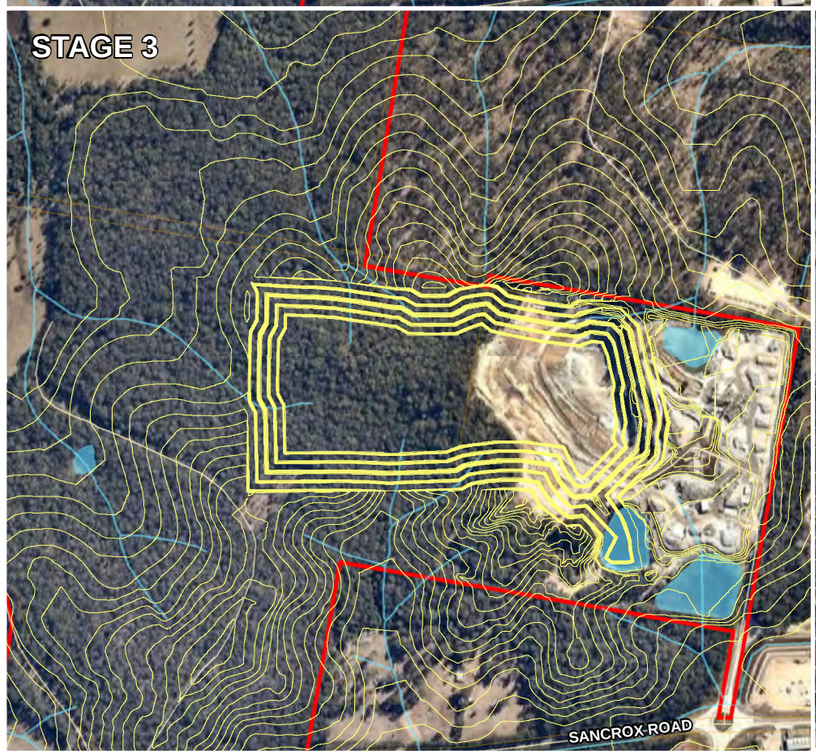

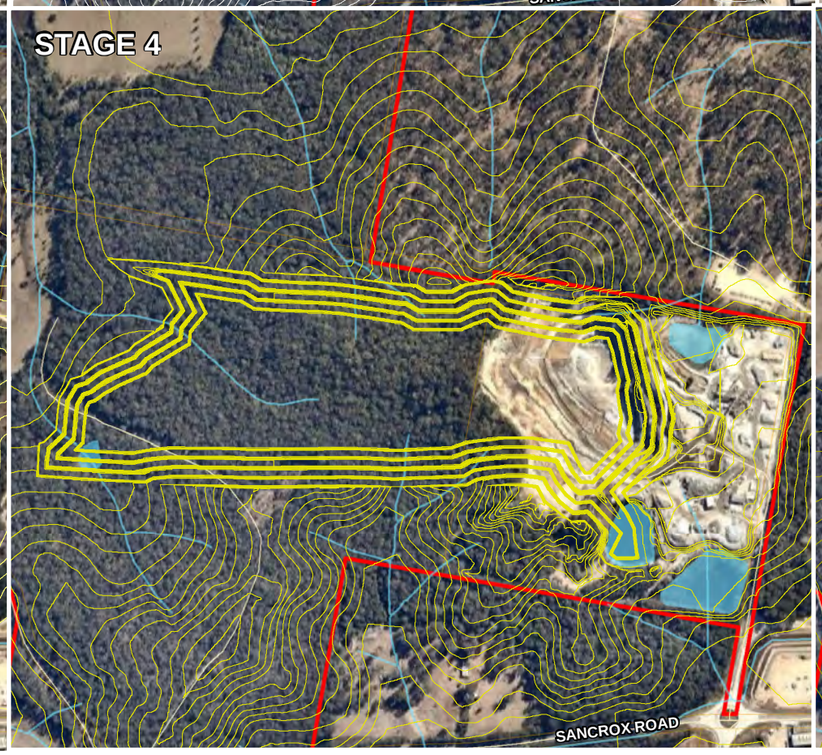

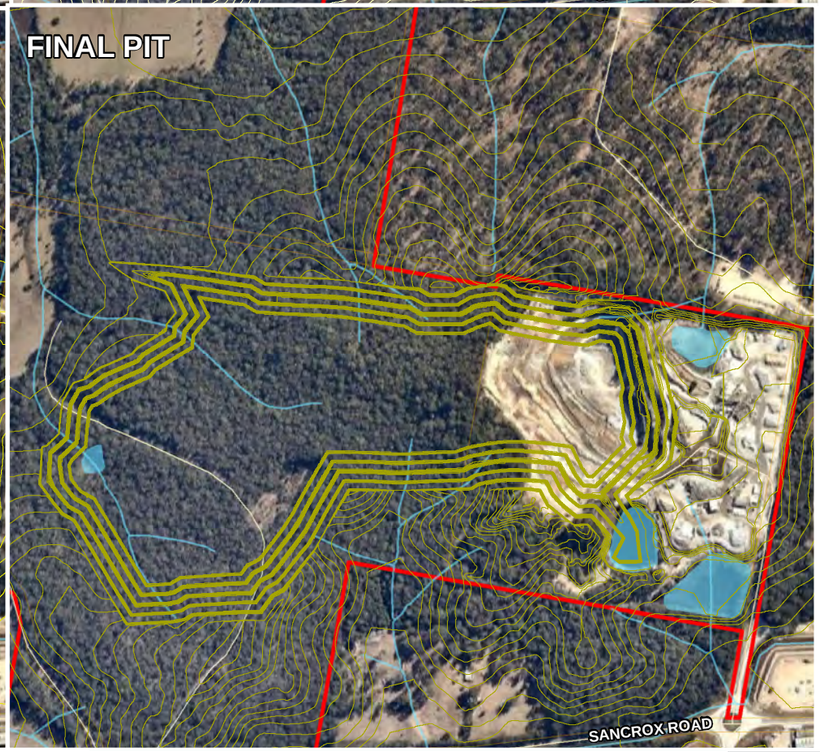

Legend

- Existing Property Ownership
- Lot Boundary
- Road Network
- Watercourses

Quarry Staging:

- Stage 1 (RL-14m)
- Stage 2 (RL-14m)
- Stage 3 (RL-40m)
- Stage 4 (RL-40m)
- Final Pit (RL-40m)

Source:
Spatial Data: DFSI DCDB, DTDB 2017
Imagery Data: nearmap August 2017

Quarry Staging

F2.3

Drawing No:	0418291s_AQA_G012_R0.mxd		Sancrox Quarry Expansion Project Air Quality Assessment Report
Date:	27/07/2018	Drawing Size: A4	
Drawn By:	LT	Reviewed By: ME	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 100 200m

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2.1.3 *Sensitive Receptors*

Sensitive receptors are locations where the general population is likely to be exposed to the resultant ground level concentrations from the atmospheric emissions. The Approved Methods defines these as:

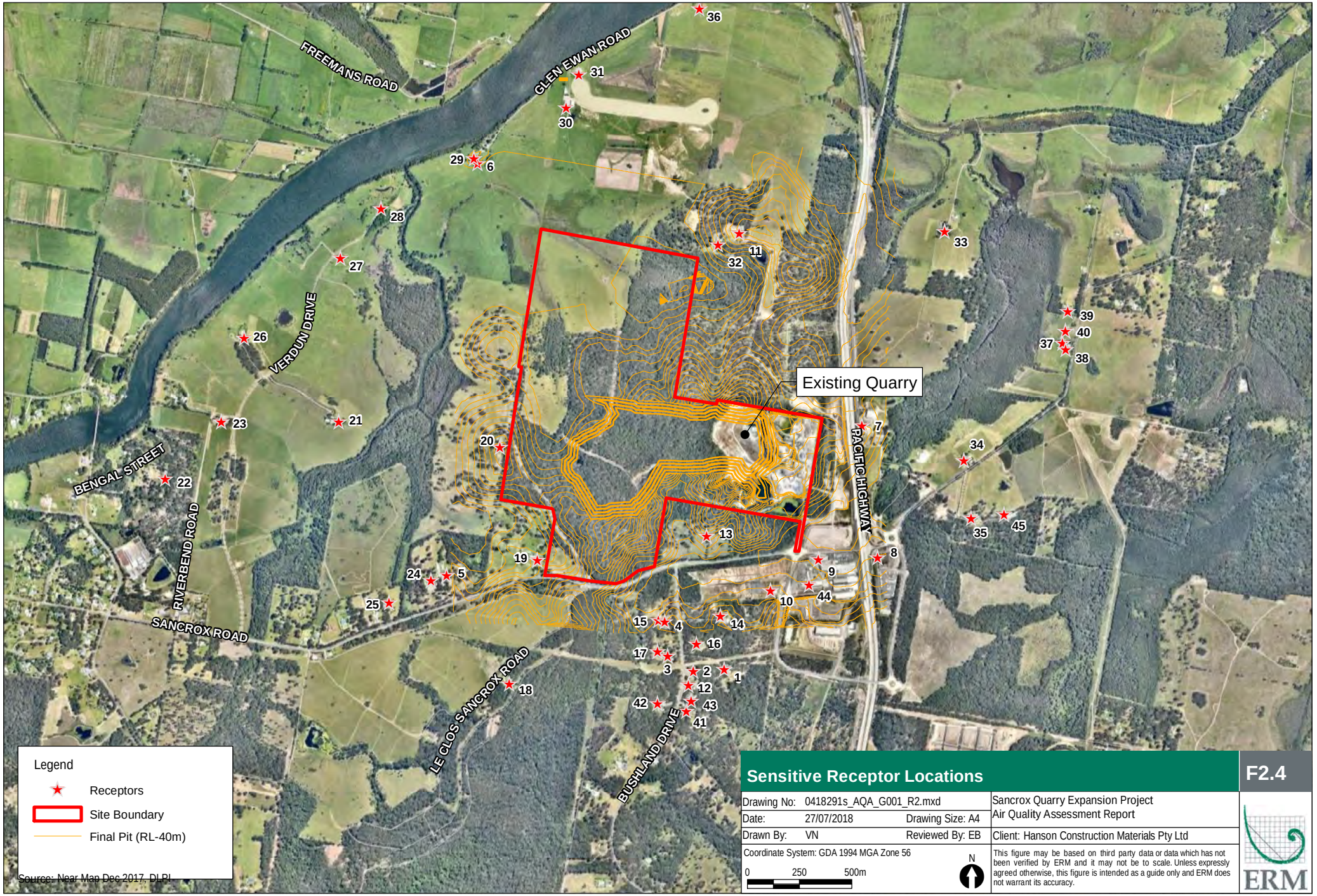
- *"A location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area"* (State of NSW and Environment Protection Authority, 2016).

Forty five sensitive receptors have been identified on the basis of proximity to Site from all directions. In addition, the assessment has undertaken atmospheric dispersion modelling over a grid of 12 km by 12 km with a spatial resolution of 150 m. The results on the modelled grid are then interpolated and contoured to provide predicted concentrations for all other sensitive receptors not specifically included in the dispersion model, but within the modelled area. The locations of the specific sensitive receptors included in the model are provided *in Table 2-1* and *Figure 2.4*.

Table 2-1 Modelled specific sensitive receptors surrounding the Site (MGA Zone 55S)

Sensitive receptor	X (m)	Y (m)
1	482552	6520977
2	482404	6520969
3	482281	6521042
4	482236	6521212
5	481222	6521428
6	481371	6523402
7	483212	6522146
8	483289	6521515
9	483004	6521505
10	482775	6521355
11	482624	6523068
12	482382	6520901
13	482469	6521618
14	482535	6521234
15	482268	6521208
16	482420	6521099
17	482233	6521062
18	481521	6520908
19	481656	6521502
20	481477	6522042
21	480704	6522163
22	479872	6521891
23	480141	6522165
24	481146	6521405
25	480946	6521299
26	480251	6522566
27	480711	6522947
28	480906	6523185

Sensitive receptor	X (m)	Y (m)
29	481353	6523426
30	481795	6523669
31	481855	6523829
32	482524	6523013
33	483609	6523077
34	483701	6521979
35	483736	6521703
36	482434	6524144
37	484174	6522543
38	484191	6522511
39	484200	6522692
40	484189	6522599
41	482372	6520779
42	482234	6520814
43	482395	6520827
44	482960	6521383
45	483894	6521719


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
Existing Quarry
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Legend
Receptors
Site Boundary
Final Pit (RL-40m)
Source: Near Map Dec 2017, DLPI
Sensitive Receptor Locations
F2.4
Drawing No: 0418291s_AQA_G001_R2.mxd
Date: 27/07/2018
Drawing Size: A4
Drawn By: VN
Reviewed By: EB
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Air Quality Assessment Report
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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2.2 PROCESS DESCRIPTION

2.2.1 *Quarry Operations*

Benches are developed by ripping, drilling and blasting. Ripped or blasted rock is loaded and then transported to either the processing plant located by the south-eastern boundary of the site, or transported directly off-site to market. The approximate split of material transported directly off-site is reportedly 10% with 90% transported to the processing area. The 90% of material to be taken to the processing plant is loaded to trucks using two excavators and hauled from the working face to the processing plant.

The processing plant reduces the size of feed rock by crushing. Screens are used to separate the material into various sizes and product types. Blending of materials will be undertaken to achieve required product specifications and quality control. It has been assumed by this Assessment that rock delivered to the processing plant is placed directly in to the feed hopper for processing. Conveyors transfer product from the screening area to stockpiles of various sizes.

The processed product is either loaded directly from stockpiles to delivery trucks by front-end loaders (FEL) or moved to a stockpile storage area to the west of the processing plant. It was considered that the proposed quantity of the material will require operation of two FELs around processing plant and stockpile area. The delivery trucks, loaded using FELs, leave the site via the weighbridge.

2.2.2 *Concrete Recycling Plant*

Concrete for recycling will be delivered from offsite using truck and dog type trucks to the aggregate storage bins located at the concrete recycling facility. The delivered concrete will be fed to a mobile primary crusher using one of the FELs in the vicinity of the processing plant and stockpile area. The concrete will be processed to the desired size and outloaded directly to the product storage bins prior to be taken offsite for the use as a recycled road base.

2.2.3 *Concrete Batching Plant*

Operations of the concrete batching plant require materials including coarse aggregate, sand, cement and cement supplement. The coarse aggregate component will be obtained from the rock processed at the processing plant, and will be delivered to the concrete batching plant from the stockpile area using the same trucks used to move material from the quarry floor. Sand will be delivered from offsite to the concrete batching plant using road truck and dogs. Cement and cement supplement will be delivered to the concrete batching plant in the agitator trucks and pneumatically fed to the bottom-loaded silos. The central mix concrete product will be pneumatically loaded to the agitator trucks, which will take the concrete offsite for application in

residential houses, commercial structures, footpaths, sporting facilities etc. The concrete batching plant will be totally enclosed with one bag filter fitted above the pan mixer to mitigate particulate matter emissions from the facility.

2.2.4 Asphalt Plant

Operations of asphalt plant require high quality aggregate and bitumen. The aggregate for asphalt production will be obtained from the rock processed at the processing plant and will be delivered directly to the aggregate storage bins at the asphalt plant. The produced asphalt will be loaded in truck and dog-type trucks and taken offsite via the weighbridge. As part of asphalt plant, one fully enclosed pug mill will be located on site. It is understood that vapour balancing system will be installed for the delivery of bitumen on site and vapour recovery system will be employed for transfer of asphalt to trucks to minimise odour and dust emissions. Moreover, the asphalt plant will be totally enclosed and particulate matter emissions will be mitigated using one fabric filter associated with the natural-gas fired dryer.

3 LEGISLATION AND GUIDELINES

3.1 AIR QUALITY

Within New South Wales (NSW), the protection of local air quality standards is considered in the following policy documents:

- *Protection of the Environment Operations (Clean Air) Regulation 2010* (New South Wales Government, 2017);
- *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales* (State of NSW and Environment Protection Authority, 2016); and
- *Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments* (NSW Government, 2018).

In addition, NSW has committed to complying with the National Environment Protection (Ambient Air Quality) Measure (Australian Government, 2016).

3.1.1 POEO Clean Air Regulation 2010

The Protection of the Environment Operations (Clean Air) Regulation (2010) (the POEO Clean Air) (New South Wales Government, 2017) is the main legislative and regulatory instrument for air quality in NSW. With respect to industrial emissions, the POEO Clean Air defines:

- the meaning of a scheduled premises;
- groupings of activities and plant, based on commencement date of operation;
- allowable stack emission concentrations for a variety of industries based on the defined group; and
- requirements for the testing and assessment of emissions from existing and proposed industry.

The POEO Clean Air provides emission limits for point (stack) sources only. In relation to the proposed development, the concrete batching plant and the asphalt plant will have associated stacks. The remainder of operations at the facility will result in fugitive emissions not controlled under emission standards within the POEO Clean Air.

Table 3-1 provides the emission limits adopted in this assessment for the bag filter at the concrete batching plant.

Table 3-1 Emission limits for bag filters at the concrete batching plant adopted from the Schedule 3, POEO Clean Air Regulation (New South Wales Government, 2017)

Emitted Species	Concentration	Reference conditions
Solid Particles	20 mg/m^3	Dry, 273 K, 101.3 kPa
Type 1 substances and Type 2 substances (in aggregate)	1 mg/m^3	Dry, 273 K, 101.3 kPa
Cadmium individually	0.2 mg/m^3	Dry, 273 K, 101.3 kPa

Note: Type 1 substance means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements. Type 2 substance means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements.

No specific emission limits are set by the POEO Regulation for asphalt plants, therefore this assessment considered emission limits set in Schedule 4 for general activities and plant. *Table 3-2* provides the emission limits adopted in this assessment for the bag filter at the asphalt plant.

Table 3-2 Emission limits for asphalt plant adopted from the Schedule 4, POEO Clean Air Regulation (New South Wales Government, 2017)

Emitted Species	Concentration	Reference conditions[1]
Solid Particles	20 mg/m^3	Dry, 273 K, 101.3 kPa, 3% O_2
NO_2	350 mg/m^3	Dry, 273 K, 101.3 kPa, 3% O_2
Type 1 substances and Type 2 substances (in aggregate)	1 mg/m^3	Dry, 273 K, 101.3 kPa, 3% O_2
Cadmium or mercury individually	0.2 mg/m^3	Dry, 273 K, 101.3 kPa, 3% O_2
Volatile organic compounds, as n-propane	40 mg/m^3 VOCs or 125 mg/m^3 CO	Dry, 273 K, 101.3 kPa, 3% O_2

1 Reference conditions are based on fuel burning equipment using gas

Note: Type 1 substance means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements. Type 2 substance means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements. Volatile organic compound (VOC) means any chemical compound that: (a) is based on carbon chains or rings, and (b) contains hydrogen, and (c) has a vapour pressure greater than 2mm of mercury (0.27 kPa) at 25°C and 101.3 kPa, and includes any such compound containing oxygen, nitrogen or other elements, but does not include methane, carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.

3.1.2 Approved Methods for the Assessment of Air Pollutants in NSW

The *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales* (Approved Methods) (State of NSW and Environment Protection Authority, 2016) is referred to in Part 5 of the POEO Regulation 2010. The Approved Methods provides the statutory methods for modelling and assessing emissions to atmosphere from stationary sources in the state.

The regulation also provides ground level assessment criteria against which results of dispersion modelling are assessed. *Table 3-3* shows the criteria for particulate matter considered in this assessment.

Table 3-3 The Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Impact Assessment Criteria (State of NSW and Environment Protection Authority, 2016)

Species	Averaging Period	Criterion
TSP	Annual	90 µg/m^3
PM_{10}	24 hour	50 µg/m^3
	Annual	25 µg/m^3
$PM_{2.5}$	24 hour	25 µg/m^3
	Annual	8 µg/m^3
Deposited Dust	Annual	2[1] g/m^2/month
		4[2] g/m^2/month

1. Maximum increase in deposited dust level
2. Maximum total deposited dust level

In addition to particulate matter the concrete batching plant emissions include metals as specified in AP-42 Section 11.12 (United States Environmental Protection Agency, 2006). Emissions from the dryer at the asphalt plant in addition to particulate matter emissions also include carbon monoxide (CO), Nitrogen dioxide (NO_2), sulfur dioxide (SO_2), organic species, metals and general odour (United States Environmental Protection Agency, 2004). *Table 3-4* presents the criteria for these additional species as contained in the Approved Methods.

Table 3-4 Approved methods criteria for other species considered in this assessment

Species	Averaging period	Criterion (µg/m^3)
NO_2	1 hour	246
	Annual	62
CO	15 min	100,000
	1 hour	30,000
	8 hour	10,000
SO_2	10 min	712
	1 hour	570
	24 hour	228
	Annual	60
Benzene	1 hour	29
Ethylbenzene	1 hour	8,000
Formaldehyde	1 hour	20
n-Hexane	1 hour	3200
Methyl chloroform	1 hour	12,500
Polycyclic aromatic hydrocarbon (PAH) as benzo[a]pyrene	1 hour	0.4
Toluene	1 hour	360
Xylene	1 hour	190
n-Pentane	1 hour	33,000
Asphalt petroleum fumes	1 hour	90

Species	Averaging period	Criterion (µg/m³)
Antimony and compounds	1 hour	9
Arsenic and compounds	1 hour	0.09
Barium (soluble compound)	1 hour	9
Cadmium and cadmium compounds	1 hour	0.018
Chromium III compounds	1 hour	9
Copper fumes	1 hour	3.7
Chromium VI compounds	1 hour	0.09
Lead	Annual	0.5
Manganese and compounds	1 hour	18
Mercury organic	1 hour	0.18
Nickel and nickel compounds	1 hour	0.18
Silver soluble compounds (as Ag)	1 hour	0.18

For the assessment of complex mixtures of odours, the Approved Methods adopts a statistical approach, dependent on the population size. As the population increases the proportion of sensitive individuals is also likely to increase, indicating that more stringent criterion is required. The Approved Methods provide an equation to determine the appropriate impact assessment criterion for general odour.

Equation 3-1 Calculation of Impact Assessment Criterion for General Odour (State of NSW and Environment Protection Authority, 2016)

$$IAC\ (OU) = \frac{(Log_{10}(Population) - 4.5)}{-0.6}$$

Where:
IAC (OU) is the Impact Assessment Criteria in Odour Units
Population is the number of people living within the model domain

The Approved Methods use *Equation 3-1* to provide a Table of acceptable criteria (*Table 3-5*).

Table 3-5 Acceptable Impact Assessment Criteria for Complex Mixtures of Air Pollutants (OU) for Various Population Sizes

Population of Affected Community	Impact Assessment Criteria for Complex Mixtures of Air Pollutants (OU)
Urban (>2000) and/or schools and hospitals	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
~2 (Single Rural Residence)	7.0

1. (State of NSW and Environment Protection Authority, 2016)

The Approved Methods does not provide a definition as to the extent of area in which the population should be defined in order to use *Equation 3-1*. At the

2017 Clean Air Society Conference in Brisbane, EPA stated that the definition for the area of population of affected community is the extent of the 2 OU contour.

The number of residences within the 2 OU contour from the dispersion modelling result (Section *8.3*) is two. Given that *Table 3-5* identifies that a single rural residence has a population of 2, this indicates that two residences will have a population of 4. Using *Equation 3-1*, this provides an assessment criterion for general odour of **6.5 OU**.

3.1.3 Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments

The Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (NSW Government, 2018) addresses particulate matter impacts from State significant mining, petroleum and extractive industry developments under Environmental Planning and Assessment Act 1979. The policy provides that where Approved Methods criteria are exceeded by the development, consideration should be given to the following criteria set out in the policy:

- Voluntary mitigation rights (*Table 3-6*); and
- Voluntary land acquisition rights (*Table 3-7*).

This Assessment has therefore considered the criteria provided in the Voluntary Land Acquisition and Mitigation Policy.

Table 3-6 Particulate matter mitigation criteria (NSW Government, 2018)

Species	Averaging Period	Criterion
$PM_{2.5}$	Annual	8 µg/m³*
	24 hour	25 µg/m³**
PM_{10}	Annual	25 µg/m³*
	24 hour	50 µg/m³**
TSP	Annual	90 µg/m³*
Deposited Dust	Annual	2[1] g/m²/month**
		4[2] g/m²/month*

1. Maximum increase in deposited dust level
2. Maximum total deposited dust level

* Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources)

** Incremental impact (i.e. increase in concentrations due to the development alone), with zero allowable exceedances of the criteria over the life of the development

The Policy provides that the particulate matter mitigation criteria provided in *Table 3-6* should be assessed at:

- At any residence on privately owned land; or

- At any workplace on privately owned land where the consequences of those exceedances in the opinion of the consent authority are unreasonably deleterious to worker health or the carrying out of busing at that workplace, including consideration of the following factors:
    - The nature of the workplace;
    - The potential for exposure of workers to elevated levels of particulate matter;
    - The likely period of exposure; and
    - The health and safety measures already employed in that workplace.

Table 3-7 Particulate matter acquisition criteria (NSW Government, 2018)

Species	Averaging Period	Criterion
$PM_{2.5}$	Annual	8 µg/m^{3*}
	24 hour	25 µg/m^{3**}
PM_{10}	Annual	25 µg/m^{3*}
	24 hour	50 µg/m^{3**}
TSP	Annual	90 µg/m^{3*}
Deposited Dust	Annual	2^1 g/m^2/month**
		4^2 g/m^2/month*

1. Maximum increase in deposited dust level
2. Maximum total deposited dust level
* Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources)
** Incremental impact (i.e. increase in concentrations due to the development alone), with up to five allowable exceedances of the criteria over the life of the development

The Policy provides that the particulate matter mitigation criteria provided in *Table 3-7* should be assessed at:

- At any residence on privately owned land; or
- At any workplace on privately owned land where the consequences of those exceedances in the opinion of the consent authority are unreasonably deleterious to worker health or the carrying out of busing at that workplace, including consideration of the following factors:
    - The nature of the workplace;
    - The potential for exposure of workers to elevated levels of particulate matter;
    - The likely period of exposure; and
    - The health and safety measures already employed in that workplace.

- On more than 25% of any privately-owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls.

To assist with the decision-making process for particulate matter impacts, the Policy provides *Figure 3-1*. Following the directions of the chart (*Figure 3-1*), it is considered that where the mitigation criteria are not exceeded at the sensitive receptor locations considered in the assessment (*Section 2.1.3*), the Proposed Project is considered to be compliant. It is further considered that where compliance with the mitigation criteria cannot be guaranteed, the particulate matter impacts are to be considered against the acquisition criteria at the sensitive receptor locations, as well as at any privately-owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls.

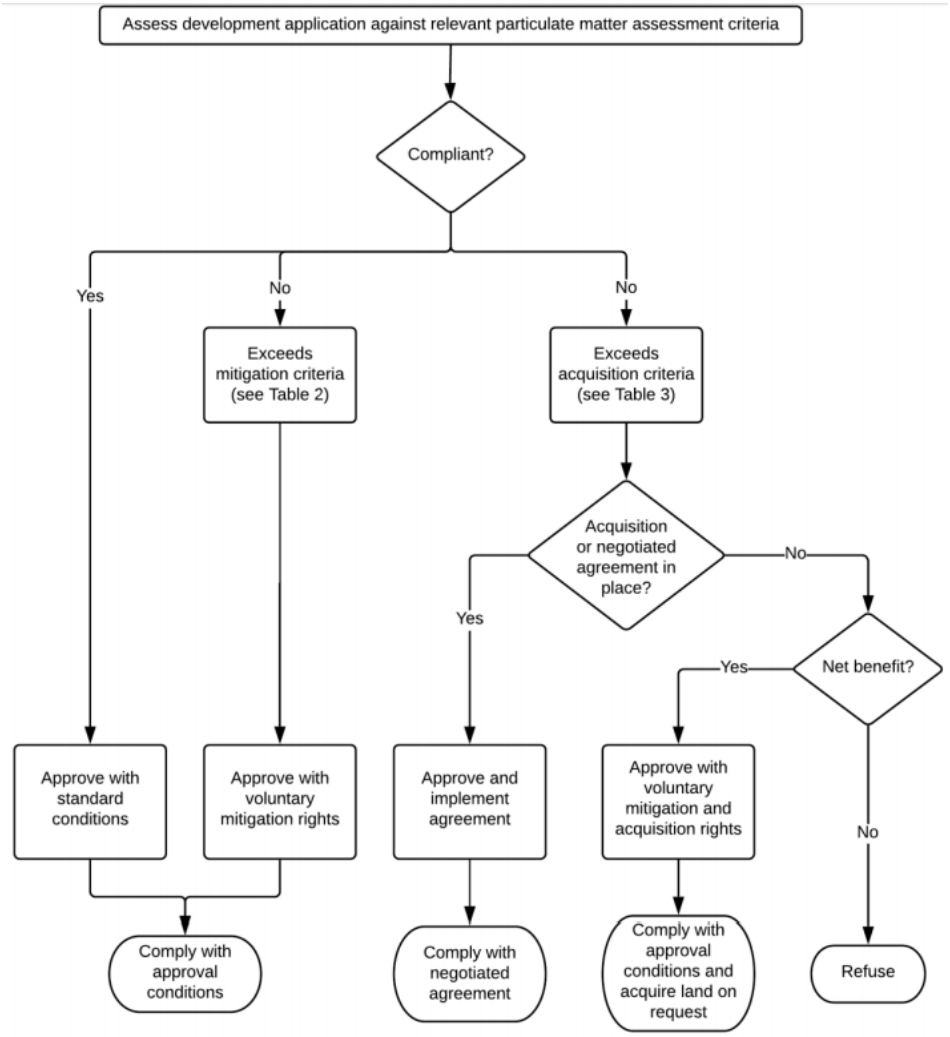


Figure 3-1 Decision-making process for particulate matter impacts (NSW Government, 2018)

3.1.4 *National Environment Protection Measure*

The National Environment Protection (Ambient Air Quality) Measure (NEPM) (Australian Government, 2016) is a Commonwealth Government initiative which sets uniform standards for ambient air quality for six major air species (carbon monoxide, nitrogen dioxide, photochemical oxidants (as ozone), sulfur dioxide, lead, particles as PM_{10} and $PM_{2.5}$.

All States and Territories including NSW have adopted the NEPM air quality standards for these species. The criteria relating to potential emissions from the Proposed Project are outlined in *Table 3-8*. The NEPM criteria have been incorporated into the NSW EPA impact assessment criteria.

Table 3-8 NEPM (Ambient Air Quality) Standards (Australian Government, 2016)

Species	Averaging Period	Maximum Concentration	Maximum Allowable Exceedances
CO	8 hours	9 ppm 11,243 µg/m³	1 day a year
NO_2	1 hour	0.12 ppm 246 µg/m³	1 day a year
	1 year	0.03 ppm 61 µg/m³	None
SO_2	1 hour	0.2 ppm 571 µg/m³	1 day a year
	1 day	0.08 ppm 228.4 µg/m³	1 day a year
	1 year	0.02 ppm 57 µg/m³	None
Lead	1 year	0.5 µg/m³	None
Particles as PM_{10}	24 hour	25 µg/m³	None
	Annual	50 µg/m³	None
Particles as $PM_{2.5}$	24 hour	25 µg/m³	None
	Annual	8 µg/m³	None

Measurements for determination of compliance against the NEPM criteria (*Table 3-8*) are completed at locations away from major roads and industry in locations where background air quality is representative of a population of 25,000 people. Consequently, it is not intended that the NEPM values indicate acceptable concentrations of ambient air quality adjacent to industry. Consequently, these standards have not been considered further in this assessment.

3.1.5 *Other Legislation*

For species considered in this Assessment and not included either in Approved Methods, the criteria were sourced from Ontario Regulation 419/06: Air Pollution – Local Air Quality (Government of Ontario, 2017) as provided in *Table 3-9*.

Table 3-9 Criteria sourced from Ontario Regulation 419/06 (Government of Ontario, 2017)

Species	Averaging period	Criterion (µg/m³)
n-Heptane	30 minutes	33,000
	24 hour	11,000
Zinc	30 minutes	100
	24 hour	120

3.1.6 Protocol for Environmental Management Mining and Extractive Industries

Ryolite is an igneous, volcanic rock, which is typically silica rich. During blasting, crushing and handling of material, there is potential that a portion of the particulate matter released will be comprised of crystalline silica. Crystaline silica has the potential to cause silicosis.

The Approved Methods does not contain standards for crystalline silica. ERM has therefore adopted the approach outlined by the Victorian Protocol for Environmental Management for the Mining and Extractive Industries (Mining PEM), which is an incorporated document to Victoria's State Environment Protection Policy for Air Quality Management.

The Mining PEM provides an assessment criterion for respirable crystalline silica (expressed as $PM_{2.5}$ of 3 µg/m³ as an annual average). This criterion was adopted in this assessment.

3.2 GREENHOUSE GAS

3.2.1 Federal Legislation

Federal parliament passed the National Greenhouse and Energy Reporting Act 2007 (the NGER Act) in September 2007 (Commonwealth of Australia, 2007). The NGER Act establishes a mandatory corporate reporting system for greenhouse gas emissions, energy consumption and production.

The NGER Act is one of a number of legislative instruments related to greenhouse reporting, which together form the National Greenhouse and Energy Reporting System (NGERs), as follows:

- The National Greenhouse and Energy Reporting Regulations 2008 (Commonwealth of Australia, 2017) includes the most recent amendments and provide the necessary details that allow compliance with, and administration of, the NGER Act.

- The National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Australian Government Department of the Environment and Energy, 2011) provides methods and criteria for calculating greenhouse gas emissions and energy data under the NGER Act.

- The National Greenhouse and Energy Reporting (Audit) Determination 2009 (Commonwealth of Australia, 2009) sets out the requirements for preparing, conducting and reporting on greenhouse and energy audits.

The NGER Act is seen as an important first step in the establishment of a domestic emissions trading scheme. This intention is stated in the objectives for the NGER Act, as follows:

- establish a baseline of emissions for participants in a future Australian emissions trading scheme;
- inform the Australian public;
- meet international reporting obligations; and
- assist policy formulation of all Australian governments while avoiding duplication of similar reporting requirements.

The NGER legislation sets corporate and facility reporting thresholds for greenhouse gas emissions and energy consumption or energy production beyond which corporations/ facilities are required to report (*Table 3-10)*. Based on the findings of this study, annual greenhouse gas emissions from the Sancrox will not exceed the NGERs facility threshold (refer to Section *5* for emission estimates). Therefore, Sancrox will not be required to report greenhouse gas emissions and energy consumption/production from the Project.

Table 3-10 NGER Reporting Threshold

Year	Corporate Threshold		Facility Threshold		
	Greenhouse gas emissions (kt CO_2-e)	Amount of energy produced (TJ)	Greenhouse Gas Emissions (kt CO_2-e)	Energy Consumed (TJ)	Energy Produced (TJ)
2008-2009	125	500			
2009-2010	87.5	350	25	100	100
2010-current	50	200			

3.2.2 State Legislation

Whilst no legislation exists in NSW mandating the reduction of GHG emissions, reference was made to the SEARs issued by the NSW Government for the Sancrox Quarry Extension Project (NSW Government Department of Planning & Environment , 2017).

The SEARs provide no specific guideline towards reporting greenhouse gas emissions for EIS purposes. Therefore emissions from the Project have been estimated in accordance to the NGER legislation (Australian Government Department of the Environment and Energy, 2011), which mandates facilities above the reporting threshold to report their annual Scope 1 and Scope 2 emissions. Scope 3 emissions are not reported under the NGER legislation and therefore not considered in this assessment.

4 EXISTING ENVIRONMENT

4.1 GENERAL METEOROLOGICAL CONDITIONS

Local meteorology plays a major role in determining the location and the degree of off-site impacts of activities proposed to be carried out at the site. Air dispersion modelling requires information about the dispersion characteristics of the area. In particular, data is required on wind direction, wind speed, temperature, atmospheric stability and mixing height. This meteorological data is outlined in the following Sections.

4.2 CLIMATE

Long-term climate data is available from the Bureau of Meteorology (BoM) weather station located in Port Macquarie (Airport), approximately 3.5 km east of the site. *Table 4-1* presents temperature, humidity and rainfall statistics from this weather station for the period 1995 to 2018, which consists of monthly average 9am and 3pm readings. Monthly averages of maximum and minimum temperatures are also presented. Rainfall data consists of mean monthly rainfall and the average number of rain days per month. Overall, the local area is characterised by:

- Annual average rainfall of 1,428.2 mm;
- Average maximum temperature of 27.7°C in January;
- Average minimum temperature of 6.4°C in July;
- Average maximum 9am humidity of 83% in March; and
- Average minimum 3pm humidity of 52% in August.

4.3 TYPICAL WIND CONDITIONS

Figure 4.1 provides the predicted wind roses (see Section *7.2*) showing the frequency of strength and direction of winds for five recent years (2012 to 2016 inclusive) at the Site. The data has been divided to show annual trends.

The wind roses indicate that typically winds at the subject Site are:

- Most frequently westerly, south-westerly and northerly;
- Occur moderately from the north-western and north-eastern directions;
- Low percentage of winds from the southern direction;
- Rarely from the east; and
- From approximately 6.7% to 11.4% calm conditions (less than 0.5 m/sec).

Table 4-1 Climate Data for Port Macquarie Station obtained from Bureau of Meteorology

Statistic Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Start Year	End Year
Mean maximum temperature (°C)	27.7	27.6	26.4	24.2	21.6	19.5	18.8	20.3	22.7	24.1	25.2	26.8	23.7	1995	2018
Mean minimum temperature (°C)	18.4	18.4	17.0	13.9	10.4	8.3	6.4	6.7	9.4	12.0	15.2	16.9	12.8	1995	2018
Mean rainfall (mm)	150.8	165.5	176.0	139.0	114.4	140.6	61.9	66.6	59.3	75.1	153.9	114.7	1428.2	1995	2018
Mean 9am temperature (°C)	23.3	22.6	20.8	19.5	16.1	13.3	12.3	14.0	17.7	20.1	20.7	22.6	18.6	1995	2010
Mean 9am relative humidity (%)	76	82	83	76	76	78	75	68	64	64	73	72	74	1995	2010
Mean 9am wind speed (km/h)	13.0	12.3	11.5	12.3	12.5	11.5	11.9	12.6	13.6	14.7	14.0	13.6	12.8	1995	2010
Mean 3pm temperature (° C)	26.1	26.0	24.9	22.5	20.1	18.2	17.5	18.7	20.5	21.9	23.1	24.9	26.1	1995	2010
Mean 3pm relative humidity (%)	65	66	65	64	61	60	55	52	56	59	65	64	61	1995	2010
Mean 3pm wind speed (km/h)	22.4	21.6	20.1	17.3	15.3	14.9	16.0	19.0	21.0	22.2	22.5	22.3	19.6	1995	2010

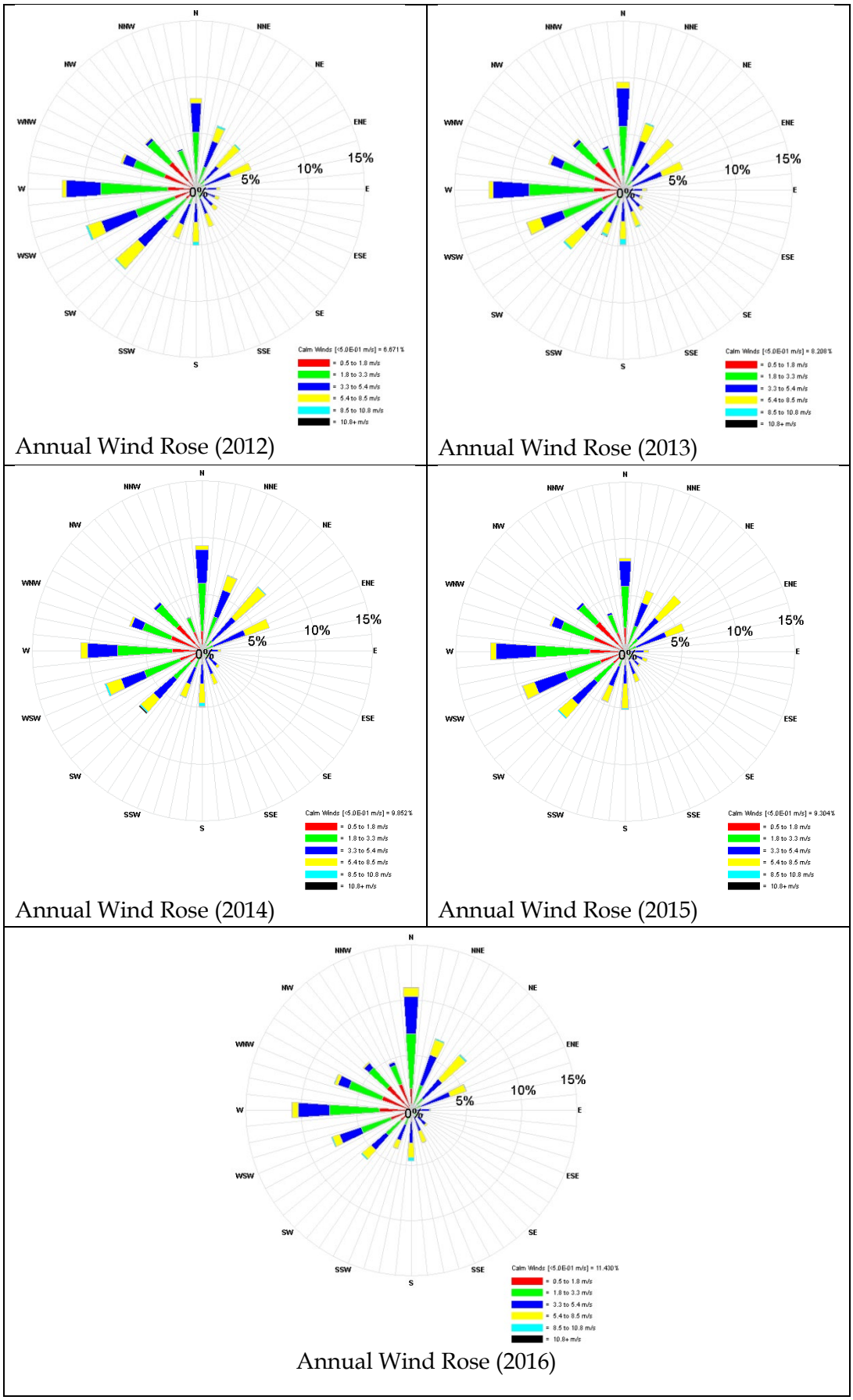


Figure 4-1 Site-Specific annual wind roses (2012-2016)

4.4 ATMOSPHERIC STABILITY

Atmospheric stability is one of the key parameters that effects dispersion and dilution of emissions away from source. In essence it describes the degree of thermal and mechanical mixing of the atmosphere that occurs due to wind and thermal heating. Higher stability of the atmosphere typically results in poor dispersion conditions and higher ground level concentrations, whilst unstable atmospheres typically have the opposite impact.

Atmospheric stability is described by the Pasquil-Gifford classification where:

- Category A describes a very unstable atmosphere;
- Category B describes an unstable atmosphere;
- Category C describe a moderately unstable atmosphere;
- Category D describes a neutral atmosphere;
- Category E describes a stable atmosphere;
- Category F describes a very stable atmosphere; and
- Category G describes a very very stable atmosphere.

Usually, categories F and G are combined when describing the frequency of these categories.

Typically, these atmospheric conditions occur under the following conditions:

- Category A – Very sunny and very windy conditions;
- Category B – Very sunny but less windy conditions;
- Category C – Moderately sunny and moderately windy conditions;
- Category D – The hours around sunrise and sunset in addition to overcast conditions;
- Category E, F and G – Mostly clear or clear night time conditions with decreasing wind speed.

Figure 4.2 shows the predicted frequency of stability categories at the Site. Stability categories have been predicted using the methodology outlined in Section *7.1*.

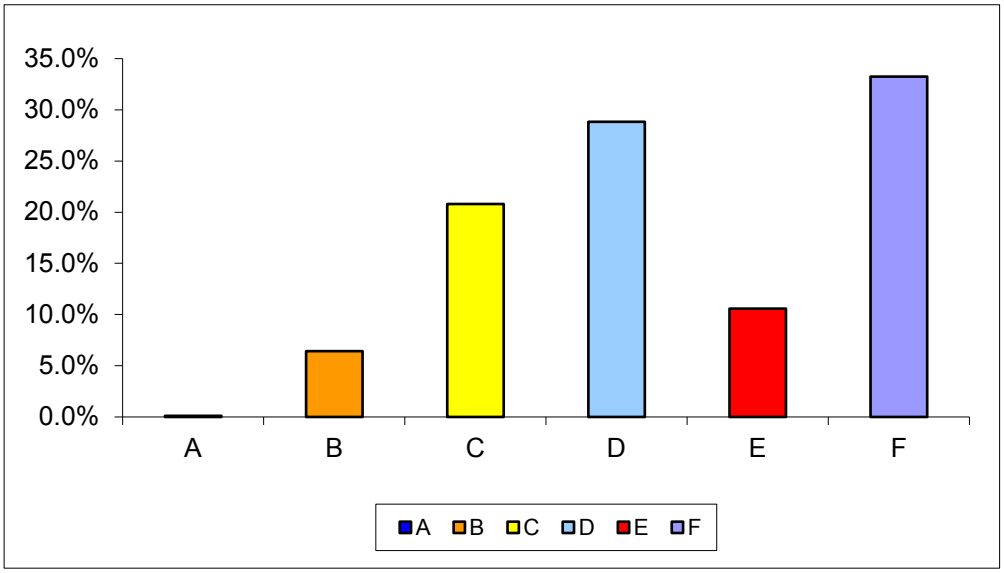


Figure 4-2 ***Frequency of Atmospheric Stability Categories predicted for the Site***

The distribution of modelled stability categories based on five recent years of data (2012 to 2016 inclusive) indicates that there are:

- Relatively few windy days with high solar insolation (category A) (0.1%);
- A relatively low amount of sunny days with lighter winds (category B) (6.4%);
- A moderate amount of moderately sunny days with moderate wind conditions (category C) (20.8%);
- A higher percentage of category D, which represents atmospheric stability around dawn and dusk, as well as overcast days and nights (28.8%) ;
- A moderate amount of calm clear night time conditions (category E) (10.6%); and
- A higher percentage of very calm and clear night time conditions (category F) (33.3%).

4.5 EXISTING AMBIENT AIR QUALITY

Background air quality is a measure of the existing air quality in the absence of the project activity. The background air quality is due to sources (natural or man-made) other than the site. It is important to consider background air quality when considering cumulative impacts on sensitive receptors in the area.

A desktop review of the National Pollutant Inventory (NPI) of reported emissions from fixed and mobile sources in the vicinity of the site was also undertaken to obtain an indication of existing industries in the project area. There are no facilities within the Port Macquarie region reporting emissions of particulate matter under the NPI reporting scheme with the exception of this

Site. The proposed operation of this Site and proposed increase in activity is included in this air quality assessment.

A review of publications for the PMHC indicated that the Local Government Area has not undertaken any recent air monitoring.

A review of the Office of Environment and Heritage (OEH) website for the NSW Air Quality Monitoring Network, indicates that ambient monitoring is completed for PM_{10}, $PM_{2.5}$ and NO_2 at the following locations for the Lower Hunter and Central Coast:

- Beresfield;
- Carrington;
- Mayfield;
- Newcastle;
- Stockton;
- Wallsend; and
- Wyong.

There are no ambient air quality measurements on the North Coast.

Of the available monitoring stations in the Lower Hunter and Central Coast, only the monitor at Wyong is both close to the coast and outside of the major urban area of Newcastle. Measurements from Wyong were therefore selected as representative background concentrations for the project area.

4.5.1 Particulate Matter

Table 4-2 provides the maximum measured 24 hour concentrations for PM_{10} and $PM_{2.5}$ as measured at Wyong for the modelled years.

Table 4-2 Maximum measured 24 hour average and annual mean concentrations (µg/m³) for PM_{10} and $PM_{2.5}$, as measured at Wyong for 2012 to 2016

Species	Averaging Period	Year					Criterion
		2012	2013	2014	2015	2016	
PM_{10}	24 Hour Mean	37.4	70.2	41.9	58.6	46	50
	Annual Mean	16.6	16.6	15.1	14.9	15.2	25
$PM_{2.5}$	24 Hour Mean	14.7	55.8	19.7	13.2	19.8	25
	Annual Mean	6.7	6.7	5.5	5.2	5.7	8

No measurements are taken at Wyong for Total Suspended Particulate (TSP). Consequently, for this assessment, the annual mean TSP concentration has conservatively been assumed to be double the annual mean PM_{10} concentration for each year.

The values in *Table 4-2* and the estimated values for TSP have been used in the level 1 assessment as outlined in Sections *8.1* and *8.2*.

As discussed in Sections *8.1* and *8.2*, a level 2 assessment was required for PM_{10} and $PM_{2.5}$. One hour average concentrations were downloaded from the Office of Environment and Heritage website, and added to the model results on an hour by hour basis as discussed in Section *7.6.4*.

4.5.2 Dust Deposition

There is no dust deposition monitoring program currently undertaken in the vicinity of the site. No public information regarding background dust deposition levels in the Sancrox region. In the absence of site specific monitoring data a cumulative assessment of dust deposition has not been undertaken.

Criteria for dust deposition, specified in the Approved Methods, allows an annual mean deposition rate of 4g/m^2/month, no more than 2g/m^2/month above background.

In the absence of site specific monitoring data, and as shown in *Table 3-3*, a criteria of an annual mean generated concentration of 2g/m^2/month has been used to ensure the a cumulative impact from the site will remain below 2g/m^2/month above background.

4.5.3 Nitrogen Dioxide

Table 4-3 provides the maximum measured 1 hour and annual mean concentrations for NO_2 as measured at Wyong for the modelled years. These values have been used in the Level 1 assessment as described in Section *8.3*.

Table 4-3 Maximum measured 1 hour average and annual mean NO_2 concentrations NO_2 as measured at Wyong for 2012 to 2016

Species	Averaging Period	Year					Criterion
		2012	2013	2014	2015	2016	
NO_2	1 Hour Mean	59.5	84.1	69.8	65.7	94.4	246
	Annual Mean	7.8	10.3	10.2	9.3	9.7	62

5 GHG EMISSIONS INVENTORY

GHG emissions from the Project have been estimated based on the methods outlined in the following documents:

- The World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard Revised Edition ("the GHG Protocol") (World Business Council for Sustainable Development, World Resources Institute, 2015).
- The National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Australian Government Department of the Environment and Energy, 2011).
- The Australian Government Department of Environment and Energy National Greenhouse and Energy Reporting Scheme Measurement – Technical Guidelines for the estimation of emissions by facilities in Australia (Australian Government Department of the Environment and Energy, 2017a)
- The Australian Government Department of Environment and Energy National Greenhouse Accounts (NGA) Factors July 2017 (Australian Government Department of the Environment and Energy, 2017b).
- The Mining Association of Canada Towards Sustainable Mining – Energy and GHG Emissions Management Reference Guide (The Mining Association of Canada, 2014)
- Australia Transport Authorities Greenhouse Group, Greenhouse Gas Assessment Workbook for Road Projects (Transport Authorities Greenhouse Group Australia and New Zealand, 2013).

The GHG Protocol establishes an international standard for accounting and reporting of GHG emissions. The GHG Protocol has been adopted by the International Standard Organisation, endorsed by GHG initiatives (such as the Carbon Disclosure Proposal) and is compatible with existing GHG trading schemes.

Three 'scopes' of emissions (Scope 1, Scope 2 and Scope 3) are defined for GHG accounting and reporting purposes, as described below and summarised in *Figure 5.1*. This terminology has been adopted in Australian GHG reporting and measurement methods (Australian Government Department of the Environment and Energy, 2011) and has been employed in this assessment.

5.1.1 *Scope 1: Direct Greenhouse Gas Emissions*

Direct GHG emissions are defined as those emissions that occur from sources that are owned or controlled by the reporting entity. Direct GHG emissions are those emissions that are the result of the following types of activities undertaken by the entity (Sancrox Quarry, Concrete Batching, Concrete Recycling and Asphalt plants):

- Construction activities – these emissions result from the combustion of fuels in Hanson owned/ controlled industrial vehicles and equipment (e.g., excavators, graders, front-end loaders etc.), as well as clearing of land and sealing haul roads;

- Generation of electricity, heat or steam – the emissions result from the combustion of fuels in stationary sources;

- Physical or chemical processing – it is assumed that no emissions are emitted as by-product from the processing plant operations;

- Blasting – emissions that result from the use of explosives onsite e.g., ANFO; and

- Transportation of materials and products - these emissions result from the combustion of fuels in Hanson owned/controlled mobile combustion sources; e.g., haul trucks, product transport trucks, etc.

5.1.2 Scope 2: Energy Product Use – Indirect Greenhouse Gas Emissions

Scope 2 emissions are a category of indirect emissions that account for GHG emissions from the generation of purchased energy products (principally, electricity and steam/heat) by the entity. Scope 2 in relation to the Project covers purchased electricity, defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity.

5.1.3 Scope 3: Other Indirect Greenhouse Gas Emissions

Scope 3 emissions are defined as those emissions that are a consequence of the activities of an entity, but which arise from sources not owned or controlled by that entity. Some examples of Scope 3 activities provided in the GHG Protocol are extraction and production of purchased materials, transportation of purchased fuels, and use of sold products and services.

The GHG Protocol provides that reporting Scope 3 emissions is optional. In the Australian context, the NGER legislation does not require reporting for Scope 3 emissions from a facility.

In the absence of Project specific requirement under the SEARs and in line with the NGER legislation, scope 3 emissions have not been accounted for in this assessment.

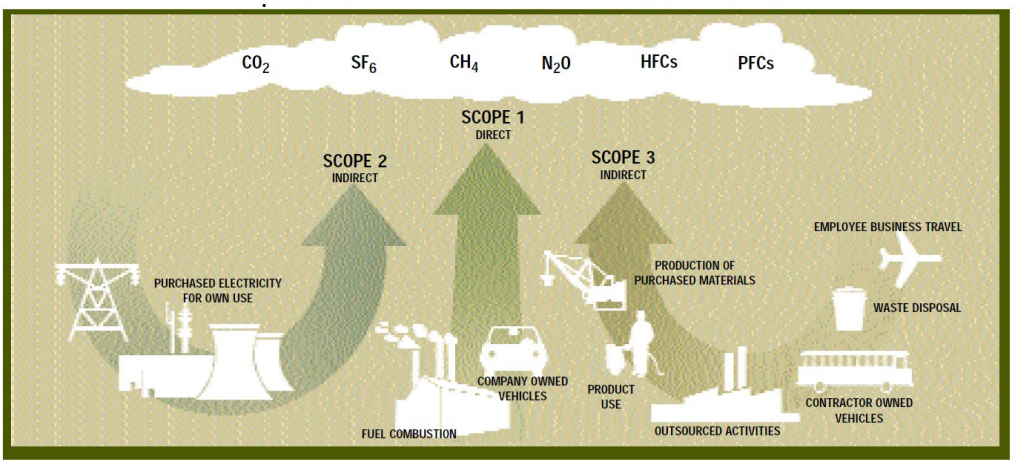


Figure 5-1 Overview of Scopes and Emissions across a Reporting Entity

Inventories of GHG emissions can be calculated using published emission factors. Different gases have different greenhouse warming effects (referred to as global warming potentials), and emission factors take into account the global warming potentials of the gases created during combustion. The estimated emissions are referred to in terms of carbon dioxide equivalent, or CO_2-e, emissions by applying the relevant global warming potential. The GHG Assessment has been conducted using the documents referenced above.

5.2 CONSTRUCTION RELATED GHG EMISSIONS

Emissions from construction related activity including vegetation clearing were calculated based on Transport Authorities Greenhouse Group Workbook (Transport Authorities Greenhouse Group Australia and New Zealand, 2013).

GHG emissions from vegetation clearing accounts for the carbon that exists in the vegetation at the time of clearing and carbon that could have been sequestered in future if vegetation was not cleared. Vegetation clearing is proposed to be undertaken in six steps, provided *Table 5-1*, together with the corresponding Quarry stages. With the exception of Step 1, each step represent activities over a two-year period per step.

Table 5-1 Vegetation clearing steps

Step	Quarry Stage	Details	Area cleared in hectare (ha)
Step 1	Stage 1	Clearing for stockpiles and processing plant	6.07
Step 2		Clearing for mining purposes	4.87
Step 3	Stage 2	Clearing for mining purposes	9.29
Step 4	Stage 3	Clearing for mining purposes	No vegetation clearing required, quarry increasing in depth not lateral extent
Step 5	Stage 4	Clearing for mining purposes	11.94
Step 6	Stage 5	Clearing for mining purposes	8.50

GHG emissions from the construction phase of the Project involve combustion of liquid fuel used in land clearing and earthmoving machinery.

A summary of the construction related GHG emissions (including vegetation clearing) is provided in *Table 5-2*. Details on the methodology including emission factors used are provided in Appendix A.

Table 5-2 Summary of construction related GHG emissions (t CO_2-e) – Scope 1

Step	Vegetation Clearing[1]	Liquid fuel combustion[1]	Total
Step 1	862	244	1,106
Step 2	692	83	775
Step 3	1,319	101	1,420
Step 4	Not required	n/a	n/a
Step 5	1,696	129	1,825
Step 6	1,207	92	1,299

1. from clearing and grubbing of vegetated areas and earth moving equipment

For each step emissions from vegetation clearing account for at least 75% or more of the total construction related emissions from the Project. The largest construction related GHG emissions can be expected to occur during Stage 1 of the quarry development due to the GHG emissions from vegetation clearing for stockpile and processing plant, additional to vegetation clearing for mining purposes.

5.3 OPERATIONS RELATED GHG EMISSIONS

The operations related GHG emissions are associated with the use of different fuels (diesel, LNG and explosives) related to mining, processing and transporting product (Scope 1) and the purchase of electricity (Scope 2).

Information on the quantity of fuel and amount of electricity consumed were based on ERM's experience with projects of similar nature and are detailed in Appendix A together with the emission rates used.

A summary of the annual GHG emissions associated with the proposed operations at Sancrox quarry is provided in *Table 5-3*.

Table 5-3 Estimated annual total GHG emissions (t CO_2-e) from operations

Type of fuel	Scope 1	Scope 2	Total
Diesel – transport related	2,017	-	2,017
Diesel – stationary energy purpose	287	-	287
Blasting – ANFO	1	-	1
Electricity	-	1,348	1,348
LNG	864	-	864
Total	3,169	1,348	4,517

5.4 GHG EMISSIONS SUMMARY

A summary of the annualised GHG emissions from the Project over the 10-year life is presented in *Table 5-4* and plotted in *Figure 5.2*. The Project over its entire life cycle is estimated to release approximately 48.4 million tonnes of CO_2-e into the atmosphere with Scope 1 and Scope 2 emissions accounting for 74% and 26% respectively of the total emissions. The main GHG emission sources over the life of the project representing 99% of all emissions are:

- Operations – Diesel for transport related purposes (38%);
- Operations – Electricity (26%);
- Operations – LNG (16%);
- Construction – Vegetation clearing (12%); and
- Operations – Diesel for stationary energy purposes (6%).

Table 5-4 Summary of estimated annual average GHG emissions (t CO_2-e) from Project – Scope 1 and Scope 2

Year	Scope 1	Scope 2	Total
Year 1	2,185[1]	674[2]	2,843
Year 2	3,541	1,348	4,889
Year 3	3,879	1,348	5,227
Year 4	3,879	1,348	5,227
Year 5	3,169	1,348	4,517
Year 6	3,169	1,348	4,517
Year 7	4,082	1,348	5,429
Year 8	4,082	1,348	5,429
Year 9	3,818	1,348	5,166
Year 10	3,818	1,348	5,166

1.
   a. Assumes construction related activity related to Processing plant takes a year for completion ;
   b. assumes that diesel usage (for operations) is 20% of the nominal required for transportation purposes;
   c. there is no LNG usage associated with asphalt plant
   d. includes construction related to sealed roads
2. Assumes electricity requirements are 50% of the nominal consumption;

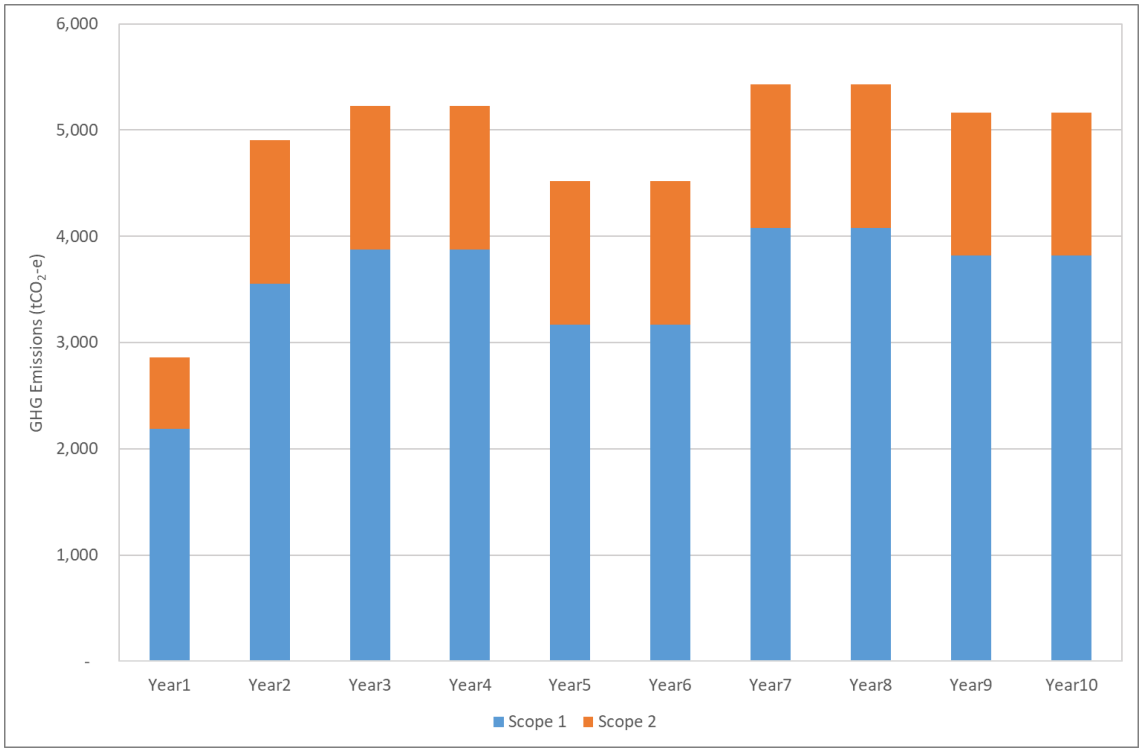


Figure 5-2 ***GHG Emissions Summary- Scope 1 and Scope 2 (Year 1 to Year 10)***

Scope 1 emissions from the Project split by emission sources is plotted in *Figure 5.3*. Relatively lower emissions are associated with Year 5 and Year 6 resulting from no proposed vegetation clearing during this time. The highest annual GHG emissions (4,082tCO_2-e) is expected to occur during Year 7 to Year 8 of operations.

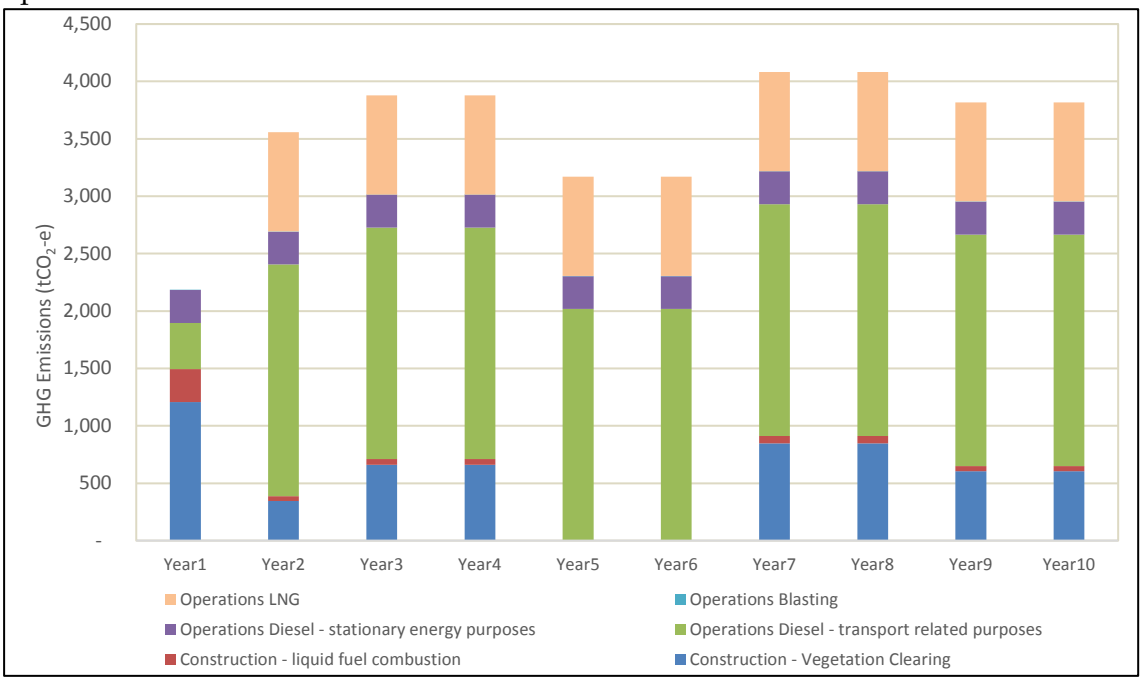


Figure 5-3 ***GHG Emissions Summary Scope 1 (Year 1 to Year 10)***

The Project's contribution to projected climate change, and the associated impacts, would be in proportion with its contribution to global GHG emissions. Peak Scope 1 and Scope 2 emissions from the Project (approximately 0.0054 Mt CO_2-e during Year 7/Year8) would represent approximately 0.0010% of Australia's commitment for annual emissions under the Kyoto Protocol (550.2 Mt CO2-e/annum for 2016-17). In comparison to the 2015 GHG emissions in NSW, the project emissions account for approximately 0.0041%. When compared to the 2015 GHG emission levels from all Mining sources in Australia (74.5 Mt CO_2-e), the Project accounts to 0.0073%.

6 AIR QUALITY EMISSIONS INVENTORY

Sections *6.1* to *6.4* discuss site operation, air emission sources and provide the summary of emission rates used in the dispersion modelling. The details of emission estimation are provided in *Annex B*.

6.1 SITE OPERATIONS

The proposed operating hours for the Project are 24 hours per day, seven days per week. Emissions from all the sources, except for some wheel-generated dust, have therefore been assumed to occur on every single hour of the year based on annual production. Wheel movements within the boundaries of the Site were assumed to spread evenly throughout 24 hours of operations. Wheel movements in and out of quarry within the dispersion model sought to represent the most likely traffic distribution scenario and therefore used typical market operational hours (6am to 6pm). It is expected that on rare occasions there may be additional movements outside of these adopted hours and impacts from these emission will be managed through real time monitoring at the boundaries of the Site to ensure there is no impact on the sensitive receptor locations (please refer to *Section 10*).

6.2 QUARRY OPERATIONS

Operations related to the quarry, will predominantly generate particulate matter from the following activities:

- Drilling;
- Blasting;
- Product handling, including:
  - Operation of excavators on quarry floor;
  - Rock truck-rear dumping at the processing plant; and
  - Operation of front-end-loaders (FEL) at the processing plant and stockpile area.
- Rock processing, including:
  - Crushing (primary, secondary and tertiary);
  - Screening; and
  - Conveying.
- Wheel generated dust from truck movements; and

- Wind generated dust from stockpiles and exposed areas.

Emissions have been estimated using the published emission factors from the following sources:

- Australian National Pollutant Inventory (NPI) Emission Estimation Technique Manual for Mining Version 3.1 (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012); and

- Australian National Pollutant Inventory (NPI) Emission Estimation Technique Manual for Mining and Processing of Non-Metallic Minerals Version 2.1 (Australian Government Department of the Environment, 2014).

6.2.1 Drilling

Drilling activities produce dust from the mechanical action of the drill. Drilling will take up to 20 hours in total in preparation for blasting a bench. The drill pattern will be determined by geological conditions on a shot by shot basis. A typical plan will be 3 x 3 metres (staggered) consisting of 125, 89mm diameter holes, with individual holes drilled up to a depth of approximately 11 metres. The drilling operations have a full dust extraction system and it is considered that dust emissions from this activity will be low.

Drilling will occur for 20 hours prior to blasting and emissions have been estimated for this time period accordingly (see *Section B.1.1* of Annex *B*).

6.2.2 Blasting

Hanson advised ERM that approximately 30 blasts per annum will be needed to yield the proposed 750,000 tonnes of rock. Area blasted in each blast will be 900 m^2 with the depth of blast holes of 11 metres. Blasting will occur over a short duration; however it will produce airborne particulate matter which has the potential to impact nearby receptors. Emissions per blast were estimated accordingly (see *Section 12B.1.2* of *Annex B*).

6.2.3 Product handling

Excavators on Quarry Floor

Blasting will reduce most of the in-situ rock to smaller fragments of less than one cubic metre in size. Each blast will yield approximately 25,740 tonnes of fragmented rock which will be sorted by one excavator at the quarry floor. Another excavator will load material into either rock trucks for transfer to the processing plant or truck-and-dog-type road trucks for direct delivery to market.

Emissions were estimated for the loading of trucks with the blasted material, occurring 24 hours a day (see Section *B.1.3* of Annex *B*).

Truck Rear Dumping

Fragmented rock delivered by rock trucks to the processing plant will be rear dumped directly to the feed hopper for processing, therefore one truck rear dumping emission source at the processing plant was included in the dispersion modelling. Water sprays will be used during truck rear dumping to minimise dust emissions.

Emissions were estimated for the rear dumping of rock, incorporating designed mitigation measures, at the process plant occurring 24 hours a day (see Section *B.1.3* of Annex *B*).

Front-End-Loaders

Processed rock at the processing facility will be stored in the stockpiles, from where the rock will be loaded to the trucks and taken either offsite, to the asphalt plant or to the concrete batching plant. Product will be loaded to the trucks using FELs. Operation of one FEL at the processing plant and one at stockpile area was included in the dispersion modelling. These FELs will also be used at the adjacent concrete recycling plant as needed. Mobile sprinkler systems will be used during the operation of FELs to minimise dust emissions.

Emissions were estimated for the use of FEL at the processing facility and the stockpile area occurring 24 hours a day (see Section *B.1.3* of Annex *B*).

6.2.4 Rock Processing

Crushing and Screening

The processing plant reduces the size of feed rock by crushing. Screens are used to separate the material into various sizes and product types. The dispersion modelling included primary, secondary and tertiary crushers and two screens. Dust suppression measures including water sprays will be in place and therefore this emission control was considered in the dispersion modelling.

Emissions were estimated for the crushing and screening at the processing facility incorporating designed mitigation occurring 24 hours a day (see Section *B.1.4* of Annex *B*).

Conveyor Transfer Points

Conveyors will transfer moist crushed product from the screening area to stockpiles of various sizes. Three conveyor transfer points and eight conveyor drop points have been included in the dispersion modelling assessment. Water sprays will be used on all conveyor transfer points.

Emissions were estimated for the conveyors incorporating designed mitigation occurring 24 hours a day (see Section *B.1.4* of Annex *B*).

6.2.5 Wheel Generated Dust

As previously discussed in Section *2.1.1*, the roads, which are likely to remain unchanged throughout the stages of the Project and to be frequently used by machinery, will be sealed using asphalt and swept daily to minimise wheel-generated dust emissions. The dispersion modelling therefore only considered dust emissions from unsealed roads.

It is estimated that 10% of broken rock will be loaded and hauled directly to market. ERM understands that the product will be taken offsite by truck and dog-type trucks. Given the volume of the material hauled (75,000 tpa) and the assumed capacity of the trucks (32.43 tonnes), it is estimated that an average of nine loaded haul movements would occur per day. Given the delivery statistics for the year 1.09.2016 to 31.08.2017 provided to ERM, the haul movements direct from quarry face to the market were assumed to occur during the busiest nine hours of the day – 7am to 4pm.

It is expected that approximately 90% of broken rock (675,000 tpa) will be taken to the processing facility. ERM understands that the site will utilise Caterpillar 769C trucks to haul the material from the working faces to the processing plant. Given the volume of the extracted material it is estimated that an average of 50 loaded haul movements per day will be required, which will occur 24 hours per day, every day of the year.

Operations at the concrete batching plant require coarse aggregate. Section 11.12 of AP-42 (United States Environmental Protection Agency, 2006) suggests that concrete mix requires approximately 46% of coarse aggregate (further discussed in Section *6.3.6*). It is therefore estimated that an average of two loaded haul trips from stockpile area to concrete batching plant will occur daily.

Operations at the asphalt plant will require high quality aggregate for production of asphalt. As asphalt plant is located next to the processing plant no additional haulage movements were included in the dispersion modelling.

All loaded haul movements, require empty trucks to return in the opposite direction. The movement of empty trucks was also included in the estimation of emissions.

Level 2 watering (more than 2 litres/m^2/hour) will be applied to unsealed roads to minimise impact from hauling.

Emissions were estimated for wheel generated dust incorporating designed mitigation (Level 2 watering). See Section *B.1.5* of Annex *B* for calculations.

6.2.6 Wind Generated Dust

Wind erosion is expected to generate particulate matter emissions from exposed areas and stockpiles. Wind erosion has been modelled occurring at wind speeds over 5.4 metres per second.

Stockpiles

Product will be continuously stockpiled around the processing plant. Wind erosion of stockpiles of unprocessed and processed material represents a potential emission source.

The approximate stockpile area of 11,695 m^2 for the current operations of 455,000 tpa was estimated using Nearmap imagery taken on 22 August 2017. It was considered that the growth of stockpile area will be proportional to the growth of output and therefore output of 750,000 tpa will require a stockpile area of approximately 35,665 m^2. Dispersion modelling has included 10 stockpiles of equal size to represent the required stockpile area. An additional nine stockpiles were included, located under conveyor drop points at the processing plant.

Water sprays will be utilised to minimise wind erosion from stockpiles during wind speeds of over 5.4 metres per second and therefore were considered in the dispersion modelling.

Emissions were estimated for wind generated dust from stockpiles, incorporating mitigation, to produce a time varying emission file that provides for emissions when wind speeds are elevated (see Section *B.1.6* of Annex *B*).

Exposed Areas

Wind erosion is expected to generate particulate matter emissions from exposed areas such as the pit floor (approximately 38.4 hectares). Emissions from this source only occur when the ground wind speed is predicted to be more than 5.4 m/sec. Ground level wind speeds predicted by meteorological modelling (discussed in Section *7.2*) however did not exceed 5.4 meter per second threshold on any hour of the five recent years of meteorology data used in the modelling. Wind generated emissions from exposed areas therefore were not included in the dispersion modelling.

6.3 CONCRETE RECYCLING PLANT

The proposed concrete recycling facility will process up to 20,000 tpa of concrete delivered at the Site. The potential sources of particulate matter emissions from central mix concrete batching plants generally include:

- Delivery of dry products to ground storage;
- Storage of dry products;
- Transfer of dry products using FELs;
- Conveyor transfer points;
- Concrete crushing using a mobile primary crusher; and
- Wheel generated dust from haul roads.

6.3.1 *Delivery of dry products*

Concrete for recycling will be delivered to site by the delivery trucks. The product will be dumped to the aggregate storage bins and therefore one rear dumping emission source at the concrete recycling facility was included in the dispersion modelling. Water sprays will be used during truck rear dumping to minimise dust emissions.

Emissions were estimated for the delivery of dry products, incorporating mitigation of water spray (see Section *B.2.1* of Annex *B*).

6.3.2 *Storage of dry products*

Concrete delivered on site will be stored in aggregate storage bins enclosed on three sides. The walls will extend one metre above the height of the maximum quantity of raw material, and extend two metre beyond the front of the stockpile. The aggregate storage bins will be fitted with water sprays to keep the stored material damp at all times. It is therefore considered that no wind-blown dust emissions will occur from the storage of product near the concrete batching plant, and have not been considered further in this assessment.

6.3.3 *Transfer of product*

The delivered concrete will be transferred from aggregate storage bins to conveyor belt using a FEL. As necessary, the concrete recycling facility will utilise one of the FELs in the vicinity of the processing plant and stockpile area. No additional FEL emission points have therefore been included in the dispersion modelling. Mobile sprinkler system will be used during the operation of FELs to minimise dust emissions.

6.3.4 *Conveyor transfer points*

ERM understands that the conveyor system at the facility will not include any uncovered conveyor transfer points and the loading point will be enclosed by a shroud. It is therefore considered that dust emissions from this source will be minimised and this source was not considered further in this assessment.

6.3.5 *Crusher*

The concrete recycling plant will include one mobile primary crusher fitted with water sprays. The details of emission estimation are presented in *Section B.2.2* of *Annex B*.

6.3.6 *Wheel Generated Dust from Haul Roads*

20,000 tpa of concrete for recycling will be delivered from offsite by road truck-and-dog-type trucks. It was estimated that approximately 2 haul trips per day will be required. Export of the recycled road base from the facility will also require approximately 2 haul trips per day and it was assumed that it will be exported using road truck-and-dog-type trucks. The hours of the deliveries on each day were randomised within 6am to 6pm as previously discussed in *Section 6.1*. Emissions were estimated for wheel based emissions associated with the concrete recycling facility, incorporating mitigation (see *Section B.2.4* of *Annex B*).

6.4 *CONCRETE BATCHING FACILITY*

The proposed concrete batching plant will produce 20,000 m^3 per annum of central mixed product. The concrete mix production requires dry products (aggregate and sand) and moist product (cement supplement and cement) (United States Environmental Protection Agency, 2006). The potential sources of particulate matter emissions from central mix concrete batching plants generally include:

- Delivery of dry products to ground storage;
- Storage of dry products;
- Transfer of dry products using FELs;
- Pneumatic unloading of moist products from delivery trucks to elevated storage silos;
- Weigh hopper loading;
- Mixer loading; and
- Wheel generated dust from haul roads.

Emissions have been estimated using published emission factors from the following source:

- United States Environment Protection Agency AP-42 Air Emissions Factors and Quantification, Chapter 11: Mineral Products Industry, Section 11.12 Concrete Batching (United States Environmental Protection Agency, 2006).

It should be noted that in addition to particulate matter emissions, emissions from the concrete batching plant include metals as specified in AP-42 Section 11.12 (United States Environmental Protection Agency, 2006). These metals were therefore also considered in this assessment (*Annex B*).

6.4.1 *Delivery of dry products*

Coarse aggregate and sand will be delivered to site by the delivery trucks. The product will be dumped to the aggregate storage bins and therefore one rear dumping emission source for all incoming dry material was included in the dispersion modelling. Water sprays will be used during truck rear dumping to minimise dust emissions.

Emissions were estimated for the delivery of dry products, incorporating mitigation of water spray (see *Section B.3*.1 of *Annex B*).

6.4.2 Storage of dry products

The product delivered on site will be stored in aggregate storage bins enclosed on three sides. The walls will extend one metre above the height of the maximum quantity of raw material, and extend two metre beyond the front of the stockpile. The aggregate storage bins will be fitted with water sprays to keep the stored material damp at all times. It is therefore considered that no wind-blown dust emissions will occur from the storage of product near the concrete batching plant, and have not been considered further in this assessment.

6.4.3 Transfer of product

The dry products will be transferred from aggregate storage bins to conveyor belt using one FEL. Mobile sprinkler system will be used during the operation of FELs to minimise dust emissions.

Emissions were estimated for the transfer of product, incorporating mobile sprinkler water application mitigation (see Section *B.3*.2 of Annex *B*).

6.4.4 Pneumatic unloading of moist products

Cement and cement supplement will be delivered to the concrete batching plant in the agitator trucks and pneumatically fed to the bottom-loaded silos. It is therefore considered that particulate matter emissions from this source are negligible, and have not been considered further in this assessment.

6.4.5 Weigh Hopper and Mixer Loading

Concrete batching plant will be totally enclosed. One bag filter will be fitted above the pan mixer to minimise particulate matter emissions from the facility.

Emissions were estimated from the bag filter based on the maximum allowable concentration for particulate emissions allowable under the POEO Regulation. Emissions of other identified species have also been estimated (see Section *B.3*.3 of Annex *B*).

6.4.6 Wheel Generated Dust from Haul Roads

The concrete mix production requires dry products (aggregate and sand) and moist product (cement supplement and cement). *Table 6-1* provides the estimated volumes of material required for the production of 20,000 m^3 of concrete.

Table 6-1 Concrete mix breakdown

Products	Fraction[1]	Volume (tpa)
Coarse aggregate	0.46	21,868
Sand	0.35	16,750
Cement	0.12	5,764
Cement supplement	0.02	853
Concrete	1	47,200[2]

1. Adopted from AP-42 Section 11.12 (United States Environmental Protection Agency, 2006)
2. Calculated using wet concrete density of the mix of 2,360 kg/m^3 (Edinburgh Napier University, n.d.)

Coarse aggregate will be delivered from the processing facility using Caterpillar 769C rock truck. As previously discussed in *Section 6.2.5*, it is estimated that an average of 2 haul trips from stockpile area to concrete batching plant will occur daily.

Sand will be delivered from offsite by road truck-and-dog-type trucks. Given the volume of material required (*Table 6-1*) and the adopted capacity of the trucks of 32.43 tonnes, it was estimated that approximately 1 haul trip per day will be required. The hours of the deliveries on each day were randomised within 6am to 6pm as previously discussed in *Section 6.1*.

Cement and cement supplement will be delivered to the concrete batching facility using agitator trucks. Given the volume of material required (*Table 6-1*) and the adopted capacity of the agitator trucks of 19.8 tonnes, it was estimated that approximately 1 haul trip per day will be required. The hours of the deliveries on each day were randomised within 6am to 6pm as previously discussed in *Section 6.1*.

Concrete mix will be taken from the site to the market by the agitator trucks and Hanson has advised ERM that approximately 11 deliveries of concrete mix per day will occur. Given the delivery statistics for the year 1.09.2016 to 31.08.2017 provided to ERM, the agitator trucks movements were assumed to occur during the busiest eleven hours of the day – 6am to 5pm.

Emissions were estimated for wheel based emissions associated with the concrete batching plant, incorporating mitigation (see Section *B.3*.4 of Annex).

6.5 ASPHALT PLANT

The proposed asphalt plant on site will produce up to 50,000 tonnes of asphalt per annum. The potential sources of particulate matter emissions from counter-flow drum mix asphalt plants generally include:

- Bitumen delivery and storage;
- High quality aggregate delivery and storage;

- Dryer emissions;
- Truck load out; and
- Wheel generated dust from haul roads.

Emissions have been estimated using published emission factors from the following source:

- United States Environment Protection Agency AP-42 Air Emissions Factors and Quantification, Chapter 11: Mineral Products Industry, Section 11.1 Hot Mix Asphalt Plants (United States Environmental Protection Agency, 2004).

6.5.1 Bitumen Delivery and Storage

Bitumen will be delivered from offsite. It is understood that vapour balancing system will be installed for the delivery of bitumen on site and therefore it is considered that odour and dust emissions from bitumen delivery on site will be negligible. Once delivered, bitumen will be stored in a 50 m^3 tank. It is considered that breathing losses from this tank will be negligible, and therefore were not considered further in this assessment.

6.5.2 High quality aggregate delivery and storage

High quality aggregate for asphalt production will be sourced from the onsite processing plant. One of the FELs located around the processing plant and stockpile area will be utilised to transfer the aggregate to the asphalt plant. No additional FEL emission points therefore were included in the dispersion model. The aggregate at the asphalt plant will be stored in aggregate storage bins enclosed on three sides. The walls will extend one metre above the height of the maximum quantity of raw material, and extend two metre beyond the front of the stockpile. The aggregate storage bins will be fitted with water sprays to keep the stored material damp at all times. It is therefore considered that no wind-blown dust emissions will occur from the storage of product near the asphalt plant.

6.5.3 Dryer Emissions

The asphalt plant will be totally enclosed. One fabric filter associated with the natural-gas fired dryer will be fitted to minimise particulate matter emissions from the facility. It should be noted that in addition to particulate matter emissions, emissions from the dryer include carbon monoxide (CO), oxides of Nitrogen (NOx), sulfur dioxide (SO_2), organic species, metals and odour (United States Environmental Protection Agency, 2004).

While POEO Regulation emission limits were considered, emission factors provided by the AP-42 resulted in much lower emission rates and therefore were adopted in this assessment (see Section *B.3.1* of Annex).

6.5.4 *Truck Load Out*

Vapour recovery system will be employed for transfer of asphalt to trucks and therefore it is considered that odour and dust emissions from this source will be negligible. Emissions from truck load out have therefore not been considered further in this assessment.

6.5.5 *Wheel Generated Dust from Haul Roads*

High quality aggregate constitutes over 92% by weight of the total mixture (46,000 tpa). Due to the proximity of the asphalt plant to the processing plant (approximately 50 metres) it is considered that the aggregate will be continuously transferred to the aggregate storage bins at the asphalt plant using one of the FELs located around processing plant/stockpile area. Therefore no additional haul roads were included in this assessment for the delivery of the aggregate. Bitumen (approximately 8% by weight of the total mixture – 4,000 tpa) will be delivered from offsite. Having considered the capacity of the trucks (assumed to be 19.8 tonnes) and the annual volume of the bitumen delivery, it was estimated that approximately 1 haul trip per day will be required. The hours of the deliveries on each day were randomised within 6am to 6pm as previously discussed in *Section 6.1*.

The asphalt plant will produce up to 50,000 tpa of asphalt. Having considered the capacity of the trucks taking asphalt to the market (assumed to be 20 tonnes), it was estimated that approximately 7 haul trips per day will be associated with export of asphalt offsite. Given the delivery statistics for the year 1.09.2016 to 31.08.2017 provided to ERM, the truck movements associated with asphalt export from the Site were assumed to occur during the busiest seven hours of the day – 9am to 4pm.

Emissions were estimated for wheel based emissions associated with the asphalt plant, incorporating mitigation (see Section *B.3.2* of Annex *B*).

6.6 *EMISSIONS SUMMARY*

Table 6-2 provides the summary of TSP and PM_{10} emission rates used in dispersion modelling. The detailed emission estimation is provided in *Annex B*. $PM_{2.5}$ emissions were derived by post-processing of the PM_{10} results and therefore are discussed in *Section 7.5*.

Table 6-2 TSP and PM_{10} emission rates used in dispersion modelling

Emission source	TSP Emission Rate	PM_{10} Emission Rate	Units	Source
Drilling	0.0001[1]	0.00005[1]	g/sec	Section 1.1.8, NPI Mining[2]
Blasting	3.71[3]	1.93	g/sec	Equation 18, NPI Mining[2]

Emission source	TSP Emission Rate	PM_{10} Emission Rate	Units	Source
Excavators	Time-varying emission rate[4]		g/sec	Equations 10 and 11, NPI Mining[2]
Truck rear dumping	Time-varying emission rate[4]		g/sec	Equations 10, NPI Mining[2]
FELs	Time-varying emission rate[4]		g/sec	Equations 10 and 11, NPI Mining[2]
Primary Crusher	0.013[5]	0.00578[5]	g/sec	Table 17, Emission factor for tertiary controlled crushing[6]
Secondary Crusher	0.008[7]	0.004[7]	g/sec	
Tertiary Crusher	0.006[8]	0.003[8]	g/sec	
Primary Screening	0.023[5]	0.0079[5]	g/sec	Table 17, Emission factor for controlled screening[6]
Secondary Screening	0.015[7]	0.005[7]	g/sec	
Conveyor Drop Points	0.00019[9]	0.00006[9]	g/sec	Table 17, Emission factor for controlled conveyor transfer point
Conveyor Transfer Points	0.00019[9]	0.00006[9]	g/sec	
Wheel generated dust	Time-varying emission rate[10]		g/m/sec	Table 2, NPI Mining[2]
Wind erosion	Time-varying emission rate[10]		g/m/sec	Section 1.1.17 NPI Mining[2]
Mixer Loading with bag filter	0.00024[11]	0.0001[11]	g/sec	POEO Regulation[12]
Dryer with bag filter	0.026	0.003	g/sec	Section 11.1 AP-42[14]

1. Accounts for dust extraction system; Calculated for 125 holes as previously adopted (Environmental Resources Management Australia Pty Ltd, 2013)
2. (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012)
3. Estimated using area of blast of 900m^2 and depth of blast hole of 11 metres as provided by Hanson; and moisture content of the blasted material of 10% as previously adopted (Environmental Resources Management Australia Pty Ltd, 2013)
4. Calculated using moisture content of 9% (Environmental Resources Management Australia Pty Ltd, 2013) and hourly wind speed at the height of 2.5 metres above the ground, predicted in accordance with methodology outlined in *Section 7.1.*
5. Calculated for total tonnage of rock processed (675,000 tpa, averaged over the year)
6. (Australian Government Department of the Environment, 2014)
7. Calculated assuming that only 5/8 of the total rock processed will require secondary crushing
8. Calculated assuming that only 4/8 of the total rock processed will require tertiary crushing
9. Conveyor drop point to stockpiles, calculated assuming equal distribution to each of eight stockpiles (1/8th of the total rock processed)
10. Calculated using silt content of 7% as previously adopted (Environmental Resources Management Australia Pty Ltd, 2013).
11. Assumed volumetric flow for a similar type of facility (Environmental Resources Management Australia Pty Ltd, 2017)
12. Based on POEO regulation allowable solid particles discharge limit, Schedule 3 Cement or lime production or cement or lime handling, Group 6 (New South Wales Government, 2017)
13. Calculated for the total asphalt production of 50,000 tpa, averaged over the year
14. (United States Environmental Protection Agency, 2004) adopted as results in lower emission rate than emission rate required under POEO Regulation

As previously discussed, in addition to particulate matter, the concrete batching and asphalt plants emissions include metals as specified in AP-42 Section 11.1 and Section 11.12 (United States Environmental Protection Agency, 2006) (United States Environment Protection Agency, 2011). *Table 6-3* presents the emission rates considered in this assessment for these additional species.

Table 6-3 Emission rates for other species considered in this assessment

Species	Concrete Batching Plant Bag filter emission rate (g/sec)[1]	Asphalt dryer Bag Filter emission rate (g/sec unless specified otherwise)[2]
NO_x	-	0.02
CO	-	0.1
SO_2	-	0.003
Benzene	-	0.0003
Ethylbenzene	-	0.0002
Formaldehyde	-	0.002
Hexane	-	0.0007
Methyl chloroform	-	0.00004
Polycyclic aromatic hydrocarbon (PAH) as benzo[a]pyrene	-	0.00015
Toluene	-	0.0001
Xylene	-	0.0002
n-Heptane	-	0.007
n-Pentane	-	0.0002
Antimony and compounds	-	$1.4x10^{-7}$ **
Arsenic and compounds	$2.2x10^{-7}$ *	$4.4x10^{-7}$ **
Barium (soluble compound)	-	$4.6x10^{-7}$ **
Cadmium and cadmium compounds	$5.3x10^{-10}$ *	$3.2x10^{-7}$ **
Total Chromium	$9.4x10^{-8}$ *	$4.5x10^{-6}$ **
Copper fumes	-	$2.5x10^{-6}$ **
Chromium VI compounds	-	$2.6x10^{-7}$ **
Lead	$2.7x10^{-8}$ *	$4.9x10^{-7}$ **
Manganese and compounds	$2.8x10^{-6}$ *	$6.1x10^{-6}$ **
Mercury	-	$2.7x10^{-7}$ **
Nickel and nickel compounds	$1.8x10^{-7}$ *	0.00005
Silver soluble compounds (as Ag)	-	$3.8x10^{-7}$ **
Zinc	-	$4.8x10^{-5}$ **
Odour	-	43,333.3 (OU/sec)***

1. Calculated using emission factors obtained from AP-42 Section 11.12 (United States Environmental Protection Agency, 2006)
2. Calculated using emission factors obtained from Section 11.1 (United States Environmental Protection Agency, 2004).

* Calculated for the total concrete mix production of 20,000 m^3 (47,200 tpa), averaged over the year

** Calculated for the total asphalt production (50,000 tpa), averaged over the year

*** Calculated using odour emission rate of 1,040,000 OU m^3/min (GHD, 2008)

6.7 SCREENING ASSESSMENT

Prior to dispersion modelling, a screening assessment was undertaken to determine whether all emissions from the proposed operation were likely to result in material impact to ambient air quality.

It was considered that as the proposed development had multiple sources of particulate matter, these emissions should automatically be considered in the air quality assessment. The asphalt and concrete batching plants are the only potential onsite sources of metals, combustion products and organic species, and these emissions were therefore taken forward to screening.

The screening assessment adopted guidance published in the United Kingdom, '*Air emissions risk assessment for your environmental permit guidance*' (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016). The approach uses conservative dispersion factors to determine the likely maximum contribution to ground level concentrations. Where the maximum concentration is below specific thresholds the species is excluded from further assessment. The details of the screening assessment are provided in *Annex C*. The following species could not be screened out and therefore were included, in addition to particulate matter, in the dispersion modelling:

- NOx;
- Formaldehyde;
- PAH;
- Nickel; and
- Odour.

Emission rates for these species used in dispersion modelling are provided in *Table 6-3*.

7 DISPERSION MODELLING ASSESSMENT

7.1 MODELLING METHODOLOGY

The Approved Methods states that:

"*Ausplume Version 6.0 is the approved dispersion model for most applications in New South Wales*" (State of NSW and Environment Protection Authority, 2016).

The Approved Methods further states that Ausplume:

"*…is not approved in some applications where other more advanced dispersion model, such as CALPUFF and TAPM, may be more appropriate*" (State of NSW and Environment Protection Authority, 2016).

Consideration of the local meteorology (*Figure 4.1*) demonstrated a relatively high occurrence (from 6.7 - 11.4%) of calm winds (less than 0.5m/sec). Gaussian plume models, such as Ausplume, are unable to account for wind speeds of less than 0.5 m/sec and therefore have the potential to under estimate impacts in locations with significant periods of calm winds. In addition, AUSPLUME is unable to model the effects of terrain on area and volume sources. This Assessment therefore used the CALPUFF dispersion model to model emissions from the proposed operations in accordance with the Approved Methods.

CALPUFF is a multi-layer, multi-species non-steady-state puff dispersion model that simulates the effects of time- and space-varying meteorological conditions on atmospheric pollution dispersion. The NSW EPA approves this model in their guidance document *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW* (State of NSW and Environment Protection Authority, 2016). CALPUFF is able to model the dispersion of emissions during calm wind events as it 'remembers' the position of historical emissions following dispersion until they have been removed from the modelled grid.

7.2 METEOROLOGICAL MODELLING

Meteorological modelling was completed for a recent five year period (2012 to 2016 inclusive). This was undertaken to provide sufficient data to the dispersion modelling to understand the inter-annual variation in predicted impacts as a result of inter-annual meteorology.

Meteorological modelling was undertaken through a two-step process:

- Prognostic modelling using TAPM (developed by CSIRO); and
- Diagnostic modelling using CALMET (the meteorological pre-processor for the CALPUFF dispersion model).

7.2.1 TAPM

Initially, the prognostic meteorological model TAPM was run to provide surface and upper air data either missing, or not collected, at the nearest Bureau of Meteorology Station (Port Macquarie Airport).

TAPM was run using the following parameters:

- Four nests of 30 km, 10 km, 3km, and 1 km;
- Grid centre of 31°26′ S, 152°49′ E (MGA Zone 55 482712mE, 6522001mS);
- Grid of 25 X 25 cells;
- Observation file for observations from Port Macquarie meteorological station with area of influence of 5 km with 4 layers of the atmosphere influenced by the readings; and
- 25 vertical levels (10 m, 25 m, 50 m, 100 m, 150 m, 200 m, 250 m, 300 m, 400 m, 500 m, 600 m, 750 m, 1000 m, 1250 m, 1500 m, 1750 m, 2000 m, 2500 m, 3000 m, 3500 m, 4000 m, 5000 m, 6000 m, 7000 m and 8000 m).

7.2.2 CALMET

The setup of CALMET was completed in accordance with published guidance using a combination of observational and prognostic data (Barclay & Scire, 2011).

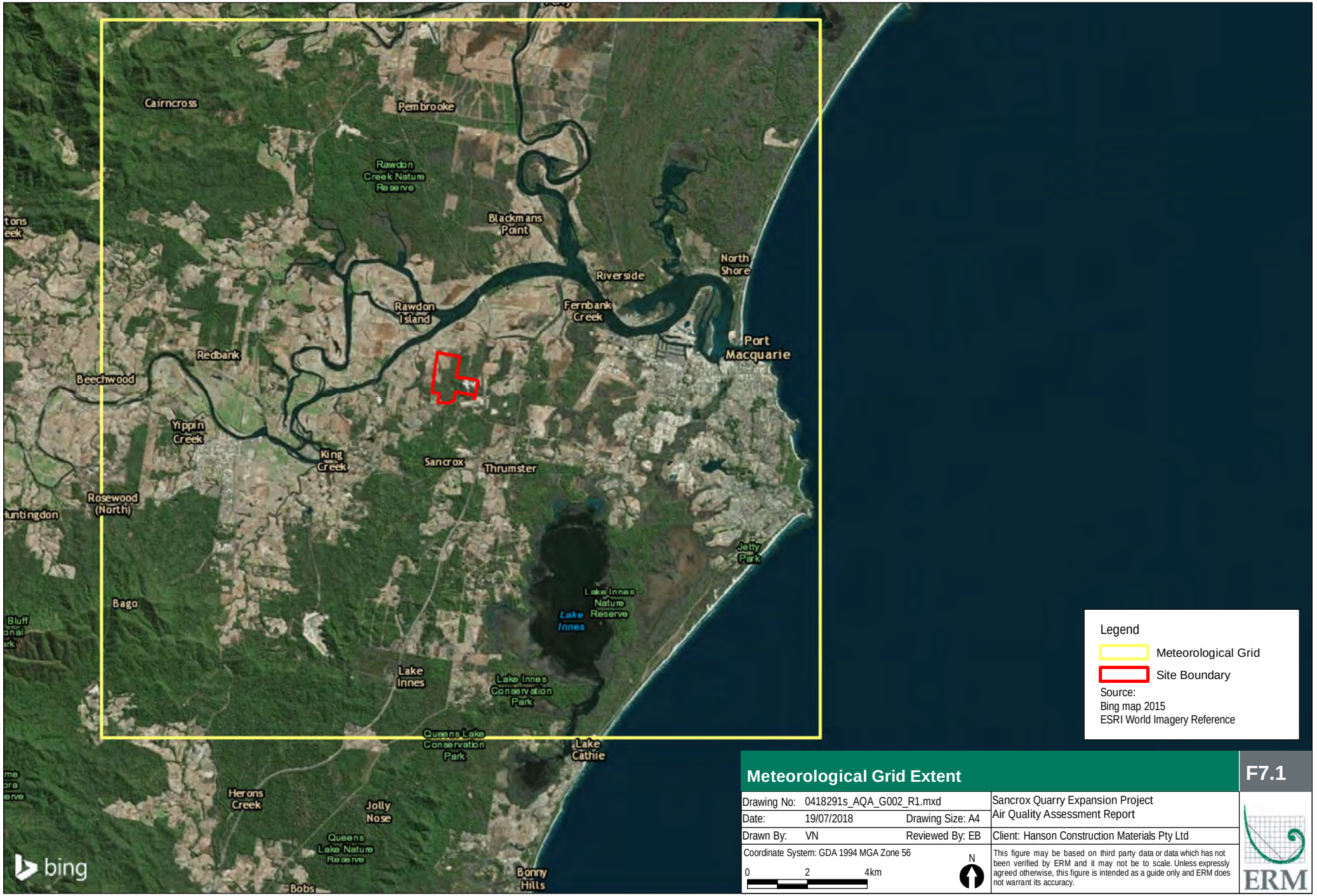
TAPM output was extracted at location 487712m E, 6533001m S (MGA Zone 55), and was used to generate a pseudo observation station for surface and upper air data within the modelled grid. For the surface data only where data was missing from Port Macquarie records for a particular hour was the data was included from the TAPM generated surface information file.

The CALMET model was set up using the system default settings with the exception of those shown in *Table 7-1*. *Figure 7.1* shows meteorological grid extent used in the dispersion modelling.

Table 7-1 Non-standard settings selected in CALMET

Parameter	Setting
Period Modelled	January 1 2012 to 31 December 2016 inclusive
UTM Zone	55 South
Grid south-west corner (MGA Zone 54)	470.483 km E, 6510.225 km N
Grid Spacing	150 m
Grid points	160 X 160
Cell face heights (m)	0, 20, 30, 40, 50, 70, 90, 100, 250, 500, 1000, 1500, 2000
Coriolis Frequency	7.5×10^{-5}
Bias adjustment for cell face heights	-1 , -1 , -.75 , -.75 , -.5 , -.25, 0 , 5 , 1 , 1 , 1 , 1
Terrad (km)[1]	0.5
RMAX 1 (km) [1]	7.5
RMAX2 (km) [1]	15.0
RMAX3 (km) [1]	30
RMIN (km) [1]	0.15
R1 (km) [1]	6.0
R2 (km) [1]	12.0
Surface Observation Station location	Port Macquarie (487.218km E, 6522.346km S),
Upper air observation (TAPM) location	487.712 km E, 6533.001 km S
Terrain data	ELVIS Elevation Information System (Australian Government Geoscience Australia, 2017)
Land use data	Catchment Scale Land Use of Australia (Department of Agriculture, 2016)

1. Selected in accordance with (Barclay & Scire, 2011)



Meteorological Grid Extent

F7.1

Drawing No:	0418291s_AQA_G002_R1.mxd		Sancrox Quarry Expansion Project Air Quality Assessment Report
Date:	19/07/2018	Drawing Size: A4	
Drawn By:	VN	Reviewed By: EB	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 2 4km

N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

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7.3 *DISPERSION MODEL RECEPTORS*

A Cartesian grid was set-up with the south west corner positioned at 476408 m E, 6516150 m N and grid receptors at regularly spaced intervals of 150m, covering an area of 12 km by 12 km.

Discrete receptors were chosen to represent nearby sensitive receptors described in *Section 2.1.3.*

7.4 *EMISSION PARAMETERS*

The configuration of the emission sources within the CALPUFF dispersion model comprised a combination of volume, point and road sources.

Table 7-2 provides emission source parameters for volume and road sources included in the dispersion model. *Table 7-3* provides emission source parameters for point sources included in the dispersion model. Source positioning is presented in *Figure 7.2*

Table 7-2 Emission source parameters for volume and road sources used in the dispersion modelling

Source ID	X (m)	Y (m)	Base Elevation above sea level (m)	Height above Ground (m)	Sigma y	Sigma Z
Drilling (Volume source)						
Drill1	482185	6521866	-12.2	15.00	0.01	0.01
Drill2	482169	6521840	-11.8	15.00	0.01	0.01
Drill3	482153	6521817	-9.8	15.00	0.01	0.01
Drill4	482137	6521796	-9.8	15.00	0.01	0.01
Drill5	482121	6521776	-9.1	15.00	0.01	0.01
Drill6	482097	6521771	-8.9	15.00	0.01	0.01
Drill7	482064	6521772	-10.1	15.00	0.01	0.01
Drill8	482034	6521767	-10.9	15.00	0.01	0.01
Drill9	481999	6521766	-10.4	15.00	0.01	0.01
Drill10	481961	6521757	-12.0	15.00	0.01	0.01
Drill11	481927	6521772	-14.4	15.00	0.01	0.01
Drill12	481915	6521804	-16.7	15.00	0.01	0.01
Blasting (Volume source)						
Blast1	482185	6521866	-12.2	15.00	6.98	6.98
Blast2	482169	6521840	-11.8	15.00	6.98	6.98
Blast3	482153	6521817	-9.8	15.00	6.98	6.98
Blast4	482137	6521796	-9.8	15.00	6.98	6.98
Blast5	482121	6521776	-9.1	15.00	6.98	6.98
Blast6	482097	6521771	-8.9	15.00	6.98	6.98
Blast7	482064	6521772	-10.1	15.00	6.98	6.98
Blast8	482034	6521767	-10.9	15.00	6.98	6.98
Blast9	481999	6521766	-10.4	15.00	6.98	6.98
Blast10	481961	6521757	-12.0	15.00	6.98	6.98
Blast11	481927	6521772	-14.4	15.00	6.98	6.98
Blast12	481915	6521804	-16.7	15.00	6.98	6.98

Source ID	X (m)	Y (m)	Base Elevation above sea level (m)	Height above Ground (m)	Sigma y	Sigma Z
Crushing and Screening at the Processing Facility (Volume source)						
PRMCRSH	482572.10	6521900.31	41.25	3.00	0.50	0.70
SECCRSH	482536.54	6521866.65	38.25	3.00	0.50	0.70
TERCRSH	482575.59	6521827.92	37.05	3.00	0.50	0.70
SCR1	482554.95	6521884.60	40.39	3.00	0.50	0.70
SCR2	482557.39	6521842.76	37.05	3.00	0.50	0.70
Primary Crusher (Concrete Recycling Facility) (Volume source)						
PRMCRSH2	482489.11	6521868.77	37.40	3.00	0.50	0.70
Conveying (Volume source)						
CNVDP1	482516.45	6521893.63	40.01	3.00	0.25	0.70
CNVDP2	482515.15	6521838.11	35.54	3.00	0.25	0.70
CNVDP3	482562.14	6521863.84	38.93	3.00	0.25	0.70
CNVDP4	482553.75	6521836.45	37.05	3.00	0.25	0.70
CNVDP5	482584.91	6521846.74	35.73	3.00	0.25	0.70
CNVDP6	482561.16	6521814.46	34.96	3.00	0.25	0.70
CNVDP7	482583.29	6521795.96	34.96	3.00	0.25	0.70
CNVDP8	482597.26	6521815.79	33.66	3.00	0.25	0.70
CNVTSP1	482577.93	6521811.26	34.96	4.00	0.25	0.93
CNVTSP2	482522.02	6521853.33	38.25	4.00	0.25	0.93
CNVTSP3	482525.48	6521889.90	40.01	4.00	0.25	0.93
Product Handling (Volume source)						
FEL1	482405.55	6521821.17	26.66	1.50	0.70	0.35
FEL2	482553.40	6521803.73	35.25	1.50	0.70	0.35
EXC1	482071.11	6521807.41	-11.98	3.20	0.35	0.74
EXC2	482052.06	6521827.52	-12.55	3.20	0.35	0.74
TDP1	482583.56	6521912.19	41.25	1.50	0.70	0.35
FEL3	482892.00	6522098.00	28.14	1.50	0.70	0.35

Source ID	X (m)	Y (m)	Base Elevation above sea level (m)	Height above Ground (m)	Sigma y	Sigma Z
TDP2	482895.00	6522084.00	28.54	1.50	0.70	0.35
TDP3	482481.00	6521829.00	33.80	1.50	0.70	0.35
Wind erosion (Volume source)						
STP1	482446.7	6521860.0	32.9	2.5	15.7	1.16
STP2	482268.1	6521915.0	29.0	2.5	15.7	1.16
STP3	482336.0	6521913.9	32.5	2.5	15.7	1.16
STP4	482475.6	6521920.2	38.9	2.5	15.7	1.16
STP5	482248.4	6521828.7	26.1	2.5	15.7	1.16
STP6	482310.0	6521852.9	27.2	2.5	15.7	1.16
STP7	482378.9	6521796.5	24.9	2.5	15.7	1.16
STP8	482376.4	6521862.6	30.6	2.5	15.7	1.16
STP9	482409.5	6521917.3	31.3	2.5	15.7	1.16
STP10	482447.6	6521787.5	26.9	2.5	15.7	1.16
STP11	482515.2	6521838.1	35.5	1.5	5.1	0.70
STP12	482553.7	6521836.4	37.0	1.5	3.4	0.70
STP13	482587.1	6521845.6	35.7	1.5	4.5	0.70
STP14	482597.3	6521815.8	33.7	1.5	3.9	0.70
STP15	482587.0	6521799.3	33.7	1.5	4.1	0.70
STP16	482570.8	6521797.4	35.0	1.5	4.6	0.70
STP17	482561.2	6521814.5	35.0	1.5	3.7	0.70
STP18	482562.1	6521863.8	38.9	1.5	3.7	0.70
STP19	482516.2	6521896.3	40.0	1.5	6.7	0.70
Wheel generated (Road source)						
HR1	multiple	multiple	multiple	2.55[1]	5.16[2]	2.37[2]

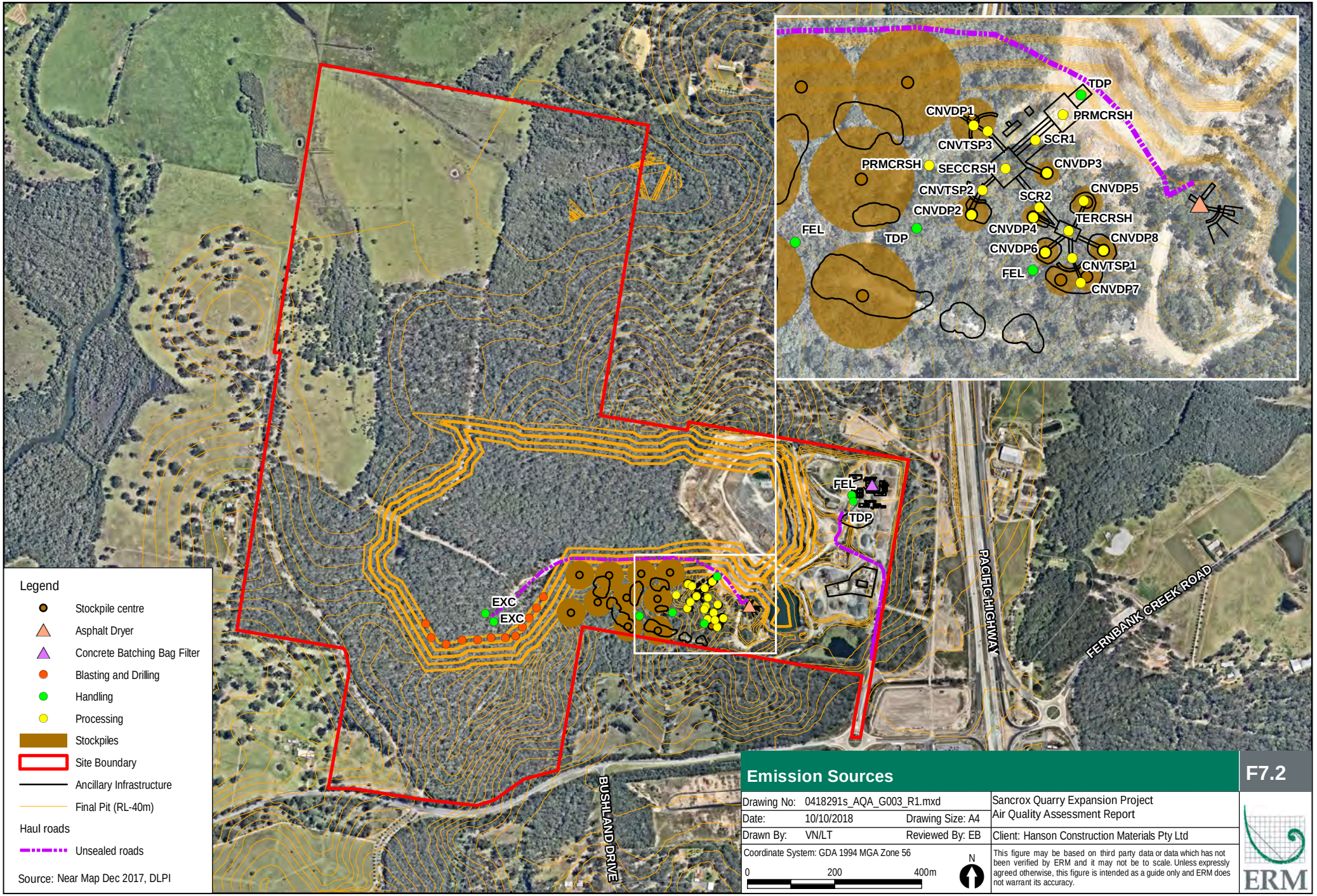
Source ID	X (m)	Y (m)	Base Elevation above sea level (m)	Height above Ground (m)	Sigma y	Sigma Z
HR4	multiple	multiple	multiple	2.55[1]	5.16[2]	2.37[2]
HR6	multiple	multiple	multiple	2.55[1]	5.16[2]	2.37[2]
HR7	multiple	multiple	multiple	2.55[1]	5.16[2]	2.37[2]
HR8	multiple	multiple	multiple	2.55[1]	5.16[2]	2.37[2]
HRA	multiple	multiple	multiple	2.55[1]	5.16[2]	2.37[2]

1. Volume release height as provided in the US EPA Haul Road Guidelines (United States Environmental Protection Agency, 2012)
2. Calculated in accordance with the modelling tip provided by Lakes Environmental (Lakes Environmental, 2016)

Table 7-3 Emission source parameters for point sources used in the dispersion modelling

Source Name	X (m)	Y (m)	Stack height (m)	Base Elevation (m)	Stack Diameter (m)	Exit Velocity (m/sec)	Exit Temperature (deg. K)
ASPHALT	482657	6521845	5.0[2]	25.9	4.3[2]	0.85[2,3]	435.9[1]
C_BATCH	482938	6522122	5.0[4]	25.9	12.0[4]	0.025[4]	313.15[4]

1. Adopted from AP-42 Asphalt mix temperature (United States Environmental Protection Agency, 2004)
2. Adopted from technical data specification for Benninghoven Asphalt Mixing Plants (A Wirtgen Group Company, n.d.)
3. Converted from 28,000 Nm^3/hour, using temperature of 435.928 K and stack diameter of 4.3 metres.
4. Assumed, given information from a similar type of facility (Environmental Resources Management Australia Pty Ltd, 2017)


TDP
CNVDP1
PRMCRSH
SCR1
CNVTSP3
PRMCRSH
SECCRSH
CNVDP3
CNVTSP2
SCR2
CNVDP5
CNVDP2
TERCRSH
FEL
CNVDP4
TDP
CNVDP8
CNVDP6
CNVTSP1
FEL
CNVDP7
FEL
TDP
EXC
EXC
PACIFIC HIGHWAY
FERNBANK CREEK ROAD
BUSHLAND DRIVE
Legend
Stockpile centre
Asphalt Dryer
Concrete Batching Bag Filter
Blasting and Drilling
Handling
Processing
Stockpiles
Site Boundary
Ancillary Infrastructure
Final Pit (RL-40m)
Haul roads
Unsealed roads
Source: Near Map Dec 2017, DLPI
Emission Sources
F7.2
Drawing No: 0418291s_AQA_G003_R1.mxd
Date: 10/10/2018
Drawing Size: A4
Drawn By: VN/LT
Reviewed By: EB
Coordinate System: GDA 1994 MGA Zone 56
0
200
400m
N
Sancrox Quarry Expansion Project
Air Quality Assessment Report
Client: Hanson Construction Materials Pty Ltd
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7.5 PARTICLE SIZE DISTRIBUTION

Particle size distribution describes the range of particle sizes within a specific particle class and allows the dispersion model to estimate how they will behave in the atmosphere. The size distribution used in the dispersion modelling is presented in *Table 7-4*. Depletion due to wet and dry processes has been included in the model.

Table 7-4 Mean Particle Size Distribution

Emission Source	TSP		PM_{10}	
	Geometric mean (μm)	Standard Deviation (μm)	Geometric mean (μm)	Standard Deviation (μm)
All sources (except for asphalt plant dryer)[1]	9.88	3.31	4.11	2.7
Asphalt plant dryer[2]	14.15	1.00	7.53	0.20

1. Adopted from AP-42 Appendix B2, Table B2.2.2, Category 3 (United States Environmental Protection Agency, 1996)
2. Adopted from AP-42 Section 11.1, Table 11.1-4 (United States Environmental Protection Agency, 2004)

7.6 POST-PROCESSING

For each scenario, the dispersion model produced results for each modelled grid point and each sensitive receptor for the five years of meteorological data considered. Post processing has been used to take the hourly modelled results and process them to derive the relevant averaged values.

7.6.1 $PM_{2.5}$

$PM_{2.5}$ results for the sources were derived from the predicted PM_{10} concentrations using POSTUTIL post-processing tool of CALPUFF dispersion model. *Table 7-5* presents the $PM_{2.5}$ ratios at source obtained from the literature review for the sources included in the dispersion modelling. By the time PM_{10} emissions reach sensitive receptor locations, some of the particles will drop out and therefore the relative contribution of $PM_{2.5}$ to PM_{10} will increase. It was conservative assumed that at the sensitive receptor locations $PM_{2.5}$ will constitute 1.5 times its original contribution. *Table 7-5* presents $PM_{2.5}$ to PM_{10} ratios adopted in this assessment.

Table 7-5 $PM_{2.5}$ to PM_{10} ratio

Emission Source	$PM_{2.5}$ to PM_{10} ratio at source	Adopted $PM_{2.5}$ to PM_{10} ratio at sensitive receptors[3]
Load-in/Load-out	0.32[1]	0.48
Wheel generated dust	0.15[1]	0.23
Wind erosion	0.40[1]	0.60
Blasting and Drilling	0.06[1]	0.09
Concrete Batching	0.29[2]	0.44

1. Source: (SKM, 2005)
2. (United States Environment Protection Agency, 2011)
3. Conservatively assumed to be 1.5 times of the $PM_{2.5}$ to PM_{10} ratio at source

7.6.2 *Respirable Crystalline Silica*

Rhyolite is a fine-grained volcanic rock of granitic composition, which contains medium silica content (as compared to basalt and granite). Silica content of rhyolite was conservatively adopted in this dispersion modelling as 70% (Northern Arizona University, n.d.). The predicted annual average concentrations of respirable crystalline silica were derived from $PM_{2.5}$ annual average concentrations as required by adopted assessment criterion (see Section *3.1.5*).

7.6.3 *Odour*

Odour is generated from the asphalt plant. The structure of the asphalt plant has the potential to generate wake effect on the stack emissions. In accordance with the Approved Methods, the 1-hour average predicted odour concentration was converted to peak ground level concentration using factor 2.3 for wake-effected point source (State of NSW and Environment Protection Authority, 2016).

7.6.4 *Background Concentrations*

The Approved Methods requires that in analysing the results, initially a Level 1 assessment is completed. This involves use addition of the maximum background concentration with the maximum modelled concentration to determine if there is an exceedance of the standard. The values contained in Section *4.5* were used for the Level 1 assessment.

For species that result in cumulative concentrations in exceedance of the acceptable standards in a level 1 assessment are then taken forward to a Level 2 assessment. This involves the addition of background measurements on an hour by hour basis to determine whether the project is likely to result in additional exceedances of the acceptable standard.

Background measurements at Wyong indicate that in 2013 maximum measured 24 hour concentrations of both PM_{10} and $PM_{2.5}$ exceeded the assessment criterion, whilst in 2015 PM_{10} exceeded the assessment criterion. Addition of

these values to the modelled concentration would therefore result in an exceedance of the assessment standard.

The background concentrations of PM_{10} and $PM_{2.5}$ for each hour of the modelled period (2012 to 2016) for Wyong were downloaded from the Office of Environment and Heritage Website. The hourly measurements for the days that had exceedances in the background data were removed from the analysis. The background concentrations were then combined with the results from the dispersion modelling in CALPOST on an hour by hour basis to provide a cumulative assessment.

8 MODELLING RESULTS

This section provides the dispersion model results and comparison to the assessment criteria.

8.1 PREDICTED PM_{10} CONCENTRATIONS

In relation to PM_{10} concentrations, the Approved Methods uses a staged approach to assessment using a Level 1 and Level 2 assessment, whereby:

- Level 1 comprises the sum of the maximum non-exceeding background concentration and the 100th percentile dispersion model predictions to obtain the potential maximum cumulative impact for each averaging period; and
- Level 2 comprises contemporaneous impact assessment of the PM_{10} 24-hour average predicted concentrations, where background data for the same time period is added to the model results to determine whether there is potential for additional exceedance of the standard given typical background and anticipated emissions.

A level 2 assessment is only completed where concentrations exceed the level 1 assessment, and is only completed for averaging periods of less than one year.

Table 8-1 provides the results of the Level 1 assessment of the PM_{10} predicted concentrations. The results of Level 1 assessment of the PM_{10} predicted concentrations indicates that the cumulative 24-hour concentrations are above the Approved Methods criterion at 43 sensitive receptors, while the cumulative annual mean concentrations are below the Approved Methods criterion at all sensitive receptors. It should be noted that the exceedances of PM_{10} 24-hour average criterion are mostly caused by the existence of elevated background levels within the measured values at Wyong.

Table 8-1 Level 1 Assessment of PM_{10} concentrations

	Predicted PM_{10} Concentrations (µg/m³) Maximum impact (increment)	
Receptor ID	**24 Hour Average**	**Annual Mean**
1	**52.7 (3.4)**	17.4 (0.76)
2	**53.7 (4.2)**	17.4 (0.78)
3	**56.7 (7.2)**	17.5 (0.91)
4	**59.6 (10.1)**	18 (1.37)
5	**53.1 (3.6)**	16.8 (0.22)
6	**50.5 (1.2)**	16.7 (0.05)
7	**56.2 (6.7)**	17.5 (0.97)
8	**52.3 (3.7)**	17.1 (0.65)
9	**55.6 (6.1)**	17.5 (1.07)
10	**53.9 (4.4)**	17.5 (1)
11	**52.1 (3.5)**	16.8 (0.28)
12	**54.1 (4.6)**	17.3 (0.65)

Receptor ID	Predicted PM_{10} Concentrations (µg/m³) Maximum impact (increment)	
	24 Hour Average	Annual Mean
13	**60.6 (16.8)**	20.2 (4)
14	**53 (3.8)**	17.6 (0.98)
15	**57.3 (7.8)**	17.9 (1.33)
16	**52.5 (3.3)**	17.4 (0.83)
17	**56.3 (6.8)**	17.6 (0.97)
18	**52.4 (3.6)**	16.9 (0.35)
19	**56.1 (14.5)**	17.4 (0.76)
20	**54.6 (7.3)**	16.8 (0.25)
21	**50.8 (2.2)**	16.7 (0.06)
22	49.97 (0.8)	16.6 (0.02)
23	49.98 (1.5)	16.6 (0.03)
24	**52.4 (2.9)**	16.8 (0.18)
25	**51.2 (1.8)**	16.7 (0.12)
26	**50.4 (1.4)**	16.6 (0.04)
27	**50.6 (1.8)**	16.6 (0.04)
28	**50.8 (1.8)**	16.6 (0.04)
29	**50.4 (1.2)**	16.7 (0.05)
30	**51 (1.5)**	16.7 (0.08)
31	**50.8 (1.3)**	16.7 (0.07)
32	**52.4 (3.7)**	16.9 (0.32)
33	**50.8 (1.6)**	16.8 (0.2)
34	**52.1 (3.5)**	17.2 (0.59)
35	**51.8 (2.6)**	17 (0.49)
36	**50.5 (1)**	16.7 (0.09)
37	**51.1 (1.7)**	16.8 (0.2)
38	**51 (1.7)**	16.8 (0.19)
39	**51.3 (1.8)**	16.8 (0.2)
40	**51.1 (1.6)**	16.8 (0.2)
41	**52.8 (3.3)**	17.1 (0.47)
42	**51.9 (2.9)**	17.1 (0.54)
43	**53.1 (3.6)**	17.1 (0.54)
44	**53.3 (4.4)**	17.4 (0.89)
45	**51.7 (2.3)**	17 (0.41)
Criterion	50[1]	25[1]

1. Source: (State of NSW and Environment Protection Authority, 2016)

Table 8-2 provides the results of Level 2 contemporaneous impact assessment of the PM_{10} 24-hour average predicted concentrations. The hourly background was added to the predicted concentrations, on an hour by hour basis for the five modelled years, to derive the maximum 24-hour average concentrations. The results of Level 2 contemporaneous impact assessment of the PM_{10} 24-hour average predicted concentrations indicate exceedances of the Approved Methods Criterion at 13 sensitive receptors.

The maximum site contribution to PM_{10} 24-hour average concentration at the sensitive receptor locations (incremental impact) is 16.8 µg/m^3. This level of impact does not exceed particulate matter mitigation criteria contained in the Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (NSW Government, 2018). Consequently, under this guidance, the level of impact to surrounding sensitive receptors is considered to be acceptable.

Table 8-2 Level 2 Assessment of PM_{10} 24-hour average concentrations

Receptor ID	Predicted 24 Hour PM_{10} Concentrations (µg/m^3)	
	Maximum Cumulative impact	Maximum Site Contribution (incremental impact)
1	**50.1**	3.4
2	**50.1**	4.2
3	**51.0**	7.2
4	**51.7**	10.1
5	49.6	3.6
6	49.4	1.2
7	49.4	6.7
8	49.4	3.7
9	49.7	6.1
10	49.9	4.4
11	49.4	3.5
12	**50.1**	4.6
13	**56.5**	16.8
14	**50.6**	3.8
15	**51.5**	7.8
16	**50.4**	3.3
17	**51.3**	6.8
18	**50.4**	3.6
19	**50.5**	14.5
20	49.4	7.3
21	49.4	2.2
22	49.4	0.8
23	49.4	1.5
24	49.5	2.9
25	49.5	1.8
26	49.4	1.4
27	49.4	1.8
28	49.4	1.8
29	49.4	1.2
30	49.4	1.5
31	49.4	1.3
32	49.4	3.7
33	49.4	1.6
34	49.4	3.5
35	49.4	2.6
36	49.4	1.0
37	49.4	1.7

Receptor ID	Predicted 24 Hour PM_{10} Concentrations (µg/m³)	
	Maximum Cumulative impact	Maximum Site Contribution (incremental impact)
38	49.4	1.7
39	49.4	1.8
40	49.4	1.6
41	49.99	3.3
42	**50.5**	2.9
43	49.98	3.6
44	49.6	4.4
45	49.4	2.3
Criteria	50[1]	50[2]

1. Source: (State of NSW and Environment Protection Authority, 2016)
2. Source: (NSW Government, 2018)

8.2 *PREDICTED $PM_{2.5}$ CONCENTRATIONS*

Table 8-3 provides the Level 1 assessment for $PM_{2.5}$ predicted concentrations. The results of Level 1 assessment of the $PM_{2.5}$ predicted concentrations indicates that the cumulative 24-hour concentrations are above the Approved Methods criterion at 16 sensitive receptors, the cumulative annual mean concentration is below the Approved Methods criterion at all sensitive receptors. It should be noted that the exceedances of $PM_{2.5}$ 24-hour average criterion are mostly caused by elevated background levels as measured at Wyong.

Table 8-3 Level 1 Assessment of $PM_{2.5}$ concentrations

	Predicted $PM_{2.5}$ Concentrations (µg/m³) Maximum impact (increment)	
Receptor ID	24 Hour Average	Annual Mean
1	**25.04 (0.9)**	6.9 (0.2)
2	**25.04 (0.9)**	6.9 (0.2)
3	**25.6 (2)**	6.9 (0.2)
4	**26.6 (4.2)**	7 (0.3)
5	24.7 (1.1)	6.8 (0.1)
6	24.3 (0.3)	6.7 (0)
7	**26 (2.6)**	6.9 (0.2)
8	24.9 (1.1)	6.8 (0.2)
9	**25.7 (2.3)**	6.9 (0.3)
10	**25.3 (1.1)**	6.9 (0.2)
11	**25.6 (2)**	6.8 (0.1)
12	24.99 (0.8)	6.9 (0.2)
13	**26.8 (3.1)**	7.6 (1)
14	24.96 (0.8)	6.9 (0.2)
15	**26.3 (3.7)**	7 (0.3)
16	24.95 (0.8)	6.9 (0.2)
17	**25.9 (2.9)**	6.9 (0.2)
18	24.97 (1)	6.8 (0.1)
19	**25.6 (2.3)**	6.9 (0.2)

Receptor ID	Predicted $PM_{2.5}$ Concentrations (µg/m³) Maximum impact (increment)	
	24 Hour Average	Annual Mean
20	**25.3 (1.8)**	6.8 (0.1)
21	24.5 (0.6)	6.7 (0)
22	24.3 (0.2)	6.7 (0)
23	24.4 (0.3)	6.7 (0)
24	24.6 (0.9)	6.7 (0)
25	24.5 (0.6)	6.7 (0)
26	24.4 (0.5)	6.7 (0)
27	24.4 (0.4)	6.7 (0)
28	24.3 (0.2)	6.7 (0)
29	24.3 (0.3)	6.7 (0)
30	24.9 (0.7)	6.7 (0)
31	24.9 (0.7)	6.7 (0)
32	**25.7 (2.1)**	6.8 (0.1)
33	24.8 (0.8)	6.8 (0.1)
34	24.9 (1.1)	6.8 (0.1)
35	24.8 (0.8)	6.8 (0.1)
36	24.6 (0.5)	6.7 (0)
37	24.6 (0.7)	6.8 (0.1)
38	24.6 (0.6)	6.8 (0.1)
39	24.6 (0.8)	6.8 (0.1)
40	24.6 (0.8)	6.8 (0.1)
41	24.8 (0.6)	6.8 (0.1)
42	**25.1 (1.3)**	6.8 (0.1)
43	24.8 (0.6)	6.8 (0.1)
44	**25.1 (1.4)**	6.9 (0.2)
45	24.8 (0.6)	6.8 (0.1)
Criterion	25[1]	8[1]

1. Source: (State of NSW and Environment Protection Authority, 2016)

Table 8-4 provides Level 2 contemporaneous impact assessment of the $PM_{2.5}$ 24-hour average predicted concentrations. The results of Level 2 contemporaneous impact assessment of the $PM_{2.5}$ 24-hour average predicted concentrations indicate no exceedances of the Approved Methods Criterion at any of the sensitive receptors. The maximum site contribution to $PM_{2.5}$ 24-hour average concentration at the sensitive receptor locations (incremental impact) is 4.2 µg/m³.

Table 8-4 Level 2 Assessment of $PM_{2.5}$ 24-hour average concentrations

Receptor ID	Predicted 24 Hour $PM_{2.5}$ Concentrations (µg/m³)	
	Maximum Cumulative impact	Maximum Site Contribution (incremental impact)
1	23.3	0.9
2	23.3	0.9
3	23.3	2.0
4	23.3	4.2
5	23.3	1.1

Receptor ID	Predicted 24 Hour $PM_{2.5}$ Concentrations (μg/m³)	
	Maximum Cumulative impact	Maximum Site Contribution (incremental impact)
6	23.3	0.3
7	23.3	2.6
8	23.3	1.1
9	23.3	2.3
10	23.3	1.1
11	23.6	2.0
12	23.3	0.8
13	23.4	3.1
14	23.3	0.8
15	23.3	3.7
16	23.3	0.8
17	23.3	2.9
18	23.3	1.0
19	23.3	2.3
20	23.3	1.8
21	23.3	0.6
22	23.3	0.2
23	23.3	0.3
24	23.3	0.9
25	23.3	0.6
26	23.3	0.5
27	23.3	0.4
28	23.3	0.2
29	23.3	0.3
30	23.3	0.7
31	23.3	0.7
32	23.8	2.1
33	23.3	0.8
34	23.3	1.1
35	23.3	0.8
36	23.5	0.5
37	23.3	0.7
38	23.3	0.6
39	23.3	0.8
40	23.3	0.8
41	23.3	0.6
42	23.3	1.3
43	23.3	0.6
44	23.3	1.4
45	23.3	0.6
Criteria	25[1]	-

1. Source: (State of NSW and Environment Protection Authority, 2016)

8.3 PREDICTED CONCENTRATIONS FOR ALL OTHER SPECIES

Table 8-5 provides the predicted concentrations for all species other than PM_{10} and $PM_{2.5}$ included in the dispersion modelling against the adopted criteria. The results for these species included in the dispersion modelling are below the adopted criteria at all sensitive receptor locations.

Table 8-5 Predicted concentrations for all species other than PM_{10} and $PM_{2.5}$ included in the dispersion modelling

Receptor ID	Predicted TSP Concentrations (µg/m³) Maximum impact (increment)	Predicted Silica Concentrations (µg/m³) Maximum impact	Predicted Dust Deposition (g/m²/month) Maximum impact (increment)	Predicted NO_2 (µg/m³) Maximum impact (increment)		Predicted Formaldehyde (µg/m³) Maximum impact	Predicted PAH (µg/m³) Maximum impact	Predicted Nickel (µg/m³) Maximum impact	Predicted Odour (OU/m³) Maximum impact
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	1 Hour Mean	Nose Response Time
1	30.6 (0.2)	0.14	0.0	10.3 (0.018)	95.2 (0.033)	0.0904	0.0055	0.0018	1.6
2	30.6 (0.2)	0.14	0.1	10.3 (0.012)	60.1 (0.039)	0.0718	0.0044	0.0015	1.2
3	30.8 (0.4)	0.16	0.1	10.3 (0.009)	70.2 (0.04)	0.0452	0.0028	0.0009	0.9
4	31.2 (0.8)	0.24	0.2	10.3 (0.009)	66.1 (0.047)	0.0470	0.0029	0.0010	1.1
5	30.5 (0.3)	0.04	0.1	10.3 (0.003)	70 (0.052)	0.0241	0.0015	0.0005	0.4
6	33.2 (0)	0.01	0.0	10.3 (0.001)	59.6 (0.067)	0.0142	0.0009	0.0003	0.2
7	33.9 (0.7)	0.17	0.2	10.3 (0.014)	66.1 (0.069)	0.0455	0.0028	0.0009	1.3
8	30.7 (0.3)	0.11	0.1	10.3 (0.007)	84.6 (0.069)	0.0510	0.0031	0.0010	0.9
9	31 (0.6)	0.19	0.2	10.3 (0.006)	94.8 (0.073)	0.0447	0.0027	0.0009	0.9
10	30.8 (0.4)	0.17	0.1	10.3 (0.007)	70.1 (0.062)	0.0354	0.0022	0.0007	0.9
11	30.1 (0.3)	0.07	0.1	10.3 (0.005)	59.8 (0.059)	0.0291	0.0018	0.0006	0.8
12	30.6 (0.2)	0.12	0.1	10.3 (0.011)	60 (0.059)	0.0624	0.0038	0.0013	1.1
13	34.2 (3.8)	0.68	0.8	10.3 (0.017)	95 (0.07)	0.0761	0.0047	0.0015	2.1
14	30.8 (0.4)	0.17	0.1	10.3 (0.013)	94.8 (0.081)	0.0412	0.0025	0.0008	1.1
15	31.1 (0.7)	0.23	0.2	10.3 (0.009)	84.5 (0.106)	0.0462	0.0028	0.0009	1.1
16	30.7 (0.3)	0.14	0.1	10.3 (0.012)	70.3 (0.117)	0.0624	0.0038	0.0013	1
17	30.9 (0.5)	0.17	0.1	10.3 (0.009)	59.9 (0.119)	0.0401	0.0025	0.0008	0.9
18	30.5 (0.3)	0.07	0.1	10.3 (0.007)	84.4 (0.145)	0.0293	0.0018	0.0006	0.7
19	31.1 (0.9)	0.14	0.3	10.3 (0.005)	66 (0.136)	0.0339	0.0021	0.0007	0.7
20	33.5 (0.3)	0.04	0.1	10.3 (0.003)	84.4 (0.135)	0.0320	0.0020	0.0007	0.5
21	33.3 (0.1)	0.01	0.0	10.3 (0.001)	84.3 (0.168)	0.0152	0.0009	0.0003	0.2
22	33.2 (0)	0.00	0.0	10.3 (0.001)	59.6 (0.189)	0.0107	0.0007	0.0002	0.1
23	33.2 (0)	0.01	0.0	10.3 (0.001)	59.6 (0.174)	0.0114	0.0007	0.0002	0.2
24	30.4 (0.2)	0.03	0.1	10.3 (0.002)	70 (0.193)	0.0225	0.0014	0.0005	0.3
25	30.3 (0.1)	0.02	0.0	10.3 (0.002)	69.9 (0.176)	0.0171	0.0010	0.0003	0.3
26	33.2 (0)	0.01	0.0	10.3 (0.001)	69.9 (0.158)	0.0119	0.0007	0.0002	0.2
27	33.2 (0)	0.01	0.0	10.3 (0.001)	65.8 (0.137)	0.0128	0.0008	0.0003	0.2
28	33.2 (0)	0.01	0.0	10.3 (0.001)	84.3 (0.147)	0.0134	0.0008	0.0003	0.1
29	33.2 (0)	0.01	0.0	10.3 (0.001)	59.6 (0.122)	0.0140	0.0009	0.0003	0.2
30	33.3 (0.1)	0.02	0.0	10.3 (0.002)	94.5 (0.104)	0.0152	0.0009	0.0003	0.2
31	33.3 (0.1)	0.02	0.0	10.3 (0.002)	69.9 (0.1)	0.0151	0.0009	0.0003	0.2
32	30.1 (0.3)	0.07	0.1	10.3 (0.005)	94.7 (0.099)	0.0294	0.0018	0.0006	0.8
33	33.3 (0.1)	0.04	0.0	10.3 (0.006)	70.1 (0.084)	0.0354	0.0022	0.0007	0.6
34	33.5 (0.3)	0.10	0.1	10.3 (0.009)	84.5 (0.09)	0.0467	0.0029	0.0009	0.9
35	30 (0.2)	0.09	0.1	10.3 (0.01)	70.4 (0.078)	0.0730	0.0045	0.0015	1.1
36	29.9 (0.1)	0.02	0.0	10.3 (0.002)	65.8 (0.094)	0.0138	0.0008	0.0003	0.3
37	33.3 (0.1)	0.04	0.0	10.3 (0.006)	59.8 (0.089)	0.0293	0.0018	0.0006	0.6
38	33.3 (0.1)	0.04	0.0	10.3 (0.006)	59.7 (0.067)	0.0273	0.0017	0.0006	0.6
39	33.3 (0.1)	0.04	0.0	10.3 (0.006)	94.7 (0.062)	0.0324	0.0020	0.0007	0.6

Receptor ID	Predicted TSP Concentrations (µg/m³) Maximum impact (increment)	Predicted Silica Concentrations (µg/m³) Maximum impact	Predicted Dust Deposition (g/m²/month) Maximum impact (increment)	Predicted NO_2 (µg/m³) Maximum impact (increment)		Predicted Formaldehyde (µg/m³) Maximum impact	Predicted PAH (µg/m³) Maximum impact	Predicted Nickel (µg/m³) Maximum impact	Predicted Odour (OU/m³) Maximum impact
40	33.3 (0.1)	0.04	0.0	10.3 (0.006)	59.8 (0.057)	0.0315	0.0019	0.0006	0.6
41	30.6 (0.2)	0.08	0.0	10.3 (0.01)	59.9 (0.053)	0.0509	0.0031	0.0010	1
42	30.6 (0.2)	0.09	0.1	10.3 (0.008)	59.9 (0.054)	0.0427	0.0026	0.0009	0.8
43	30.6 (0.2)	0.10	0.0	10.3 (0.011)	60 (0.051)	0.0552	0.0034	0.0011	1.1
44	30.8 (0.4)	0.16	0.1	10.3 (0.006)	94.7 (0.051)	0.0371	0.0023	0.0008	0.8
45	30 (0.2)	0.07	0.0	10.3 (0.009)	70.3 (0.054)	0.0673	0.0041	0.0014	1
Criteria	**90**	**3**	**2**	**62**	**246**	**20**	**0.4**	**0.18**	

9 MITIGATION MEASURES

This air quality impact assessment considered all reasonable and feasible mitigation measures to minimise the emissions from the proposed activities at the site. The mitigation measured considered in this assessment include:

- Roads, which are likely to remain unchanged throughout the Project stages and to be frequently used by machinery, will be sealed using asphalt and swept daily to minimise wheel-generated dust emissions;
- Full dust extraction system for drilling;
- Utilisation of water sprays during truck rear dumping;
- The use of mobile sprinkler systems during the operation of FELs;
- Dust suppression measures such as water sprays in place at the crushers and screeners;
- Water sprays used on all conveyor transfer points;
- The conveyor loading to be enclosed by a shroud;
- Level 2 watering (more than 2 litres/m^2/hour) applied to unsealed roads to minimise impact from hauling;
- Water sprays to be utilised to minimise wind erosion from stockpiles during wind speeds of over 5.4 metres per second;
- The dry product delivered to the concrete batching, concrete recycling and asphalt plants to be stored in aggregate storage bins enclosed on three sides. The walls to extend one metre above the height of the maximum quantity of raw material, and two metre beyond the front of the stockpile. The aggregate storage bins to be fitted with water sprays to keep the stored material damp at all times;
- Cement and cement supplement to be delivered to the concrete batching plant in the agitator trucks and pneumatically fed to the bottom-loaded silos;
- Concrete batching loading point to be totally enclosed with all particulate matter emissions generated by the facility captured by one bag filter located above the pan mixer;
- Concrete recycling facility outloading to be directly to processed material storage bins enclosed on three sides. The walls to extend one metre above the height of the maximum quantity of raw material, and two metre beyond the front of the stockpile. The recycled concrete storage bins to be fitted with water sprays to keep the stored material damp at all times;

- Vapour balancing system to be installed for the delivery of bitumen at the asphalt plant;

- Asphalt plant will be totally enclosed. All particulate matter emissions generated at the plant will be captured by one fabric filter associated with the natural-gas fired dryer; and

- Vapour recovery system to be employed for transfer of asphalt to trucks.

10 MONITORING AND MANAGEMENT MEASURES

It is recommended that in addition to management measures described in Section *9*, the Site employs real-time ambient air quality monitoring system. This will allow staff to identify when additional mitigation measures are to be implemented to minimise impact from the onsite activities on the days when the background concentrations of PM_{10} and $PM_{2.5}$ exceed the criteria set by the Approved Methods. Given the proximity of Receptor 13 to the site boundary and moderate occurrence of winds from the north-western and north-eastern directions (*Figure 4.1*), it is recommended that one real-time monitor is placed along the southern boundary of the Site to capture the Site emissions and another monitor is placed along the northern boundary to obtain background concentrations when the winds are blowing from offsite.

Table 10-1 provides recommendations for the environmental management to ensure minimisation of air quality impact to the surrounding land use as a result of construction activities.

Table 10-1 Recommendations for the environmental management plan

Item	Mitigation/ Management/Control Measure	Trigger/Timing	Responsibility
Clearing, Site Preparation and Excavation			
1	Modify working practices by limiting clearing, stripping and spoil handling during periods of adverse weather (hot, dry and windy conditions) and when dust is seen leaving the site.	When visible dust is being generated	Supervisors, Construction Manager
2	Limit the extent of clearing of vegetation and topsoil to the designated footprint required for construction and appropriate staging of any clearing.	During construction works planning stage	Construction Manager
3	All disturbed areas where trees and other vegetation are removed are to be stabilised and or revegetated/ rehabilitated in accordance with the contractual requirements as soon as practical following final land shaping	After final land shaping	Supervisors, Construction Manager
4	Minimise the exposure of fill and excavated material to active work fronts.	Ongoing	Supervisors
5	Use water sprays as a suppressant during road construction, when movement of materials generates visible dust.	When visible dust is being generated.	Supervisors, Construction Manager
6	Minimise drop heights for material transport to prevent dust dispersal.	Ongoing	Supervisors
7	Maintain all construction equipment, machinery and vehicles to ensure optimal performance which would minimise exhaust emissions.	Ongoing	Supervisors
8	Minimise idling of construction equipment, machinery and vehicles to no more than 5 minutes to minimise exhaust emissions.	Ongoing	Supervisors
9	Plan construction methodology to ensure capacity of construction equipment, machinery and vehicles is fully utilised.	During construction works planning stage	Construction Manager
Haulage and Heavy Plant and Equipment Movements			
10	Modifying work practices during periods of high winds and/or dry conditions by limiting scraper/ grader activity.	Ongoing	Supervisors
11	All vehicles on-site will be confined to a designated route with a speed limit of 30 km/hr enforced.	Ongoing	Supervisors
12	Trips and trip distances will be controlled and reduced where possible, for example by coordinating delivery and removal of materials to avoid unnecessary trips.	Ongoing	Supervisors, Construction Manager
13	All trucks delivering fill or leaving the site with spoil material will have their load covered.	Ongoing	Supervisors

Item	Mitigation/ Management/Control Measure	Trigger/Timing	Responsibility
14	No idling of vehicles unless power is required for unloading or cooling for the occupant of vehicle on days of high temperature.	Ongoing	Supervisors
Wind Erosion			
15	Wind erosion from exposed ground will be limited by avoiding unnecessary vegetation and topsoil clearing and limiting to the minimum footprint required.	Ongoing	Supervisors, Construction Manager
16	Wind erosion from temporary stockpiles will be limited by minimising the number of work faces on stockpiles, minimising the number of stockpiles and through covering or temporary stabilisation (compaction of surface, water sprays, seeding, veneering) of the stockpiles.	Ongoing	Supervisors, Construction Manager
Dust monitoring			
17	Visual checks for excessive dust generation will be undertaken daily during construction	Ongoing	Supervisors, Construction Manager

11 CONCLUSIONS

ERM was engaged by Hanson to undertake specialist assessments to inform the EIS for the proposed Sancrox Quarry Extension Project. This assessment addresses the Secretary's Requirements for the preparation of an EIS for the Sancrox Quarry Extension Project (Department of Planning and Environment, 2017) and undertook the following scope of works:

- Assessment of potential for ambient air quality impacts and greenhouse gas emissions from construction and operation of the Project;
- Provision of mitigation measures to minimise impacts to the surrounding land use; and
- Recommendations for ambient monitoring to ensure compliance with legislation.

The assessment of ambient air quality impacts identified that:

- The cumulative annual mean concentrations of PM_{10} are below the Approved Methods criterion at all sensitive receptors;
- Contemporaneous analysis identified that the cumulative (background plus Site contributions) PM_{10} 24-hour average predicted concentrations indicate exceedances of the Approved Methods Criterion at 13 sensitive receptors. The maximum incremental impact, however, does not exceed particulate matter mitigation criteria contained within the Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (NSW Government, 2018) and consequently under this guidance the level of impact to surrounding land use is considered to be acceptable;
- The cumulative annual mean concentrations of $PM_{2.5}$ are below the Approved Methods criterion at all sensitive receptors;
- The results of Level 2 contemporaneous impact assessment of the $PM_{2.5}$ 24-hour average predicted concentrations are below the Approved Methods Criterion at all sensitive receptors; and
- The predicted concentrations for all other species are below the adopted criteria at all sensitive receptor locations.

The Project over its entire life cycle is estimated to release approximately 48.4 million tonnes of CO_2-e into the atmosphere with scope 1 and scope 2 emissions accounting for 74% and 26% respectively of the total emissions. The main GHG emission sources over the life of the project representing 99% of all emissions are:

- Operations – Diesel for transport related purposes (38%);

- Operations – Electricity (26%);
- Operations – LNG (16%);
- Construction – Vegetation clearing (12%); and
- Operations – Diesel for stationary energy purposes (6%).

Peak Scope 1 and Scope 2 emissions from the Project (approximately 0.0054 Mt CO_2-e during Year 7/Year8) represent approximately 0.0010% of Australia's commitment for annual emissions under the Kyoto Protocol (550.2 Mt CO2-e/annum for 2016-17). In comparison to the 2015 GHG emissions in NSW, the project emissions account for approximately 0.0041%. When compared to the 2015 GHG emission levels from all Mining sources in Australia (74.5 Mt CO_2-e), the Project accounts to 0.0073%.

This assessment considered all reasonable and feasible mitigation measures to minimise the emissions from the proposed activities at the site and provided recommendations for ambient monitoring to ensure compliance with legislation.

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Annex A

GHG Emission Estimation

A.1 GHG EMISSION CALCULATIONS

A.1.1 Construction GHG Emissions

Vegetation Clearing

Greenhouse gas (GHG) emissions from vegetation clearing was estimated using the following equation:

Equation 1:

$$E_{CO_2-e} = A\ X\ EF$$

where:

E_{CO2-e}	Emissions of GHG due to loss in carbon sink from vegetation clearing	(t CO_2-e)
A	Estimated extent of vegetation clearing	(hectare)
EF	Emission factor for vegetation clearing	(t CO_2-e/ha)

The emissions factor was sourced from Transport Authorities Greenhouse Group Workbook (Transport Authorities Greenhouse Group Australia and New Zealand, 2013) and is detailed in *Table A-2*.

Table A-2 GHG Emission Rate – Vegetation clearing

Activity	Emission Factor	Unit
Vegetation Clearing	142	t CO_2–eq /ha

Note:

1. Reference: Table 11, Supporting Document for Greenhouse Gas Assessment Workbook for Road Projects (Transport Authorities Greenhouse Group of Australia & New Zealand, 2013b).
2. Applicable for maximum biomass class 4 (150 - 250 tonnes dry matter/ha) & Vegetation Class 'C' (Open Forest).
3. Relates to emissions resulting from lost carbon sequestration associated with vegetation clearance.

The extent of cleared land is provided in *Table 5-1*. Soil removal depth of 100cm was used to estimate the volume of material moved.

Diesel combustion

The quantity of fuel used during construction was estimated using the following equation.

Equation 2:

$$Q = \frac{Q_r \times A}{1000}$$

where:

Q	Quantity of fuel used during construction	(kL)
Q_r	Fuel usage rate	(kL/ha or kL/m^3)
A	Extent of disturbance	(ha or m^3)

The fuel usage rate was sourced from Transport Authorities Greenhouse Group Workbook (Transport Authorities Greenhouse Group Australia and New Zealand, 2013) and is detailed in *Table A-3*.

Table A-3 Fuel usage rate –associated with vegetation clearing and construction

Activity	Emission Rate	Unit	Assumptions
Liquid Fuel combustion - clearing and grubbing of vegetated areas	2.8	kL / ha	Applicable for High shrubs and medium dense trees < 10m, assumed to be equivalent to woodland with a vegetation mass of 210t/ha of cleared area
Liquid Fuel combustion - earthmoving equipment	0.0012	kL/ m^3	Assumes earthwork using conventional method (graders and dozers)
Liquid Fuel combustion – sealing of haul roads	0.00169	kL/m^2	Tale 5-8, Default Quantity Factors for Pavements for Full Depth Asphalt

Note:

1. Reference: Table 5-6, Greenhouse Gas Assessment Workbook for Road Projects, Transport Authorities Greenhouse Group, February 2013 (Transport Authorities Greenhouse Group Australia and New Zealand, 2013).

The resulting quantity of fuel used during construction is presented in *Table A-4*.

Table A-4 Estimated quantity of fuel used in construction

Stage	Quantity of fuel – clearing and grubbing of vegetated areas (kL)	Quantity of fuel – earthmoving equipment (kL)	Quantity of fuel – sealing haul roads
Stage 1	17.0	72.9	0
Stage 2	13.6	5.8	11.3
Stage 3	26.0	11.1	0
Stage 4	0.0	0.0	0
Stage 5	33.4	14.3	0
Stage 6	23.8	10.2	0

Greenhouse gas (GHG) emissions from diesel consumption during construction was estimated using the following equation:

Equation 3:

$$E_{CO_2-e} = \frac{Q \times EF}{1000}$$

where:

E_{CO2-e}	Emissions of GHG from diesel combustion	(t CO2-e)[1]
Q	Estimated combustion of diesel	(GJ)[2]
EF	Emission factor for diesel combustion	(kg CO2-e/GJ)[3]

[1] tCO2-e = tonnes of carbon dioxide equivalent

[2] GJ = gigajoules

[3] kg CO2-e/GJ = kilograms of carbon dioxide equivalents per gigajoule

The quantity of diesel consumed in GJ is calculated using an energy content factor for diesel of 38.6 gigajoules per kilolitre (GJ/kL) (Australian Government Department of the Environment and Energy, 2017a). The emission factor for diesel combustion for stationary energy purpose is 70.2 kg CO_2 eq/GJ (Australian Government Department of the Environment and Energy, 2017a).

A.1.2 Operational GHG Emissions

At Sancrox quarry, it is assumed that diesel will be used for the following operational purposes:

- Fuel in trucks for haulage of materials onsite;
- Fuel in trucks for haulage of finished product to offsite client premises; and
- Fuel to operate machinery including but not limited to excavators, front end loaders and dozers.

Diesel Oil – Onsite Operations

Greenhouse gas (GHG) emissions from diesel consumption were estimated using Equation 3.

The annual quantity of diesel consumed (Q) was based on ERM's experience in projects of similar nature in Australia. The following assumptions were made:

- Assumed 80% of diesel oil during operations is associated with the operation of haul trucks for transporting ore and waste onsite; and
- Assumed 20% of the diesel oil during operational phase of the project is from stationary energy sources including excavators, front-end loaders and other mining equipment.

The estimated quantity of diesel oil used for operations onsite is presented in *Table A-5*.

Table A-5 Quantity of Diesel oil – operations onsite

Items	Quantity of fuel (kL)
Diesel – transport related	424
Diesel – stationary energy purpose	106

Diesel Oil – offsite transport

Greenhouse gas (GHG) emissions from diesel consumption were estimated using Equation 3.

The following assumptions were made to estimate the quantity of diesel oil used for transporting pre-mix concrete, quarried material and products to client facilities:

- Average fuel use of 40 litres/100km was assumed;
- Assumed trucks travel on average 30km (including return) to deliver products to client premises; and
- Assumed all haul truck fleet for delivering product is 100% owned/leased by Sancrox (i.e., Scope 1).

The quantity of diesel oil used for transporting products offsite is presented in *Table A-6*.

Table A-6 Diesel oil – transportation of products offsite

Items	Pre-mix concrete	Quarried material	Other Product
No. of truck trips – one way	4015[1]	2313	20,140
Distance travelled for return trip (km/year)	120,450	69,390	604,200
Diesel oil usage (litres/year)	48,180	27,756	241,680

Note:

1. An average day involves 11 pre-mix deliveries (information provided by Sancrox)

Operational Emissions – Diesel

The quantity of diesel consumed in GJ is calculated using an energy content factor for diesel of 38.6 gigajoules per kilolitre (GJ/kL).

- The Scope 1 emission factor for diesel combustion for stationary energy purpose is 70.2 kg CO2 e/GJ (Australian Government Department of the Environment and Energy, 2017a); and

- The Scope 1 emission factor for diesel combustion for transport energy for Euro III compliant trucks is 70.5 kg CO2 e/GJ (Australian Government Department of the Environment and Energy, 2017a).

The estimated annual average GHG emissions from diesel usage are presented in the *Table A-7*.

Table A-7 Estimated Scope 1 emissions from diesel consumption (tCO_2-e)

Fuel	Fuel usage (kL)	Emissions (tCO_2 –eq)
Diesel oil – stationary energy purpose	106	287
Diesel oil – transport energy purpose - onsite	424	1,153
Diesel oil – transport energy purpose – offsite	318	864
Total		**2,304**

ANFO

Ammonium Nitrate/ Fuel Oil (ANFO) is used as a fuel for blasting. GHG emissions from explosives usage were estimated using the following equation:

Equation 2:

$$E_{co2-e} = Q \times EF$$

where:

E_{CO2-e}	Emissions of GHG from explosives	(t CO2-e)
Q	Estimated quantity of explosives	(t)
EF	Emission factor (Scope 1) for explosive combustion	(kg CO2-e/kg of explosive)[3]

The amount of ANFO used is based on ERM's experience in similar projects and is presented in *Table A-8*, together with the emission factor used.

Table A-8 Blasting - quantity of fuel and emission rate

Item	Value	Unit
Quantity of ANFO	4.12	Tonnes
Blasting emission factor	0.189[1]	kg of CO_2-e / kg of fuel

[1] Appendix D, Towards Sustainable Mining, Energy and GHG Emissions Management Reference Guide published by The Mining Association of Canada, June 2014 (The Mining Association of Canada, 2014)

LNG

Liquefied Natural Gas (LNG) is used as fuel in the proposed asphalt plant. The amount of LNG used was derived based on work undertaken by (Wojciech Grabowski, 2010). The GHG emissions was calculated based on Equation 3. The quantity of LNG consumed in GJ is calculated using an energy content

factor for LNG of 25.3 gigajoules per kilolitre (GJ/kL). The Scope 1 emission factor for LNG combustion is 51.53 kg CO_2 e/GJ (Australian Government Department of the Environment and Energy, 2017a). The LNG emission factor and quantity of fuels is provided in *Table A-9*.

Table A-9 LNG - quantity of fuel and emission factor

Item	Value	Unit
Fuel input rate	13[1]	Litres per tonnes of hot mix asphalt
Asphalt production rate	50,000[2]	Tonnes per annum

[1] Derived from Table 2 and Table 3, Issues of Energy Consumption during Hot Mix Asphalt (HMA) production, paper presented at the 10th International Conference on Modern Building materials, structures and techniques (Wojciech Grabowski, 2010)

[2] supplied by Sancrox

Electricity

GHG emissions from electricity consumption was estimated using the following equation:

$$E_{CO_2-e} = \frac{Q \times EF}{1000}$$

where:

E_{CO2-e}	Emissions of GHG from electricity usage	(t CO2-e)[1]
Q	Estimated electricity use	(kWh/annum)[2]
EF	Emission factor (Scope 1) for electricity usage	(kg CO2-e/kWh)[3]

[1] tCO2-e = tonnes of carbon dioxide equivalent

[2] kWh = kilo-watt-hour

[3] kg CO2-e/GJ = kilograms of carbon dioxide equivalents per kWh

The quantity of electricity used (Q) per annum is based on ERM's experience with projects of similar nature and is presented in *Table A-10* together with the Scope 2 emission factor used.

Table A-10 Electricity – amount and emission rate

Item	Value	Unit	Comments
Operations - electricity	1,623,786	kWh	Includes electricity used for office, workshop and asphalt plant operations
Operations – concrete batching plant	11.73	kWh	Electricity for concrete batching plant
GHG Emission Rate	0.83[1]	kg of CO_2-e / kWh	Applicable for NSW, Table 7.2, NGER Technical Guidelines, 2017-18 (Australian Government Department of the Environment and Energy, 2017a)

Annex B

Air Quality Emission Estimation

The following sections provide an outline of activities on site which are expected to generate particulate emissions.

B.1 QUARRY OPERATIONS

B.1.1 Drilling

Section 1.1.8 of NPI Emission Estimation Technique Manual for Mining Version 3.1 (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012) provides default emission factor of:

- 0.59 kg/hole of TSP; and
- 0.31 kg/hole of PM_{10}.

The drill pattern will be determined by geological conditions on a shot by shot basis with typical plan consisting 125 holes. Drilling will take up to 20 hours in total in preparation for blasting a bench and will have a full dust extraction system, which will achieve 99% emission control (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012).

Emission estimation for emissions from drilling were therefore calculated using *Equation B-1*. The calculated emission rates of 0.0001 g/sec and 0.00005 g/sec for TSP and PM_{10} respectively were adopted in the dispersion modelling.

Equation B-1 Emission estimation for drilling

$$ER_i = \frac{EF_i \times N}{20 \times 3{,}600} \times \left(\frac{100 - C}{100}\right)$$

Where
ER_i is emission rate for TSP/PM_{10} (g/sec)
EF_i is emission factor for TSP/PM_{10} (kg/hole)
N is number of holes
C is control factor

B.1.2 Blasting

NPI Emission Estimation Technique Manual for Mining Version 3.1 (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012) provides *Equation B-2* for calculating TSP emissions factor for blasting. The emission factor of 13.35 kg of TSP per blast was calculated, using *Equation B-2* and site-specific information provided to ERM (*Table B-1*).

NPI manual indicates that for blasting PM_{10} constitutes 52% of the TSP. The emission factor of 6.94 kg of PM_{10} per blast was therefore calculated in accordance with the manual.

Equation B-2 Emission factor for blasting estimation (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012)

$$EF_{TSP} = \frac{344 \times A^{0.8}}{M^{1.9} \times D^{1.8}}$$

Where
EF_{TSP} is emission factor for TSP (kg/blast)
A is area blasted (m^2)
M is moisture content in percent
D is depth of the blast hole (m)

Table B-1 Site-specific parameters used for estimation of emission factors for blasting

Site-specific parameters	Value	Units
Area blasted	900[1]	m^2
Moisture of blasted material	10[2]	percent
Depth of blast hole	11[1]	meters

1. Provided by Hanson
2. As previously adopted (Environmental Resources Management Australia Pty Ltd, 2013)

Emissions from blasting occurs instantaneously, however the emission rate in terms of grams per second input to the dispersion model will apply for each second of that hour. Input of the actual instantaneous emission rate to the model would therefore result in a significant over estimate of emissions and impact. The instantaneous emission rate is therefore averaged over the hour in order that the total emissions over the modelled hour are equal to the total emissions within the instantaneous blast. To achieve this, *Equation B-3* was used to estimate TSP and PM_{10} emission rates for blasting. The calculated emission rates of 3.71 g/sec and 1.93 g/sec for TSP and PM_{10} respectively were adopted in the dispersion modelling.

Equation B-3 Blasting emission rate estimation

$$ER = EF \times \frac{1{,}000}{3{,}600}$$

Where:
ER is emission rate (g/sec)
EF is emission factor (kg/blast)

B.1.3 Product Handling

Excavators on Quarry Floor

NPI Emission Estimation Technique Manual for Mining Version 3.1 (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012) provides *Equation B-4* for calculating TSP and PM_{10} emissions factors for excavation. Time-varying emission factors were estimated using hourly wind speed at the height of 2.5 metres above the ground (approximately the height of loading of trucks), predicted in accordance with methodology outlines in Section *7.2* and moisture content of 9% as previously adopted (Environmental Resources Management Australia Pty Ltd, 2013).

Equation B-4 Emission factor for excavators (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012)

$$EF = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where:
EF is emission factor (kg of pollutant/tonne of material)
k is a constant equal to 0.74 for particles less than 30 μm aerodynamic diameter and 0.35 for particles less than 10 μm aerodynamic diameter
U is mean wind speed in m/sec
M is moisture content (9% by weight was adopted)

Equation B-5 was then used to estimate TSP and PM_{10} emission rates for excavation. The calculation adopted volume of material of 750,000 tpa (the proposed throughput) shared between two excavators.

Equation B-5 Excavators emission rate estimation

$$ER = EF \times \frac{Q}{N} \times \frac{1{,}000}{365 \times 24 \times 3{,}600}$$

Where:
ER is emission rate (g/sec)
EF is emission factor (kg/tonne)
Q is quantity of material (tpa)
N is number of excavators at the quarry floor

Truck Rear Dumping

NPI Emission Estimation Technique Manual for Mining Version 3.1 (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012) provides *Equation B-4* for calculating TSP and PM_{10} emissions factors for loading and unloading trucks (rear dumping). Time-varying emission factors were estimated using hourly wind speed at the height of 2.5 metres above the ground (approximately the height of release from the dumping activity), predicted in accordance with methodology outlines in Section *7.2* and moisture content of 9% as previously adopted (Environmental Resources Management Australia Pty Ltd, 2013).

As previously discussed in Section *6.2.3*, one rear dumping emission point at the feed hopper at the processing plant was included in the dispersion modelling. Time-varying emission rates for this source were further calculated using *Equation B-6* for total volume of material to be processed at the processing plant of 675,000 tpa (90% of the total throughput). The derived emission rates were further reduced by 70% to account for the use of water sprays.

Equation B-6 Emission rates factor calculation for truck rear dumping

$$ER = EF \times \frac{Q \times 1{,}000}{365 \times 24 \times 3{,}600}$$

Where:
ER is emission rate in g/sec
EF is emission factor (kg of pollutant/tonne of material)
Q is quantity of material delivered on site (tpa)

FELs

The NPI Emission Estimation Technique Manual for Mining Version 3.1 (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012) provides *Equation B-4* for calculating TSP and PM_{10} emissions factors for operation of FELs. Time-varying emission factors were estimated using hourly wind speed at the height of 2.5 metres above the ground, predicted in accordance with methodology outlines in Section *7.2* and moisture content of 9% as previously adopted (Environmental Resources Management Australia Pty Ltd, 2013).

Equation B-5 was then used to estimate TSP and PM_{10} emission rates for operations of FELs. The calculation adopted the total volume of material of 695,000 tpa (675,000 tpa - 90% of the proposed throughput of the quarry, and 20,000 tpa of road base output from the nearby concrete recycling facility) shared between two FELs working around the processing plant area. The derived emission rates were further reduced by half to account for mitigation factor of 50% associated with the use of mobile sprinkler systems.

B.1.4 Rock Processing

Crushing

The NPI Emission Estimation Technique Manual for Mining and Processing of Non-Metallic Minerals Version 2.1 (Australian Government Department of the Environment, 2014) provides emission factors for tertiary crushing of 0.0006 kg of TSP and 0.00027 kg of PM_{10} per tonne of material crushed, using wet suppression. As no emission factors are provided by the manual for primary and secondary crushing, the tertiary crushing emission factors were conservatively adopted for primary, secondary and tertiary crushing.

Equation B-6 was then used to calculate emission rates in grams per second. The emission estimation for primary crushing adopted the quantity of material of 675,000 tpa (total expected throughput at the processing plant). The emission rate for secondary crushing adopted the quantity of material of 421,875 tpa, assuming that only 62.5% of the total material processed will require secondary crushing. Emission rate for tertiary crushing adopted the quantity of material of 337,500 tpa, assuming that 50% of the total material processed will require tertiary crushing. *Table B-2* presents emission rates adopted in the dispersion modelling for primary, secondary and tertiary crushing.

Table B-2 ***Emission rates for primary, secondary and tertiary crushing adopted in the dispersion modelling***

Emission source	TSP emission rate (g/sec)	PM_{10} emission rate (g/sec)
Primary crushing	0.013	0.006
Secondary crushing	0.008	0.004
Tertiary crushing	0.006	0.003

Screening

The NPI Emission Estimation Technique Manual for Mining and Processing of Non-Metallic Minerals Version 2.1 (Australian Government Department of the Environment, 2014) provides emission factors for screening of 0.0011 kg of TSP and 0.00037 kg of PM_{10} per tonne of material screened, using wet suppression. These emission factors were adopted for both primary and secondary screening at the processing plant.

Equation B-6 was then used to calculate emission rates in grams per second. The emission estimation for primary screening adopted the quantity of material of 675,000 tpa (total expected throughput at the processing plant). Emission rate for secondary screening adopted the quantity of material of 421,875 tpa, assuming that only 5/8 of the total material processed will require secondary crushing. *Table B-3* presents emission rates adopted in the dispersion modelling for primary and secondary screening.

Table B-3 ***Emission rates for primary and secondary screening adopted in the dispersion modelling***

Emission source	TSP emission rate (g/sec)	PM_{10} emission rate (g/sec)
Primary screening	0.024	0.008
Secondary screening	0.015	0.005

Conveyor Transfer Points

As discussed in Section *6.2.4* two conveyor transfer points and eight conveyor drop points have been included in the dispersion modelling assessment. The NPI Emission Estimation Technique Manual for Mining and Processing of Non-Metallic Minerals Version 2.1 (Australian Government Department of the Environment, 2014) provides emission factors for conveyor transfer points of 0.00007 kg of TSP and 0.000023 kg of PM_{10} per tonne of material transferred, using wet suppression. These emission factors were adopted for conveyor transfer and drop points at the processing plant.

Equation B-6 was then used to calculate emission rates in grams per second. The emission estimation assumed equal distribution of the processed material to each of eight stockpiles and therefore adopted the quantity of material of 84,375 tpa (12.5 % of the total expected throughput at the processing plant) for each emission point. Emission rates of 0.00019 g/sec of TSP and 0.000062 g/sec of PM_{10} were adopted for each of conveyor transfer points included in the dispersion modelling.

B.1.5 Wheel Generated Dust

The NPI Emission Estimation Technique Manual for Mining Version 3.1 (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012) provides *Equation B-7* for calculating emissions factor for wheel generated dust emissions from unpaved roads at industrial sites.

Equation B-7 Wheel generated dust emission factor (kg/vehicle km travelled) (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012)

$$EF = \frac{0.4536}{1.6093} \times k \times \left(\frac{S}{12}\right)^{a} \times \left(\frac{W \times 1.1023}{3}\right)^{b}$$

Where:
EF is emission factor (kg/vehicle kilometre travelled)
k is value equal to 4.9 for TSP and 1.5 for PM_{10}
S is silt content of material (%)
W is vehicle mass (t)
a is an empirical constant equal to 0.7 for TSP and 0.9 for PM_{10}
b is an empirical constant equal to 0.45

Wheel dust from unpaved roads at the quarry is generated by the following types of trucks:

- Caterpillar 769C rock trucks, used for haulage within the site; and
- Truck and dog-type trucks, used for haulage offsite;

Table B-5 presents emission factors calculated for the types of trucks used at the quarry, using *Equation B-7* and site-specific information provided in *Table B-4*.

Table B-4 Site-specific parameters used for estimation of emission factors for wheel generated emissions

Site-specific parameters	Value	Units
Silt content of overburden	7[1]	percent
Loaded weight of a rock truck	67.586[2]	tonnes
Unloaded weight of a rock truck	30.675[2]	tonnes
Loaded weight of a truck and dog	42.5[3]	tonnes
Unloaded weight of a truck and dog	10.07[4]	tonnes

1. As previously adopted (Environmental Resources Management Australia Pty Ltd, 2013)
2. (RitchieSpecs, 2018)
3. (National Heavy Vehicle Regulator, 2017)
4. Assuming truck capacity of 34.43 tonnes

Table B-5 Emission factors estimated for wheel generated dust from unpaved roads by trucks at the quarry

Truck type	TSP (kg/VKT[1])	PM_{10} kg/VKT)
Unloaded rock truck	2.82	0.77
Loaded rock truck	4.02	1.10
Unloaded truck and dog-type truck	1.71	0.47
Loaded truck and dog-type truck	3.26	0.9

1. VKT stands for Vehicle Kilometre Travelled

TSP and PM_{10} emission rates in grams per second per meter were then calculated using *Equation B-8*.

Equation B-8 Wheel generated dust emission rate estimation (g/m/sec)

$$ER = \frac{EF \times 1,000 \times L}{T} \times \frac{T}{3,600} \times \frac{N}{L \times 1,000} \times C$$

Where:
ER is emission rate (g/m/sec)
EF is emission factor (kg/vehicle kilometre travelled)
L is road length (km)
T is time it takes for one trip assuming speed of 20 km/hr (sec)
N is number of trips per day
C is activity control level (75% due to level 2 watering as per NPI guidance)

B.1.6 Wind Generated Dust

Wind erosion is expected to generate particulate matter emissions from exposed areas and stockpiles. As discussed in Section *6.2.6*, wind erosion from exposed areas was not included in the dispersion modelling and therefore is not discussed in this section. Dispersion modelling of wind erosion from stockpiles included 10 stockpiles of equal size located in the stockpile area and eight stockpiles under the conveyor drop points

The NPI Emission Estimation Technique Manual for Mining Version 3.1 (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012) provides *Equation B-9* for calculating TSP emission factors for wind erosion from the stockpiles. For each year assessed, *Equation B-9* and site-specific information (*Table B-6*) were used to estimate the total TSP content.

Equation B-9 Wind erosion from stockpiles and exposed conveyors

$$EF_{TSP} = 1.9 \times (\frac{S}{1.5}) \times 365 \times (\frac{365 - p}{235}) \times (\frac{f}{15})$$

Where:

EF_{TSP} is emission factor of TSP (kg/ha/y)

S is the silt content

p is the number of days per year when rainfall is greater than 0.25mm

f is the percentage of time that wind speed is greater than 5.4 m/s at the mean height of the stockpile

Table B-6 Site-specific parameters used for wind erosion emission factors calculation

Site-specific parameters	Year	Value	Units
Silt content of product[1]	All	7	percent
Rainy days (>0.25mm)[2]	2012	122	days
	2013	114	
	2014	115	
	2015	120	
	2016	106	
Time when wind speed is >5.4 m/sec at the mean height of the stockpile[2]	2012	16.55	percent
	2013	16.54	
	2014	16.21	
	2015	14.77	
	2016	13.89	
Number of hours when rainfall < 0.25mm and wind speed is >5.4 m/sec[2]	2012	567	hours
	2013	576	
	2014	657	
	2015	486	
	2016	459	

1. As previously adopted (Environmental Resources Management Australia Pty Ltd, 2013)
2. Calculated based on the predicted meteorology for the Site

Taking into account wind erosion based particulate matter size distribution between PM_{10} and PM_{30}, a factor of 0.5 was used to calculate the emission factor for PM_{10} emissions from wind erosion (SKM, 2005). *Table B-7* presents the calculated emission factors for TSP and PM_{10} for wind erosion.

Table B-7 Estimated emission factors for TSP and PM_{10} emissions as a result of wind erosion

Species	2012	2013	2014	2015	2016
TSP (kg/ha/year)	3692.94	3811.82	3720.65	3322.69	3302.641
PM_{10} (kg/ha/year)	1846.47	1905.91	1860.32	1661.35	1651.321

This total emission per year was divided between the number of hours where both the wind speed and rainfall conditions contained in *Equation B-9* were met (*Table B-6*) and converted to grams per second using *Equation B-10*.

Equation B-10Wind erosion emission rate estimation

$$ER = \frac{A \times EF \times C}{Hr} \times \frac{1{,}000}{3{,}600}$$

Where:
ER is emission rate (g/sec)
EF is emission factor (kg/ha/y)
Hr is number of hours where wind speed is greater than 5.4 m/s and the rainfall average of the last 24 hours is less than 0.25mm
A is the area of the stockpile (ha)
C is activity control level (50% for use of water sprays)

Table B-8 presents stockpile areas for each stockpile modelled used in the emission estimation and the derived emission rates for TSP and PM_{10} used in dispersion modelling.

Table B-8 Stockpile areas and emission rates used in dispersion modelling

		2012		2013		2014		2015		2016	
Source Name	Area (ha)	TSP (g/sec)	PM_{10} (g/sec)	TSP (g/sec)	PM_{10} (g/sec)	TSP (g/sec)	PM_{10} (g/sec)	TSP (g/sec)	PM_{10} (g/sec)	TSP (g/sec)	PM_{10} (g/sec)
STP1	0.36	0.32	0.16	0.33	0.16	0.14	0.28	0.17	0.34	0.36	0.18
STP2	0.36	0.32	0.16	0.33	0.16	0.14	0.28	0.17	0.34	0.36	0.18
STP3	0.36	0.32	0.16	0.33	0.16	0.14	0.28	0.17	0.34	0.36	0.18
STP4	0.36	0.32	0.16	0.33	0.16	0.14	0.28	0.17	0.34	0.36	0.18
STP5	0.36	0.32	0.16	0.33	0.16	0.14	0.28	0.17	0.34	0.36	0.18
STP6	0.36	0.32	0.16	0.33	0.16	0.14	0.28	0.17	0.34	0.36	0.18
STP7	0.36	0.32	0.16	0.33	0.16	0.14	0.28	0.17	0.34	0.36	0.18
STP8	0.36	0.32	0.16	0.33	0.16	0.14	0.28	0.17	0.34	0.36	0.18
STP9	0.36	0.32	0.16	0.33	0.16	0.14	0.28	0.17	0.34	0.36	0.18
STP10	0.36	0.32	0.16	0.33	0.16	0.14	0.28	0.17	0.34	0.36	0.18
STP11	0.04	0.03	0.02	0.04	0.02	0.03	0.01	0.02	0.01	0.04	0.02
STP12	0.02	0.02	0.01	0.02	0.01	0.01	0.01	0.03	0.01	0.02	0.01
STP13	0.03	0.03	0.01	0.03	0.01	0.02	0.01	0.02	0.01	0.03	0.01
STP14	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01
STP15	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.03	0.01	0.02	0.01
STP16	0.03	0.03	0.01	0.03	0.01	0.02	0.01	0.02	0.01	0.03	0.02
STP17	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01
STP18	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01
STP19	0.06	0.06	0.03	0.06	0.03	0.05	0.03	0.06	0.03	0.06	0.03

B.2 CONCRETE RECYCLING PLANT

The following sections describe the emission estimation for sources included in the dispersion modelling.

B.2.1 Delivery of Dry Products

As discussed in Section *6.3.1*, one truck rear dumping point was included in the dispersion modelling. Time-varying emission factors were estimated using:

- *Equation B-4* provided by the NPI Emission Estimation Technique Manual for Mining Version 3.1 (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012);
- Hourly wind speed at the height of 2.5 metres above the ground, predicted in accordance with methodology outlines in Section *7.2;* and
- Assumed moisture content of 9%.

Time-varying emission rates for this source were further calculated using *Equation B-6* for 20,000 tpa of concrete delivered on site for recycling. The derived emission rates were further reduced by 70% to account for the use of water sprays for mitigation.

B.2.2 Crushing

The NPI Emission Estimation Technique Manual for Mining and Processing of Non-Metallic Minerals Version 2.1 (Australian Government Department of the Environment, 2014) provides emission factors for tertiary crushing of 0.0006 kg of TSP and 0.00027 kg of PM_{10} per tonne of material crushed, using wet suppression. As no emission factors are provided by the manual for primary crushing, the tertiary crushing emission factors were conservatively adopted for crushing at the concrete recycling facility.

Equation B-6 was then used to calculate emission rates in grams per second. The emission estimation for crushing was based on the quantity of material to be delivered at the facility of 20,000 tpa. *Table B-2* presents emission rates adopted in the dispersion modelling for primary, secondary and tertiary crushing.

Table B-9 Emission rates for primary, secondary and tertiary crushing adopted in the dispersion modelling

Emission source	TSP emission rate (g/sec)	PM_{10} emission rate (g/sec)
Crushing	3.81×10^{-4}	1.71×10^{-4}

B.2.3 Wheel Generated Dust from Haul Roads

Wheel dust from unpaved roads at the concrete recycling facility is associated with:

- The delivery of concrete for recycling to the facility; and
- The delivery of recycled road base output from the facility.

The emission factors for wheel generated dust emissions were calculated using *Equation B-7* provided by NPI Emission Estimation Technique Manual for Mining Version 3.1 (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012).

Table B-13 presents emission factors calculated for the types of trucks used at the concrete recycling plant, using *Equation B-7* and site-specific information provided in *Table B-12*.

Table B-10 Site-specific parameters used for estimation of emission factors for wheel generated emissions

Site-specific parameters	Value	Units
Adopted silt content	7	percent
Loaded weight of a truck and dog	42.5[1]	tonnes

1. (National Heavy Vehicle Regulator, 2017)

Table B-11 Emission factors estimated for wheel generated dust from unpaved roads by trucks at the quarry

Truck type	TSP (kg/VKT[1])	PM_{10} kg/VKT)
Loaded truck and dog-type truck	3.26	0.9

1. VKT stands for Vehicle Kilometre Travelled

TSP and PM_{10} emission rates in grams per second per meter were then calculated using *Equation B-8*.

B.3 CONCRETE BATCHING PLANT

The following sections describe the emission estimation for sources included in the dispersion modelling.

B.3.1 Delivery of Dry Products

As discussed in Section *6.2.3*, one truck rear dumping point was included in the dispersion modelling. Time-varying emission factors were estimated using:

- *Equation B-4* provided by the NPI Emission Estimation Technique Manual for Mining Version 3.1 (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012);
- Hourly wind speed at the height of 2.5 metres above the ground, predicted in accordance with methodology outlines in Section *7.2*; and
- Assumed moisture content of 9%.

Time-varying emission rates for this source were further calculated using *Equation B-6* for the total volume of dry material dumped at the concrete batching plant (21,868 tpa of coarse aggregate delivered from the processing area and 16,750 tpa of sand delivered from offsite as provided in *Table 6-1*). The derived emission rates were further reduced by 70% to account for the use of water sprays for mitigation.

B.3.2 Transfer of Product

As discussed in Section *6.2.3*, one FEL operating at the concrete batching plant was included in the dispersion modelling. Time-varying emission factors were estimated using:

- *Equation B-4* provided by NPI Emission Estimation Technique Manual for Mining Version 3.1 (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012);
- Hourly wind speed at the height of 2.5 metres above the ground, predicted in accordance with methodology outlines in Section *7.2*; and
- Assumed moisture content of 9%.

TSP and PM_{10} emission rates were further calculated using *Equation B-5* for the total volume of dry material delivered to the facility (21,868 tpa of coarse aggregate delivered from the processing area and 16,750 tpa of sand delivered from offsite as provided in *Table 6-1*).

B.3.3 Weigh Hopper and Mixer Loading

The concrete batching plant will be totally enclosed. All particulate matter emissions generated by the facility will be captured by one bag filter located above the pan mixer.

TSP emission rate from the bag filter was calculated in accordance with the POEO Clean Air Regulations discharge limit of 20 mg/Nm^3 for solid particles, contained in Schedule 3 for cement or lime production or cement or lime handling (New South Wales Government, 2017). *Equation B-11* presents the equation used to calculate TSP emission rate. It should be noted that whilst the United States Environment Protection Agency AP-42 Air Emissions Factors and Quantification, Chapter 11: Mineral Products Industry, Section 11.12 Concrete Batching (United States Environmental Protection Agency, 2006) provides emission factor for TSP emissions from these type of facilities, the emission rate calculated using POEO Regulation was estimated to be more stringent and therefore was adopted in this assessment.

Equation B-11 Concrete batching plant bag filter TSP emission rate estimation

$$ER = \frac{DL \times VF}{1{,}000 \times 3{,}600}$$

Where:
ER is emission rate (g/sec)
DL is POEO discharge limit of 20 mg/Nm^3
VF is volumetric flow of 42.9 Nm^3/hour adopted from a similar facility (Environmental Resources Management Australia Pty Ltd, 2017)

PM_{10} emission rate from the bag filter was estimated using particle size distribution adopted from AP-42 Appendix B.2 Generalised Particle Size Distribution for concrete batching of 51% (United States Environmental Protection Agency, 1996). *Table B-9* presents emission rates for TSP and PM_{10} adopted in the dispersion modelling.

Table B-12 TSP, PM_{10} and $PM_{2.5}$ emission rates for bag filter at the concrete batching plant adopted in the assessment

Source	TSP emission rate (g/sec)	PM_{10} emission rate (g/sec)
Bag filter	0.00024	0.000122

In addition to particulate matter, United States Environment Protection Agency AP-42 Air Emissions Factors and Quantification, Chapter 11: Mineral Products Industry, Section 11.12 Concrete Batching (United States Environmental Protection Agency, 2006) provide emission rates for the following metals:

- Arsenic;
- Cadmium;
- Total Chromium;
- Lead;
- Manganese;
- Nickel; and
- Total Phosphorus.

No criteria exist for Total Phosphorus (*Section 3*) and therefore this species was not considered further in this assessment.

Table B-10 presents metal emission factors as provided in United States Environment Protection Agency AP-42 Air Emissions Factors and Quantification, Chapter 11: Mineral Products Industry, Section 11.12 Concrete Batching (United States Environmental Protection Agency, 2006).

Table B-13 Emission factors for metals emitted from concrete batching plants (United States Environmental Protection Agency, 2006)

Source	Emission factor (kg/tonne of material loaded)					
	Arsenic	Cadmium	Total Chromium	Lead	Manganese	Nickel
Central Mix Batching with Fabric Filter	1.48×10^{-7}	3.55×10^{-10}	6.34×10^{-8}	1.83×10^{-8}	1.89×10^{-6}	1.24×10^{-7}

Table B-11 provides the calculated emission rates for metals adopted in this assessment, calculated using *Equation B-12*.

Equation B-12 Concrete batching plant bag filter TSP emission rate estimation

$$ER = \frac{EF \times Q \times 1{,}000}{365 \times 24 \times 3{,}600}$$

Where:
ER is emission rate (g/sec)
EF is emission factor (kg pollutant per tonne of material loaded)
Q is total material loaded (47,200 tpa as provided in *Table 6-1*)

Table B-14 Emission factors for metals emitted from concrete batching plants (United States Environmental Protection Agency, 2006)

Source	Emission factor (kg/tonne of material loaded)					
	Arsenic	Cadmium	Total Chromium	Lead	Manganese	Nickel
Central Mix Batching with Fabric Filter	2.2×10^{-7}	5.3×10^{-10}	9.4×10^{-8}	2.7×10^{-8}	2.8×10^{-6}	1.9×10^{-7}

B.3.4 Wheel Generated Dust from Haul Roads

Wheel dust from unpaved roads at the concrete batching plant is associated with:

- The delivery of coarse aggregate from the processing plant using rock trucks;

- The delivery of sand and concrete for recycling using road truck-and-dog-type trucks from offsite;
- The delivery of cement and cement supplement using agitator trucks from offsite; and
- The delivery of cement mix from the site to the market using the agitator trucks.

The delivery of coarse aggregate has been considered as part of quarry operations (Section *B.1.5*) and therefore is not discussed further in this section. The emission factors for wheel generated dust emissions from other sources were calculate using equation *Equation B-7* provided by NPI Emission Estimation Technique Manual for Mining Version 3.1 (Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012).

Table B-13 presents emission factors calculated for the types of trucks used at the concrete batching plant, using *Equation B-7* and site-specific information provided in *Table B-12*.

Table B-15 Site-specific parameters used for estimation of emission factors for wheel generated emissions

Site-specific parameters	Value	Units
Adopted silt content	7	percent
Loaded weight of a truck and dog	42.5[1]	tonnes
Unloaded weight of a truck and dog	10.07[2]	tonnes
Loaded weight of an agitator truck	32[3]	tonnes
Unloaded weight of an agitator truck	12.2[3]	tonnes

2. (National Heavy Vehicle Regulator, 2017)
3. Assuming truck capacity of 34.43 tonnes
4. (Excel Concrete Pty Ltd, 2011)

Table B-16 Emission factors estimated for wheel generated dust from unpaved roads by trucks at the quarry

Truck type	TSP (kg/VKT[1])	PM_{10} kg/VKT)
Unloaded truck and dog-type truck	1.71	0.47
Loaded truck and dog-type truck	3.26	0.9
Unloaded agitator truck	1.86	0.51
Loaded agitator truck	2.87	0.79

1. VKT stands for Vehicle Kilometre Travelled

TSP and PM_{10} emission rates in grams per second per meter were then calculated using *Equation B-8*.

B.4 ASPHALT PLANT

The following sections describe the emission estimation for sources included in the dispersion modelling for the asphalt plant.

B.4.1 Dryer Emissions

Emissions have been estimated using published emission factors from the United States Environment Protection Agency AP-42 Air Emissions Factors and Quantification, Chapter 11: Mineral Products Industry, Section 11.1 Hot Mix Asphalt Plants (United States Environmental Protection Agency, 2004). The source provides emission rates for a wide range of species, however no criteria exist for all the species (*Section 3*) and therefore only species included in *Table B-14* were considered further in this assessment. In addition to species presented provided by Chapter 11, the asphalt plant will emit odour and therefore the potential for odour impact was also considered in this assessment.

Table B-14 presents emission factors and the associated emission rates calculated using *Equation B-13*, with exception of odour. The odour emission rate was sourced from a similar study and adapted to site-throughput using *Equation B-14* (GHD, 2008).

Table B-17 Emission factors and rates for species associated with the asphalt plant

Species	Emission factor (kg/tonne asphalt produced)[1]	Asphalt dryer Bag Filter emission rate (g/sec unless specified otherwise)[2]
TSP	0.033	0.026
PM_{10}	0.0042	0.003
NO_x	0.026	0.02
CO	0.13	0.1
SO_2	0.0034	0.003
Benzene	0.00039	0.0003
Ethylbenzene	0.00024	0.0002
Formaldehyde	0.0031	0.002
Hexane	0.00092	0.0007
Methyl chloroform	0.000048	0.00004
Polycyclic aromatic hydrocarbon (PAH) as benzo[a]pyrene	0.00019	0.00015
Toluene	0.00015	0.0001
Xylene	0.0002	0.0002
n-Heptane	0.0094	0.007
n-Pentane	0.00021	0.0002
Antimony and compounds	0.00000018	$1.4x10^{-7}$
Arsenic and compounds	0.00000056	$4.4x10^{-7}$
Barium (soluble compound)	0.0000058	$4.6x10^{-7}$
Cadmium and cadmium compounds	0.00000041	$3.2x10^{-7}$
Total Chromium	0.0000055	$4.5x10^{-6}$
Copper fumes	0.0000031	$2.5x10^{-6}$
Chromium VI compounds	0.00000045	$2.6x10^{-7}$
Lead	0.00000062	$4.9x10^{-7}$
Manganese and compounds	0.0000077	$6.1x10^{-6}$
Mercury	0.000000336	$2.7x10^{-7}$
Nickel and nickel compounds	0.000032	0.00005
Silver soluble compounds (as Ag)	0.00000048	$3.8x10^{-7}$
Zinc	0.000061	$4.8x10^{-5}$
Odour[3]	-	43,333.3 (OU/sec)

1. (United States Environmental Protection Agency, 2004).
2. Calculated for the total asphalt production (50,000 tpa), averaged over the year
3. Calculated from odour emission rate of 1,040,000 OUm^3/min (GHD, 2008)

Equation B-13Concrete batching plant bag filter TSP emission rate estimation

$$ER = \frac{EF \times Q \times 1{,}000}{365 \times 24 \times 3{,}600}$$

Where:
ER is emission rate (g/sec)
EF is emission factor (kg pollutant per tonne of asphalt produced)
Q is total quantity of asphalt produced (50,000 tpa)

Equation B-14Concrete batching plant bag filter TSP emission rate estimation

$$ER_{Site} = \frac{ER_{GHD} \times 50{,}000}{20{,}000 \times 60}$$

Where:
ER_{Site} is site emission rate (g/sec)
ER_{GHD} is emission rate provided in GHD assessment (GHD, 2008)

B.4.2 Wheel Generated Dust from Haul Roads

Wheel dust from unpaved roads at the asphalt plant is associated with:

- The delivery of bitumen using agitator trucks from offsite; and
- The delivery of asphalt from the site to market using road truck-and-dog-type trucks.

The emission factors calculated for the types of trucks used at the asphalt plant are provided in *Table B-13*. TSP and PM_{10} emission rates in grams per second per meter were then calculated using *Equation B-8*.

Annex C

Screening Assessment

There are a number of species of metals, combustion related emissions and organic compounds that have the potential to be released from both the concrete batching and asphalt plants. The emissions from these sources are small, and therefore a screening assessment was completed to determine which sources and species should be taken forward to dispersion modelling. It should be noted that particulate matter from these sources was not subject to the screening method, as it was considered that given the contribution from other sources at the Site, additional emissions from these sources should be included in the cumulative assessment.

The screening assessment for the concrete batching and asphalt plants was undertaken in accordance with UK '*Air emissions risk assessment for your environmental permit guidance*' (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016) using emission rates provided in *Table 6-3*. The Guidance provides dispersion factors expressed as $\mu g/m^3/g/sec$ for a variety of release heights and averaging periods (*Table C-1*) (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016).

Table C-18 Dispersion factors provided in the Air Emissions Risk Assessment for your Environmental Permit Guidance (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016)

Effective height of release in metres	Annual dispersion factor	Monthly dispersion factor	Hourly dispersion factor
0	148	529	3900
10	32	33.7	580
20	4.6	6.2	161
30	1.7	2.3	77
50	0.52	0.68	31
70	0.24	0.31	16
100	0.11	0.13	8.6
150	0.048	0.052	4
200	0.023	0.026	2.3

The release height of bag filter at the concrete batching facility was assumed to be 5 metres based on the information from a similar type of facility (Environmental Resources Management Australia Pty Ltd, 2017). The release height of the point source at the asphalt plant of 5 metres was adopted based on the technical data specification for Benninghoven Asphalt Mixing Plants (A Wirtgen Group Company, n.d.).

A linear interpolation method was used to derive the dispersion factor for the height of 5 metres using the dispersion factors in *Table C-1 (Equation C-1*). The relevant dispersion factors are provided in *Table C-2*.

Equation C-1 Linear interpolation of dispersion factors provided in the Air Emissions Risk Assessment for your Environmental Permit Guidance (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016)

$$\mathrm{DF}_{n+1} = \frac{(H_{n+1} - H_n)(DF_{n+2} - DF_n)}{(H_{n+2} - H_n)} + DF_n$$

Where:

DF_n and DF_{n+2} are dispersion factors provided in the Guidance in $\mu g/m^3/g/sec$

DF_{n+1} is the dispersion factor required in $\mu g/m^3/g/sec$

H_n and H_{n+2} are the associated effective heights of release in metres; and

H_{n+1} is the required release height in metres.

Table C-19 Dispersion factors adopted in the assessment

Averaging period	Dispersion factor (µg/m³/g/sec)[1]
10 minute	2,375[5]
15 minute	2,224[3]
30 minute	1,907[5]
1 hour	1,660
8 hour	1,162[4]
24 hour	979[2]
Annual	58

1. The dispersion factors presented in Table are subject to interpolation of the dispersion factors provided in the Guidance;
2. 24 hour dispersion factor was derived from the hourly dispersion factor using factor of 0.59 as recommended in the Guidance;
3. 15 minute dispersion factor was derived from the hourly dispersion factor using factor of 1.34 as recommended in the Guidance;
4. 8 hour dispersion factor was derived from the hourly dispersion factor using factor of 0.7 as recommended in the Guidance;
5. Conversion of 1 hour model results to 10 minute and 30 minute averages has been undertaken using the peak to mean ratio as described in Victorian EPA Publication 1551 (Environment Protection Authority Victoria, 2013).

Equation C-2, contained within the Guidance, was used to combine the emission rates in *Table 6-3* with the dispersion factors in *Table C-2* to provide the estimated maximum short-term and long-term ground level concentrations attributed to each source.

Equation C-2 Estimation environmental concentrations for the species

$$EC = ER \times DF$$

Where:
EC is the environmental concentration of the species in micrograms per cubic meter
ER is emission rate in gram per second
DF is dispersion factor in micrograms per cubic metre per gram per second

Table C-3 provides short-term and long-term environmental concentrations for species emitted from concrete batching plant.

Table C-3 Short-term and long-term contribution to environmental concentrations for species emitted from concrete batching plant

	Concentration (ug/m^3)	Criterion (ug/m^3)	Percent (%)
Arsenic	0.0004	0.09	0.4
Cadmium	$8.8x10^{-7}$	0.018	0.0
Chromium	0.0002	0.09	0.2
Lead	$1.6x10^{-6}$	0.5	0.0
Manganese	0.005	18	0.0
Nickel	0.0003	0.18	0.2

The Guidance outlines that the following criteria must be met in order to screen out species that result in an insignificant contribution to ambient air quality and for which no further assessment is required (UK Department for Environment, Food and Rural Affairs Environment Agency, 2016):

- The estimated short-term environmental concentration is less than 10% of the short-term environmental standard; and
- The estimated long-term environmental concentration is less than 1% of the long-term environmental standard.

Table C-3 indicates that the total short-term environmental concentrations related to the batching plant are below 10 percent of the relevant criteria for all species and the total long-term environmental concentrations are below one percent of the relevant criteria for all species. It is therefore considered that emissions from the concrete batching facility are not likely to be significant contributors to ambient air quality concentrations and no further assessment is required. It should be also considered that dispersion factors in the Guidance result in a very conservative assessment and the environmental concentrations for the species in reality will be much lower than presented in *Table C-3*.

Table C- 4 provides short-term and long-term environmental concentrations for species emitted from asphalt plant. *Table C- 4* indicates that the total short-term environmental concentrations are below 10 percent of the relevant criteria for all species, except for NO_2, formaldehyde, PAH and nickel, and the total long-term environmental concentrations are below one percent of the relevant criteria for all species, except for NO_2. Only NO_2, formaldehyde, PAH and

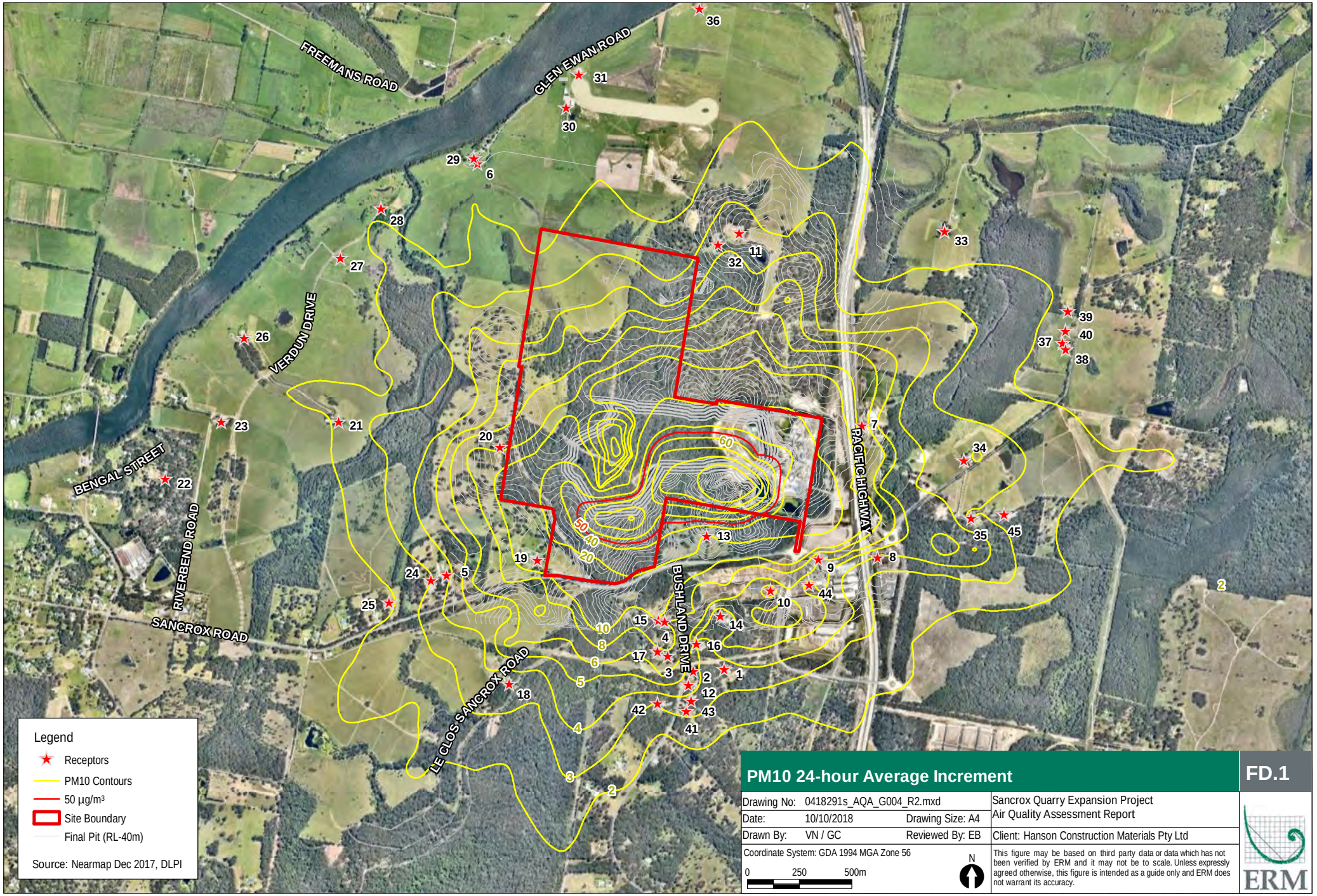
nickel were included in the dispersion modelling and no further assessment was required for any other species contained in *Table C-4* It should be also considered that dispersion factors in the Guidance result in a very conservative assessment and the environmental concentrations for the species in reality will be much lower than presented in *Table C- 4*

Table C-20 Short-term and long-term contribution to environmental concentrations for species emitted from asphalt plant

Species	Averaging period	Concentration (ug/m³)	Criterion (ug/m³)	Percent (%)
NO_2	1 hour	34.2	246	**13.91**
	Annual	1.2	62	**1.93**
Formaldehyde	1 hour	4.1	20	**20.40**
PAH	1 hour	0.3	0.4	**62.51**
Nickel	1 hour	0.1	0.18	**46.06**
CO	15 min	229.2	100000	0.23
	1 hour	171.1	30000	0.57
	8 hour	119.7	10000	1.20
SO2	10 min	6.4	712	0.90
	1 hour	4.5	570	0.78
	24 hour	2.6	228	1.16
	Annual	0.2	60	0.26
Benzene	1 hour	0.5	29	1.77
Ethylbenzene	1 hour	0.3	8000	0.00
Hexane	1 hour	1.2	3200	0.04
Methyl chloroform	1 hour	0.1	12500	0.00
Toluene	1 hour	0.2	360	0.05
Xylene	1 hour	0.3	190	0.14
Heptane	30 min	16.6	33000	0.05
n-Pentane	1 hour	0.3	33000	0.00
Antimony	1 hour	0.0002	9	0.00
Arsenic	1 hour	0.0007	0.09	0.82
Barium	1 hour	0.008	9	0.08
Cadmium	1 hour	0.0005	0.018	3.00
Chromium	1 hour	0.007	9	0.08
Copper	1 hour	0.004	3.7	0.11
Hexavalent Chromium	1 hour	0.0006	0.09	0.66
Lead	Annual	0.00003	0.5	0.01
Manganese	1 hour	0.0101	18	0.06
Mercury	1 hour	0.0004	0.18	0.25
Silver	1 hour	0.0006	0.18	0.35
Zinc	30 min	0.09	100	0.09
	24 hour	0.05	120	0.04
Asphalt petroleum fumes	1 hour	6.9	90	7.66

Annex D

Contour Plots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GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE GLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
Legend
Receptors
PM10 Contours
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PM10 24-hour Average Increment
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Client: Hanson Construction Materials Pty Ltd
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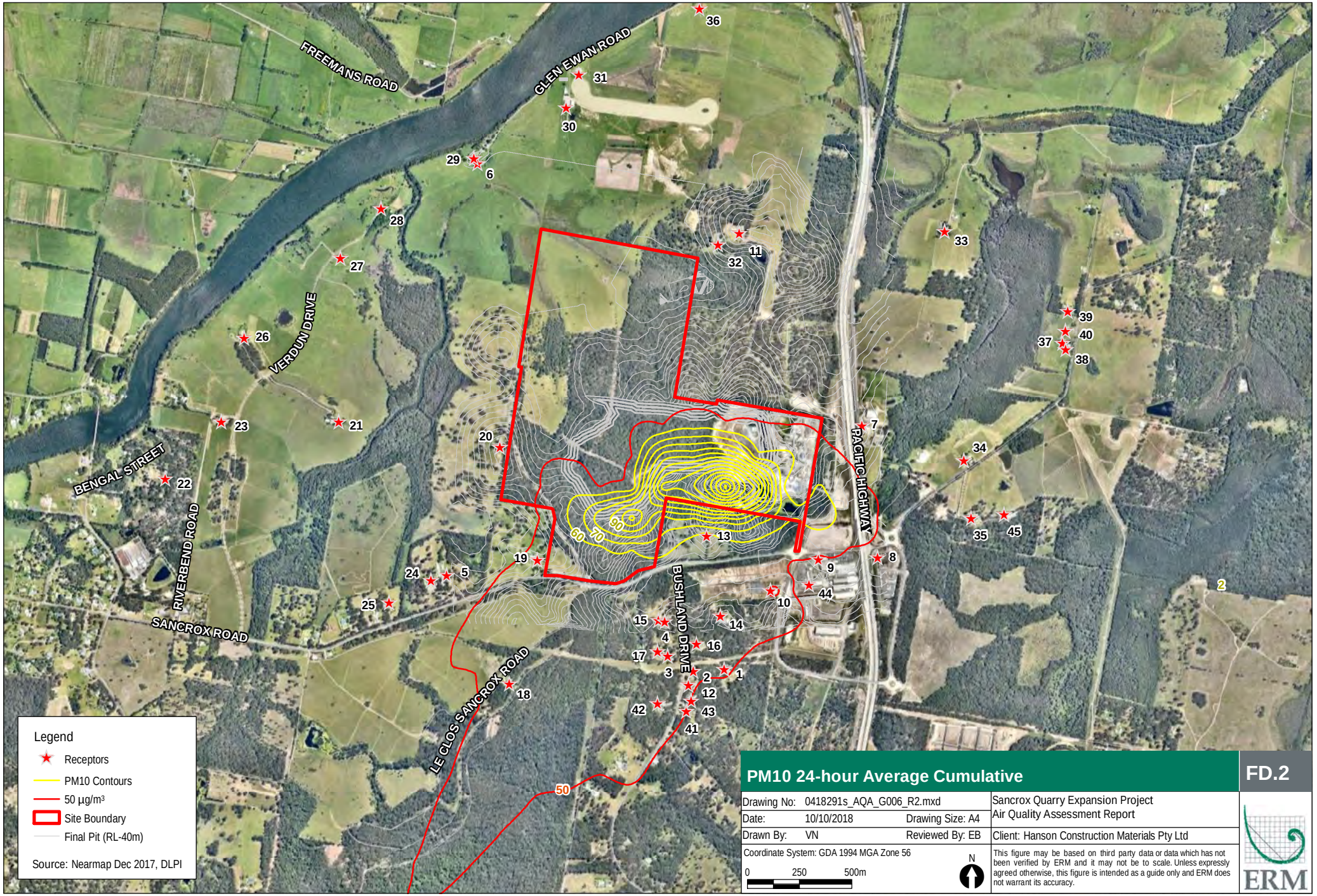
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BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
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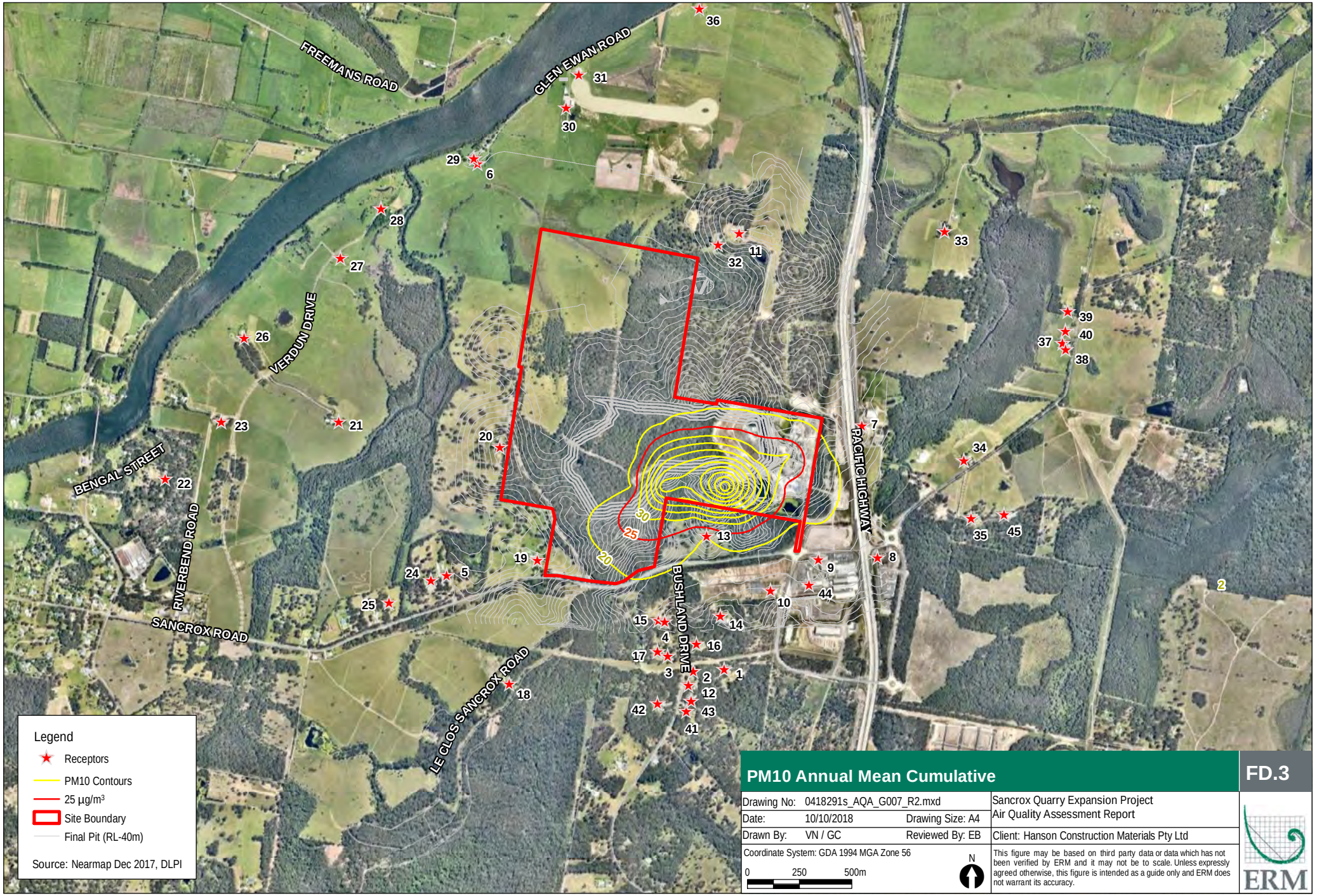
Legend
Receptors
PM10 Contours
50 µg/m³
Site Boundary
Final Pit (RL-40m)
Source: Nearmap Dec 2017, DLPI
PM10 24-hour Average Cumulative
FD.2
Drawing No: 0418291s_AQA_G006_R2.mxd
Date: 10/10/2018
Drawing Size: A4
Drawn By: VN
Reviewed By: EB
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Air Quality Assessment Report
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
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Legend
Receptors
PM10 Contours
25 µg/m³
Site Boundary
Final Pit (RL-40m)
Source: Nearmap Dec 2017, DLPI
PM10 Annual Mean Cumulative
FD.3
Drawing No: 0418291s_AQA_G007_R2.mxd
Date: 10/10/2018
Drawing Size: A4
Drawn By: VN / GC
Reviewed By: EB
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Air Quality Assessment Report
Client: Hanson Construction Materials Pty Ltd
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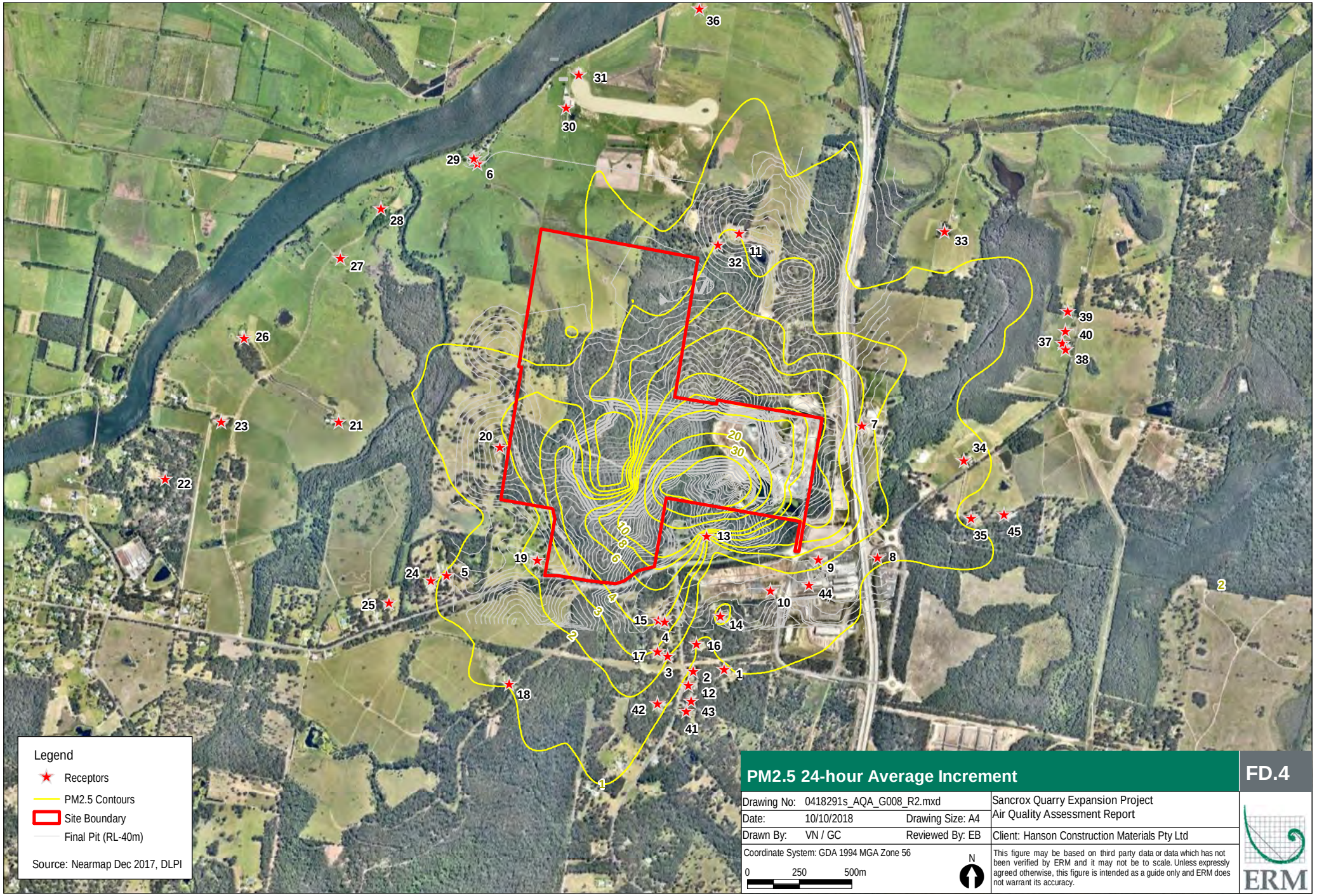
ERM


Legend
Receptors
PM2.5 Contours
Site Boundary
Final Pit (RL-40m)
Source: Nearmap Dec 2017, DLPI
PM2.5 24-hour Average Increment
FD.4
Drawing No: 0418291s_AQA_G008_R2.mxd
Date: 10/10/2018
Drawing Size: A4
Drawn By: VN / GC
Reviewed By: EB
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Air Quality Assessment Report
Client: Hanson Construction Materials Pty Ltd
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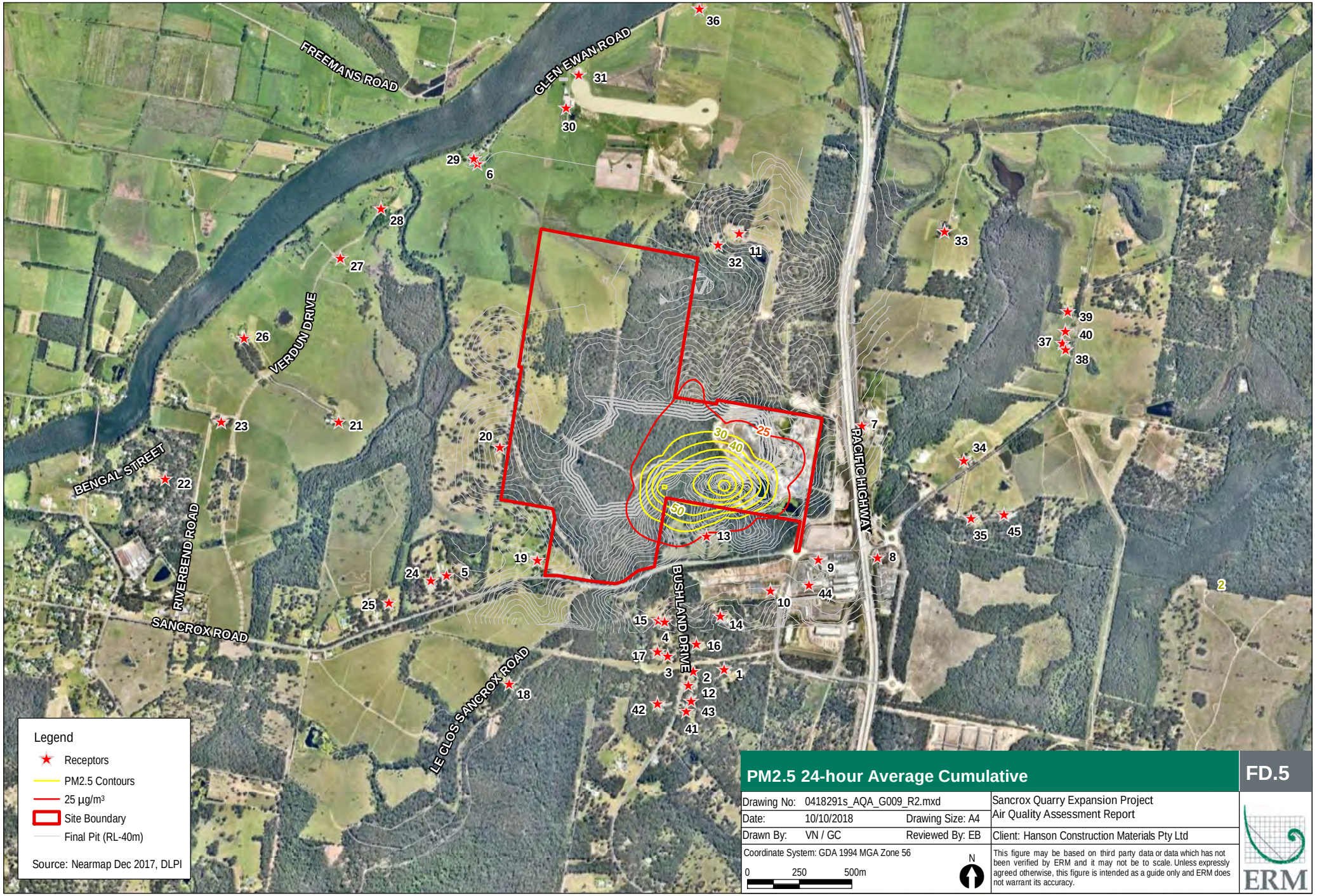
ERM


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
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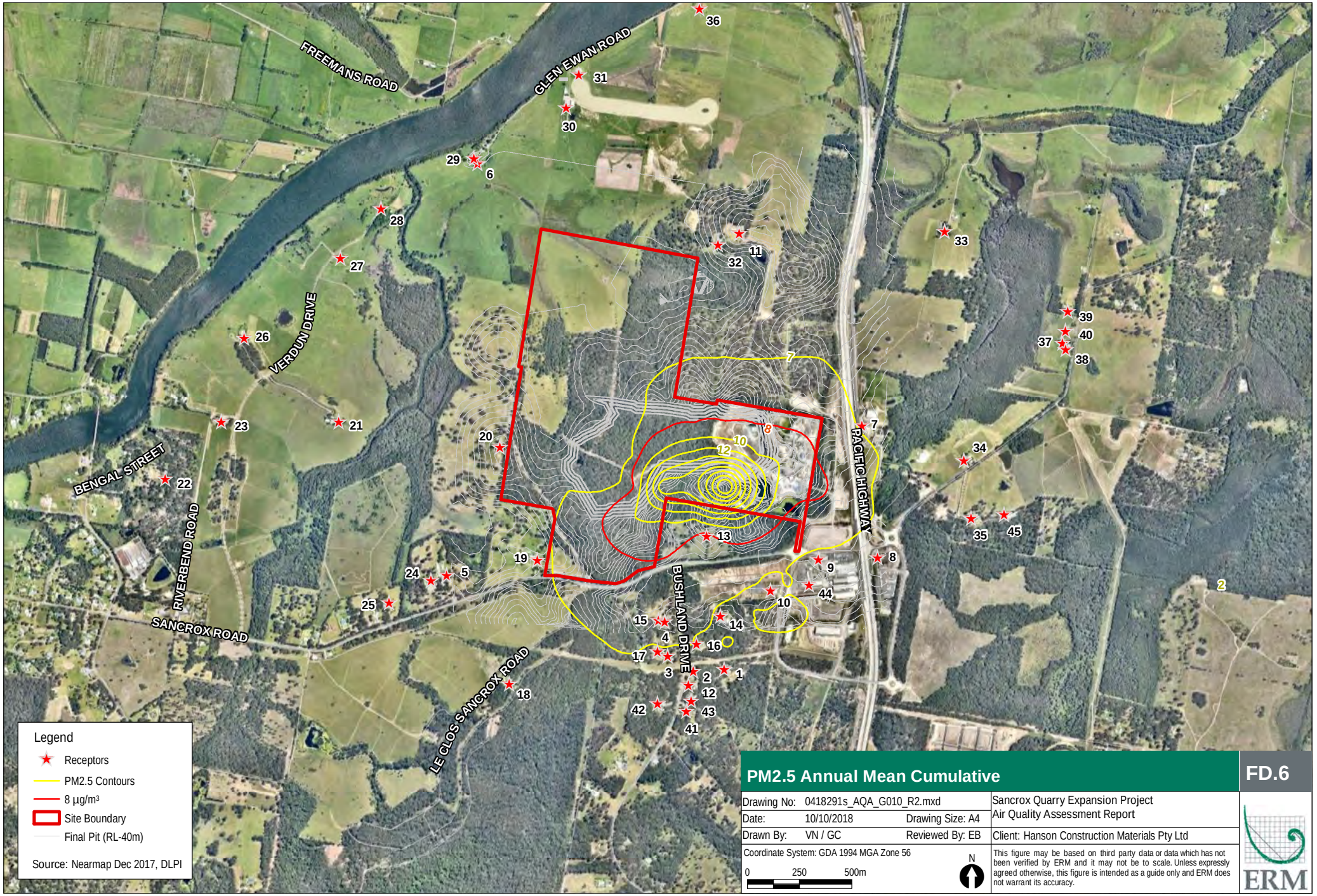
Legend
Receptors
PM2.5 Contours
25 µg/m³
Site Boundary
Final Pit (RL-40m)
Source: Nearmap Dec 2017, DLPI
PM2.5 24-hour Average Cumulative
FD.5
Drawing No: 0418291s_AQA_G009_R2.mxd
Date: 10/10/2018
Drawing Size: A4
Drawn By: VN / GC
Reviewed By: EB
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Air Quality Assessment Report
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM



PM2.5 Annual Mean Cumulative

FD.6

Drawing No:	0418291s_AQA_G010_R2.mxd		Sancrox Quarry Expansion Project Air Quality Assessment Report
Date:	10/10/2018	Drawing Size: A4	
Drawn By:	VN / GC	Reviewed By: EB	Client: Hanson Construction Materials Pty Ltd

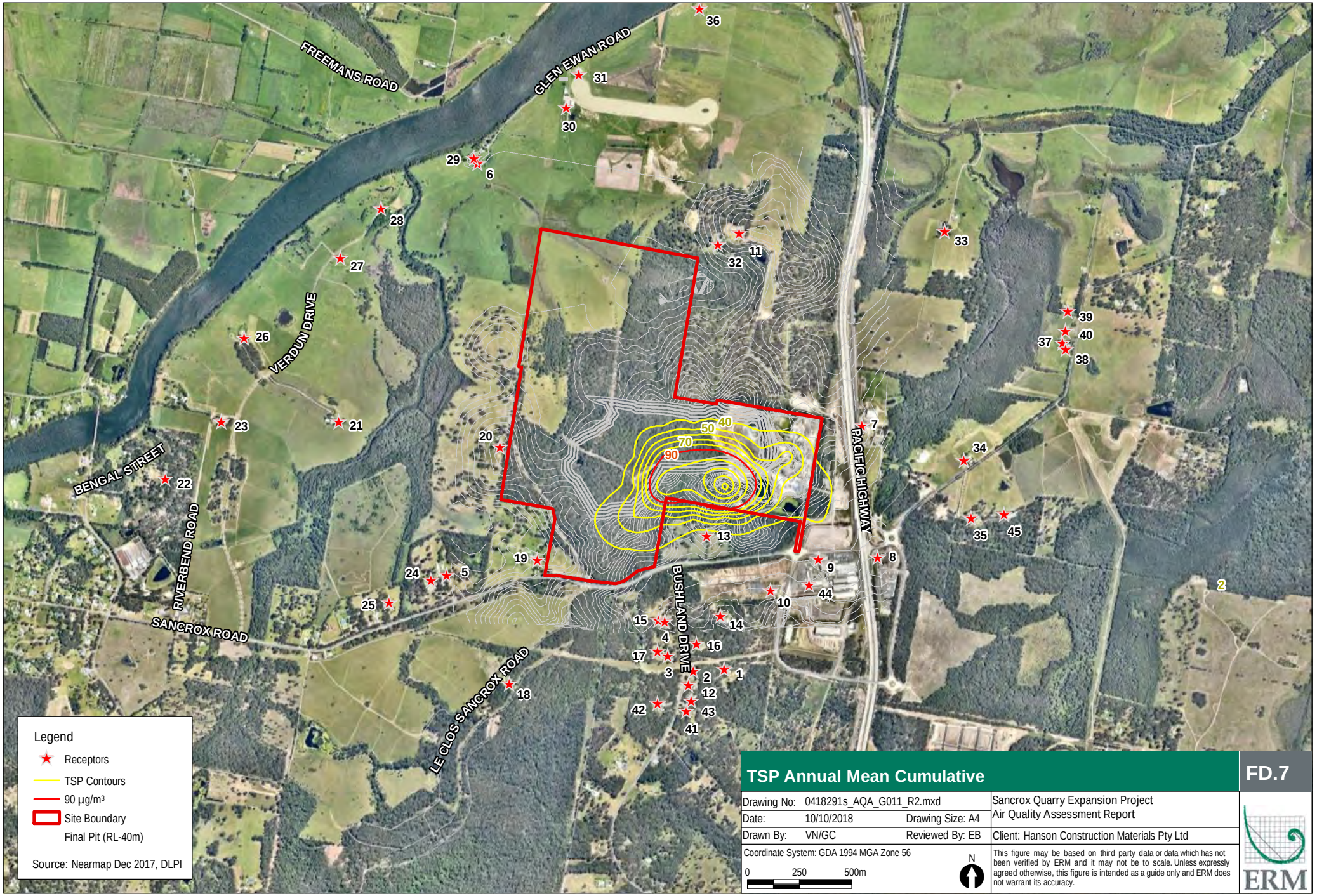
Coordinate System: GDA 1994 MGA Zone 56

0 250 500m

N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



TSP Annual Mean Cumulative

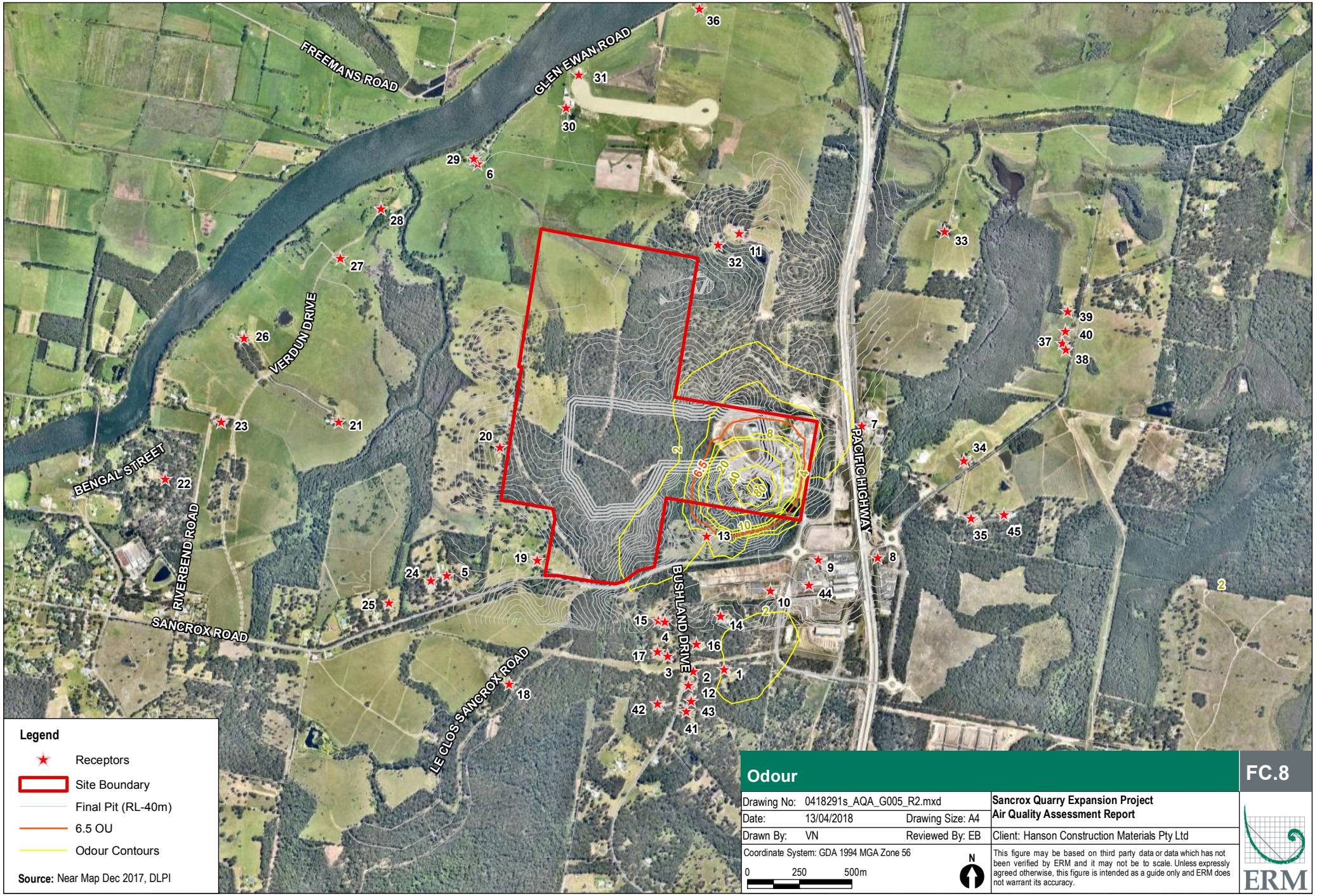
FD.7

Drawing No:	0418291s_AQA_G011_R2.mxd		Sancrox Quarry Expansion Project Air Quality Assessment Report
Date:	10/10/2018	Drawing Size: A4	Client: Hanson Construction Materials Pty Ltd
Drawn By:	VN/GC	Reviewed By: EB	

Coordinate System: GDA 1994 MGA Zone 56

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM


FREEMANS ROAD
GLEN EWAN ROAD
VERDUN DRIVE
BENGAL STREET
RIVERBEND ROAD
SANCROX ROAD
LE CLOS SANCROX ROAD
BUSHLAND DRIVE
PACIFIC HIGHWAY
Legend
Receptors
Site Boundary
Final Pit (RL-40m)
6.5 OU
Odour Contours
Source: Near Map Dec 2017, DLPI
Odour
FC.8
Drawing No: 0418291s_AQA_G005_R2.mxd
Date: 13/04/2018
Drawing Size: A4
Drawn By: VN
Reviewed By: EB
Coordinate System: GDA 1994 MGA Zone 56
0 250 500m
N
Sancrox Quarry Expansion Project
Air Quality Assessment Report
Client: Hanson Construction Materials Pty Ltd
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

ERM has over 160 offices across the following countries and territories worldwide

Argentina
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Colombia
France
Germany
Hong Kong
Hungary
India
Indonesia
Ireland
Italy
Japan
Kazakhstan
Malaysia
Mexico
The Netherlands
New Zealand
Panama
Peru
Poland
Portugal
Puerto Rico
Romania
Russia
Singapore
South Africa
South Korea
Spain
Sweden
Taiwan
Thailand
United Arab Emirates
UK
US
Vietnam

ERM's Melbourne Office

Level 6, 99 King Street,
Melbourne, Victoria 3000
T: +61 0 9696 8011
F: +61 3 9696 8022

www.erm.com

Annex I

Traffic Count Data

Ticketed time	Count	% of sales	New DA	256 sales days
6am - 7am	161	1.5	491	2
7am - 8am	1310	12.3	3995	16
8am - 9am	1228	11.5	3745	15
9am - 10am	968	9.1	2952	12
10am - 11am	1395	13.1	4254	17
11am - 12pm	1404	13.2	4282	17
12pm - 1pm	1042	9.8	3178	12
1pm - 2pm	1107	10.4	3376	13
2pm - 3pm	1211	11.4	3693	14
3pm - 4pm	691	6.5	2107	8
4pm - 5pm	120	1.1	366	1
5pm - 6pm	11	0.1	34	0
Misc	2	0.0	0	0
	10650	100	32473	127

Total sales in tonnes	245930
Total applied for in DA	750000
	3.049648

Highest number of sales in 1 hour on highest truck movement day 29.03.2017 was 18 bewteen 10am and 11am this was a 3001t sales day.

Date	Truck Trips
1/09/2016	46
2/09/2016	40
5/09/2016	37
6/09/2016	68
7/09/2016	58
8/09/2016	50
9/09/2016	35
12/09/2016	19
13/09/2016	25
14/09/2016	28
15/09/2016	26
16/09/2016	13
19/09/2016	52
20/09/2016	58
21/09/2016	15
22/09/2016	24
23/09/2016	43
26/09/2016	32
27/09/2016	49
28/09/2016	18
29/09/2016	44
30/09/2016	22
4/10/2016	13
5/10/2016	25
6/10/2016	36
7/10/2016	22
10/10/2016	19
11/10/2016	27
12/10/2016	38
13/10/2016	23
14/10/2016	26
17/10/2016	19
18/10/2016	39
19/10/2016	36
20/10/2016	55
21/10/2016	46
24/10/2016	25
25/10/2016	36
26/10/2016	33
27/10/2016	103
28/10/2016	25
31/10/2016	59
1/11/2016	73
2/11/2016	44
3/11/2016	96
4/11/2016	36
7/11/2016	57
8/11/2016	54
9/11/2016	31
10/11/2016	27
11/11/2016	33

14/11/2016	25
15/11/2016	30
16/11/2016	44
17/11/2016	38
18/11/2016	20
19/11/2016	1
21/11/2016	30
22/11/2016	36
23/11/2016	23
24/11/2016	16
25/11/2016	20
28/11/2016	24
29/11/2016	20
30/11/2016	27
1/12/2016	19
2/12/2016	30
5/12/2016	10
6/12/2016	19
7/12/2016	22
8/12/2016	33
9/12/2016	36
12/12/2016	50
13/12/2016	67
14/12/2016	68
15/12/2016	35
16/12/2016	38
19/12/2016	35
20/12/2016	38
21/12/2016	80
22/12/2016	6
9/01/2017	19
10/01/2017	42
11/01/2017	53
12/01/2017	70
13/01/2017	76
16/01/2017	72
17/01/2017	48
18/01/2017	39
19/01/2017	43
20/01/2017	60
21/01/2017	1
23/01/2017	61
24/01/2017	62
25/01/2017	42
27/01/2017	32
30/01/2017	43
31/01/2017	41
1/02/2017	25
2/02/2017	28
3/02/2017	93
4/02/2017	1
6/02/2017	59
7/02/2017	43
8/02/2017	88

9/02/2017	103
10/02/2017	66
13/02/2017	94
14/02/2017	25
15/02/2017	25
16/02/2017	54
17/02/2017	100
20/02/2017	34
21/02/2017	35
22/02/2017	45
23/02/2017	41
24/02/2017	45
25/02/2017	2
27/02/2017	17
28/02/2017	7
1/03/2017	14
2/03/2017	25
3/03/2017	39
6/03/2017	27
7/03/2017	37
8/03/2017	34
9/03/2017	10
10/03/2017	34
13/03/2017	101
14/03/2017	30
15/03/2017	4
16/03/2017	12
17/03/2017	2
20/03/2017	4
21/03/2017	9
22/03/2017	13
23/03/2017	68
24/03/2017	2
27/03/2017	66
28/03/2017	101
29/03/2017	130
30/03/2017	10
31/03/2017	8
1/04/2017	1
3/04/2017	16
4/04/2017	39
5/04/2017	32
6/04/2017	12
7/04/2017	94
8/04/2017	1
10/04/2017	52
11/04/2017	32
12/04/2017	90
13/04/2017	79
18/04/2017	34
19/04/2017	62
20/04/2017	31
21/04/2017	40
22/04/2017	1

24/04/2017	19
26/04/2017	33
27/04/2017	32
28/04/2017	21
29/04/2017	2
1/05/2017	46
2/05/2017	52
3/05/2017	59
4/05/2017	41
5/05/2017	83
8/05/2017	29
9/05/2017	63
10/05/2017	102
11/05/2017	86
12/05/2017	96
15/05/2017	39
16/05/2017	43
17/05/2017	47
18/05/2017	88
19/05/2017	11
22/05/2017	40
23/05/2017	81
24/05/2017	74
25/05/2017	54
26/05/2017	47
29/05/2017	70
30/05/2017	61
31/05/2017	65
1/06/2017	113
2/06/2017	89
5/06/2017	65
6/06/2017	64
7/06/2017	71
8/06/2017	45
9/06/2017	6
13/06/2017	9
14/06/2017	4
15/06/2017	23
16/06/2017	27
19/06/2017	38
20/06/2017	47
21/06/2017	81
22/06/2017	80
23/06/2017	58
24/06/2017	4
26/06/2017	60
27/06/2017	60
28/06/2017	70
29/06/2017	22
30/06/2017	11
3/07/2017	57
4/07/2017	52
5/07/2017	58
6/07/2017	85

7/07/2017	31
10/07/2017	52
11/07/2017	42
12/07/2017	79
13/07/2017	23
14/07/2017	46
17/07/2017	48
18/07/2017	49
19/07/2017	29
20/07/2017	37
21/07/2017	36
24/07/2017	70
25/07/2017	66
26/07/2017	39
27/07/2017	39
28/07/2017	48
31/07/2017	52
1/08/2017	42
2/08/2017	55
3/08/2017	40
4/08/2017	81
5/08/2017	1
7/08/2017	34
8/08/2017	24
9/08/2017	46
10/08/2017	27
11/08/2017	48
12/08/2017	2
14/08/2017	55
15/08/2017	69
16/08/2017	33
17/08/2017	45
18/08/2017	25
21/08/2017	9
22/08/2017	53
23/08/2017	36
24/08/2017	46
25/08/2017	34
26/08/2017	1
28/08/2017	41
29/08/2017	36
30/08/2017	31
31/08/2017	39
Grand Total	**10650**

Total sales in t	245930
Total applied f	750000
	3.049648274

Yearly truck trips at 245930t

Average	41.6015625	
Max	130	3001t sold
Median	38	

Yearly truck trips at 750,000t

Average	127	
Max	396	9152t sold
Median	116	

Number of trucks over bridge for new DA assuming deliveries are at same % for truck type (unlikely as more would become T/D).
The truck movements at 750,000 would be similar to our closest quarry in NSW which is Brandy Hill Quarry. BHQ has a 750,000t limit and in the same period as the sales date looked at BHQ had a max sales day of 201 deliveries out the gate for 5,904t. Hitting 396 deliveres in a day would be extremely unlikely. Higher median deliveries would be more likely seeing somewhere in the range of 2,000 to 4,000 tonne per day rather than stand out 9152t days as shown above.

Annex J

Capital Investment Value Report

acp. Quantity Surveyors
BUILDING VALUE

Budget Estimate Council DA Submission

Date	**3–August-18**
Address	**Sancrox Quarry Expansion Project, Port Macquarie**
Client	**Hanson Construction Materials Pty Ltd**

ACP QUANTITY SURVEYORS IS A DIVISION OF AUSTRALIAN COST PLANNERS PTY LTD
ACN 092 316 722 ABN 14 092 316 722

Sydney
U13a, Q North Business Centre, 829 Old Northern Road, Dural NSW 2158
p 1300 550 311 **e** info@quantitysurveyors.com.au

MEMBER OF AIQS AUSTRALIAN INSTITUTE OF QUANTITY SURVEYORS

acp. Quantity Surveyors
BUILDING VALUE

3 August 2018

Belinda Pignone
Graduate Environ and Compliance Co-Ordinator
Hanson Construction Materials Pty Ltd
E. belinda.pignone@hanson.com.au

Dear Belinda,

Re: Sancrox Quarry Expansion
Capital Investment Valuation
Quantity Surveyor's Assessment

Further to my review of the documentation provided including site plans prepared by ERM, I have prepared a cost estimate for the proposed expansion of the Sancrox quarry.

Purpose of Report

This estimate has been provided for the purpose of providing an initial assessment of the likely cost of expanding the existing facility – specifically:-

1. To prepare a valuation of the capital investment as defined by Clause 3 of the Environmental Planning and Assessment Regulation 2000 - including all relevant assumptions.

Documents Examined

The following documents have been reviewed:-

- Site Plan and Ancillary Infrastructure plan prepared by ERM
- Satellite Image Overview courtesy of Google Maps
- Clause 3 of the Environmental Planning and Assessment Regulation 2000

Scope of Rehabilitation Works

This estimate includes for the construction of all additional processing plant, asphalt plant, batching plant, roads, site works, power supply, infrastructure and consultants fees.

Cost Estimate

Based on my review of the available documents, I have prepared an estimate of the works totalling **$18,916,517.42 (Excluding GST)**. Full details of my estimate are attached for your review (**Annexure 'A'**). I note that my estimate should be read in conjunction with the qualifications noted below:-

With respect to the attached estimate I advise the following:-

Cost Escalation

1. Rates used in my estimate are considered to include for cost escalation until August 2018. No allowance has been made for cost escalation after this date.

Notes and Assumptions

2. General assumptions as included in the body of the attached estimate (Refer **Annexure 'A'** of this report).

GST

3. In accordance with Clause 3 of the EPAR-2000, no allowance has been made for the Good and Services Tax (Refer **Annexure 'C'** of this report).

Writer's Expertise

I attach a copy of my professional curriculum vitae (attached as **Annexure 'B'**) and advise that I am an associate member of the Australian Institute of Quantity Surveyors (AIQS) with current standing.

Conclusion

I trust that this clarifies my pricing and ask that you do not hesitate to call if you have any questions. This estimate should be reviewed as the documentation is further developed.

Yours Faithfully,
AUSTRALIAN COST PLANNERS PTY LTD

MICHAEL STURGESS
DIRECTOR (AAIQS)

Encl.
Annexure 'A' - Cost Estimate
Annexure 'B' – Writer's CV
Annexure 'C' - Extract - Clause 3 of the EPAR-2000,
Annexure 'D' - Plans of Proposed Expansion

acp. Quantity Surveyors
BUILDING VALUE

Estimate - <u>ANNEXURE 'A'</u>

SUMMARY		Page No.		
Consultants, Fees and Monitoring		BQ/2		439,152.48
Roads & Access		BQ/3		600,743.00
Electrical - Easement HV and Substation		BQ/4		2,199,927.60
Civil Works - Establishment		BQ/5		301,509.00
Civil Works - Infrastructure		BQ/6		1,690,222.25
Civil Works - Services		BQ/7		61,776.00
Plant - Structure		BQ/8		1,313,472.42
Plant - Conveyors & Equipment		BQ/9		4,165,200.00
Plant - Equipment		BQ/10		5,744,680.58
Plant - Electrical & CCTV		BQ/11		1,640,268.86
Buildings - Office and Weighbridge (Exist)		BQ/12		60,000.00
Buildings - Workshop (Exist)		BQ/13		NIL
Ancillary Plant - Precoat		BQ/14		699,565.23
TOTAL AMOUNT				**18,916,517.42**

Note: This Estimate contains pages numbered BQ/1 - BQ/14.

	Consultants, Fees and Monitoring				
	Fees and Contributions				
A	Department of Planning fees	item	1	36205.65	36,205.65
	Consultants Fees				
B	Project management	item	1	28957.50	28,957.50
C	Asbestos management plan	item	1	29250.00	29,250.00
D	Engineer - civil	item	1	11700.00	11,700.00
E	Structural engineer	item	1	15444.00	15,444.00
F	Air monitoring and sampling	item	1	16380.00	16,380.00
G	Heritage impact study	item	1	4095.00	4,095.00
H	Surveyor	item	1	23945.22	23,945.22
J	Test pits	item	1	2340.00	2,340.00
K	Traffic study	item	1	5850.00	5,850.00
	Journal				
L	Site journal	item	1	7020.00	7,020.00
	EMPS				
M	*Environmental management plan and strategy	item	1	88900.11	88,900.11
	Wad				
N	Wad fee	item	1	35100.00	35,100.00
	Weather				
P	Weather station	item	1	25740.00	25,740.00
	Monitoring				
Q	Blast monitors x 4	item	1	25740.00	25,740.00
R	Dust monitoring and tracking module	item	1	15210.00	15,210.00
S	Noise monitors	item	1	5850.00	5,850.00
T	Water table monitoring	item	1	5265.00	5,265.00

	Consultants, Fees and Monitoring (Cont)				
	(Cont) Monitoring				
	Naturally Occuring Asbestos				
A	NOA monitors, setup and infrastructure	item	1	56160.00	56,160.00
B	Monitoring and training - is part of ongoing operational work and has been excluded.	item	1		EXCL

	Roads & Access				
	Work Outside the Boundary				
A	Allowance for minor work outside the boundary	item	1	58500.00	58,500.00
	Access Roads				
	New roads as noted on drawing 0418291s_EIS_G003-RO.mxd				
B	Seal roads	m	700	350.00	245,000.00
C	Unsealed roads	m	450	250.00	112,500.00
D	Subcontract machinery and labour	item	1		INCL
E	Aggregate and materials	item	1		INCL
	Entry				
F	Upgrade entry	item	1	111150.00	111,150.00
G	Shaker construction	item	1	73593.00	73,593.00

	Electrical - Easement HV and Substation				
	Easement				
A	Easement design	item	1	67860.00	67,860.00
B	HV easement creation	item	1	107874.00	107,874.00
	Conduits				
C	Run conduits to electrical points	item	1	320580.00	320,580.00
	High Voltage				
D	High voltage including control wiring, trenches, pits, meter boxes and commissioning	item	1	1.84e+06	1,840,410.00
	Reticulation				
E	Site reticulation - various	item	1	98280.00	98,280.00
	Substation				
F	Control panel and switching	item	1	107815.50	107,815.50
G	Transformer supply	item	1	207090.00	207,090.00
H	Subtotal				*2,749,909.50*
	Existing Services				
J	Credit existing for services (say 20% of the above)	%	-0.2	2.75e+06	-549,981.90

	Civil Works - Establishment				
	Geotechnical				
A	Geotechnical tests and investigations	item	1	28080.00	28,080.00
	Earthworks				
B	Wet weather access	item	1	7371.00	7,371.00
C	Design	item	1	82485.00	82,485.00
D	Plumbing and drainage	item	1	23400.00	23,400.00
E	Earthworks	item	1	97110.00	97,110.00
F	Watertanks	item	1	4680.00	4,680.00
	Signage				
G	Entry sign	item	1	21528.00	21,528.00
	Fences				
H	Existing fences generally	note			
J	Fencing - new areas only	item	1	29250.00	29,250.00
	Communications				
K	Telephone connection	item	1	7605.00	7,605.00

	Civil Works - Infrastructure				
	Stripping				
A	Survey and strip vegetation	item	1	32058.00	32,058.00
	Blasting				
B	Blasting and shot drilling	item	1	124020.00	124,020.00
	Crushing				
C	Crushing contract - included in roadworks	item	1		EXCL
	Dam Liner				
D	Geofabric in making good dam liner - if required	item	1	5139.81	5,139.81
	Machine Hire				
E	Hire minor items of plant and equipment (not otherwise supplied)	item	1	25740.00	25,740.00
	Retaining Wall				
F	Allowance for retaining walls	item	1	46800.00	46,800.00
	Civil Works - Infrastructure				
G	Civil works contractor	item	1	1.82e+06	1,822,860.00
H	Aggregate supply	item	1	56160.00	56,160.00
J	Subtotal				*2,112,777.81*
	Existing Services				
K	Credit existing for civil works (say 20% of the above)	%	-0.2	2.11e+06	-422,555.56

	Civil Works - Services				
	Generally				
A	Dams are existing	note			
	Dam Pump				
B	Dam pump unit including installation - assumed existing units	item	1		N/A
	Plumber and Drainer				
C	Sundry machine hire - to modify drainage lines	item	1	43407.00	43,407.00
D	Materials for drainage - to modify drainage lines	item	1	18369.00	18,369.00
E	Pump station - sewer	item	1		N/A

	Plant - Structure				
	Plant				
A	New concrete batching and processing plant	item	1	912600.00	912,600.00
B	New asphalt batching plant	item	1	257400.00	257,400.00
C	Concrete for crushing plant	item	1	124349.94	124,349.94
D	Craneage	item	1	19122.48	19,122.48

	Plant - Conveyors & Equipment				
	Conveyors				
A	Allowance for conveyors and associated plant	item	1	4.17e+06	4,165,200.00

	Plant - Equipment				
	Plant				
A	Plant construction	item	1	5.71e+06	5,705,592.11
	Sundry Equipment				
B	IBC spill, drum racks, drum heater, conveyor sprays, adblue bund and pumps, locks	item	1	39088.47	39,088.47

	Plant - Electrical & CCTV				
	Engineer				
A	Allowance for electrical engineer's input	item	1	2503.80	2,503.80
	Plant Electrical				
B	Plant electrical installation	item	1	1.93e+06	1,927,205.28
	Earth Grid Supply				
C	Earth grid supply and install	item	1	24102.00	24,102.00
	CCTV				
D	Plant camera cctv	item	1	87750.00	87,750.00
E	Mcc lock	item	1	8775.00	8,775.00
F	Subtotal				*2,050,336.08*
	Existing Services				
G	Credit existing for services (say 20% of the above)	%	-0.2	2.05e+06	-410,067.22

	Buildings - Office and Weighbridge (Exist)				
	Generally				
A	Office and weighbridge are all existing	note			
B	Allowance for small office to new plant areas only	item	1	60000.00	60,000.00
	Office				
C	Office slab and construction	item	1		N/A
	Phones and Data				
D	Office phone system	item	1		N/A
E	Data and power fileter	item	1		N/A
	Furniture				
F	Office furniture	item	1		N/A
	Weighbridge				
G	Weigbridge slab and construction	item	1		N/A

	Buildings - Workshop (Exist)				
	Generally				
A	The workshop is an existing structure	note			
	Workshop				
B	Workshop construction	item	1		N/A
	Crane				
C	5T overhead crane	item	1		N/A
D	Commissioning	item	1		N/A
	Fuel Cell				
E	Fuel cell supply and install	item	1		N/A

	Ancillary Plant - Precoat				
	Precoating Plant				
A	Allowance for supply and installation of precoat treatment plant	item	1	549465.93	549,465.93
B	Concrete infrastructure	item	1	50280.75	50,280.75
	Electrical				
C	Electrical supply	item	1	98209.80	98,209.80
D	Flow meter	item	1	1608.75	1,608.75

SUMMARY		Page No.		
Consultants, Fees and Monitoring		BQ/2		439,152.48
Roads & Access		BQ/3		600,743.00
Electrical - Easement HV and Substation		BQ/4		2,199,927.60
Civil Works - Establishment		BQ/5		301,509.00
Civil Works - Infrastructure		BQ/6		1,690,222.25
Civil Works - Services		BQ/7		61,776.00
Plant - Structure		BQ/8		1,313,472.42
Plant - Conveyors & Equipment		BQ/9		4,165,200.00
Plant - Equipment		BQ/10		5,744,680.58
Plant - Electrical & CCTV		BQ/11		1,640,268.86
Buildings - Office and Weighbridge (Exist)		BQ/12		60,000.00
Buildings - Workshop (Exist)		BQ/13		NIL
Ancillary Plant - Precoat		BQ/14		699,565.23
TOTAL AMOUNT				**18,916,517.42**

Note: This Estimate contains pages numbered BQ/1 - BQ/14.

CV of Michael Sturgess - ANNEXURE 'B'

CURRICULUM VITAE for MICHAEL STURGESS

TERTIARY EDUCATION

- Bachelor of App.Sc.(Quantity Surveying)
  University of Technology, Sydney

  6 year part time course undertaken 1984-1989

  MEMBERSHIPS ETC.

- Associate Member Australian Institute of Quantity Surveyors
- Holder of NSW Builders licence (No. 43556)
- Tax Agent No. 20864006
- Member of National Tax & Accountant's Association (No. 26827)

PROFESSIONAL EXPERIENCE

2002 to Current

Australian Cost Planners Pty Ltd

Position: Director

- Preparation of bills of quantities
- Estimating/cost planning
- Bank reporting
- Expert witness reports
- Attendance at expert witness workshops
- insurance valuation reports
- assessment of project variation costs
- preparation of building work tax depreciation schedules
- consultant liaison
- report writing
- use of Buildsoft estimating software

2001

Southland Constructions Pty Ltd

Position: Director

- Design and construction of development projects
- council and authority liaison and applications
- site supervision

- engagement of consultants and surveyors
- subcontract tendering
- co-ordination of subdivision works
- site programming
- monitoring of construction budgets
- finance procurement

1994 – 2000, 2002

Hugh B. Gage Pty. Ltd.

Position: Senior Quantity Surveyor

- Appraisal of the viability of development budgets on behalf of various Financial Institutions and industry clients.
- site inspections during the project construction stage, assessment of builder's progress claim submissions and certification of Bank funding.
- preparation of builder's bills of quantities
- estimating
- vetting of conditions of contract
- assessment of project variation costs
- auditing of construction accounts
- site meetings, client, bank and consultant liaison
- report writing
- use of Buildsoft estimating software

1995 - 1998

Northern Sydney Institute of TAFE

Position: Part Time Teacher, Builder's Estimating

- Teaching construction estimating to students enrolled in the Associate Diploma, Building course.
- marking, conflict resolution

1992 – 1994

3D Scaffolding and Bricklaying Pty Ltd

Position: Estimator/Administrator

- Scaffolding and masonry estimating
- preparation of tenders
- measurement of bills of quantities
- contract administration
- cash flow forecasting

1991 – 1992

Self Employed as a Contract Estimator for

the following clients:

- 3D Scaffolding and Bricklaying Pty Ltd
- Constructor Pty Ltd
- Von Roll Transport Systems Pty Ltd
- McGregor Constructions

1990 - 1991

Employed as a Contract Quantity Surveyor

Client: Department of Public Works

- Cost planning
- estimating
- compilation of an asset registers including recommended building replacement costs for insurance purposes
- reporting on reasons for variations and extensions of time on government projects
- use of Buildsoft estimating software

Dept. Public Works (Cont.)

Lidcombe College of TAFE Site

- Preparation of project final account
- assessment and negotiation of Head contract variations
- assessment of builder's prolongation claim and preparation of a prolongation report

1989 – 1990

Girvan (NSW) Metroplaza site (Optus Building), North Sydney

Position: Quantity Surveyor

- Administration of subcontract trade packages
- assessment of subcontract progress claims and variations
- submission and negotiation of Head contract variations
- feasibility analysis of alternative construction methods
- use of "Jobpac" cost control software

1988 - 1989

L.A. Casey Burne and Associates

Position: Cadet Quantity Surveyor

- Preparation of detailed bills of quantities
- cost planning
- estimating
- liaison with consultants
- assessment of variations
- preparation of building work tax depreciation schedules

only one dwelling and that has a capacity, or combined capacity, of less than 40,000 litres.

building premises, in relation to a building, means the building and the land on which it is situated.

capital investment value of a development or project includes all costs necessary to establish and operate the project, including the design and construction of buildings, structures, associated infrastructure and fixed or mobile plant and equipment, other than the following costs:

(a) amounts payable, or the cost of land dedicated or any other benefit provided, under a condition imposed under Division 6 or 6A of Part 4 of the Act or a planning agreement under that Division,

(b) costs relating to any part of the development or project that is the subject of a separate development consent or project approval,

(c) land costs (including any costs of marketing and selling land),

(d) GST (within the meaning of *A New Tax System (Goods and Services Tax) Act 1999* of the Commonwealth).

Category 1 fire safety provision means the following provisions of the *Building Code of Australia*, namely, EP1.3, EP1.4, EP1.6, EP2.1, EP2.2 and EP3.2 in Volume One of that Code and P2.3.2 in Volume Two of that Code.

Category 2 fire safety provision means the following provisions of the *Building Code of Australia*, namely, CP9, EP1.3, EP1.4, EP1.6, EP2.2 and EP3.2 in Volume One of that Code.

Category 3 fire safety provision means the following provisions of the *Building Code of Australia*, namely, EP1.3, EP1.4, EP1.6, EP2.2 and EP3.2 in Volume One of that Code.

class, in relation to a building or part of a building, means:

(a) in a provision of this Regulation that imposes requirements with respect to a development consent, the class to which the building belongs, as identified by that consent, or

(b) in any other provision of this Regulation, the class to which the building or part of a building belongs, as ascertained in accordance with the *Building Code of Australia*.

Class 1 aquaculture development means development of the kind referred to in clause 5 (1) (d).

coastal council means a council whose area, or part of whose area, is included within the coastal zone (within the meaning of the *Coastal Protection Act 1979*) or whose area includes land that adjoins the tidal waters of the Hawkesbury River, Sydney Harbour and Botany Bay, and their tributaries.

Drawings - ANNEXURE 'D'

Pit Floor

Dam

Concrete Batching Plant & Recycling Facility

Old Processing Plant (to be relocated)

New Processing Plant

New Asphalt Production Plant

New Stockpile Area

Dam

Dam

Existing Site Office, Weightbridge & Workshop

Legend

- Existing Property Ownership
- Lot Boundary
- Road Network
- Infrastructure

Haul roads

- Sealed roads
- Unsealed roads

Source:
Spatial Data: DFSI DCDB, DTDB 2017
Imagery Data: nearmap August 2017

Ancillary Infrastructure

F.3

Drawing No:	0418291s_EIS_G003_R0.mxd		Sancrox Quarry Expansion Project
Date:	11/04/2018	Drawing Size: A4	
Drawn By:	GC	Reviewed By: ME	Client: Hanson Construction Materials Pty Ltd

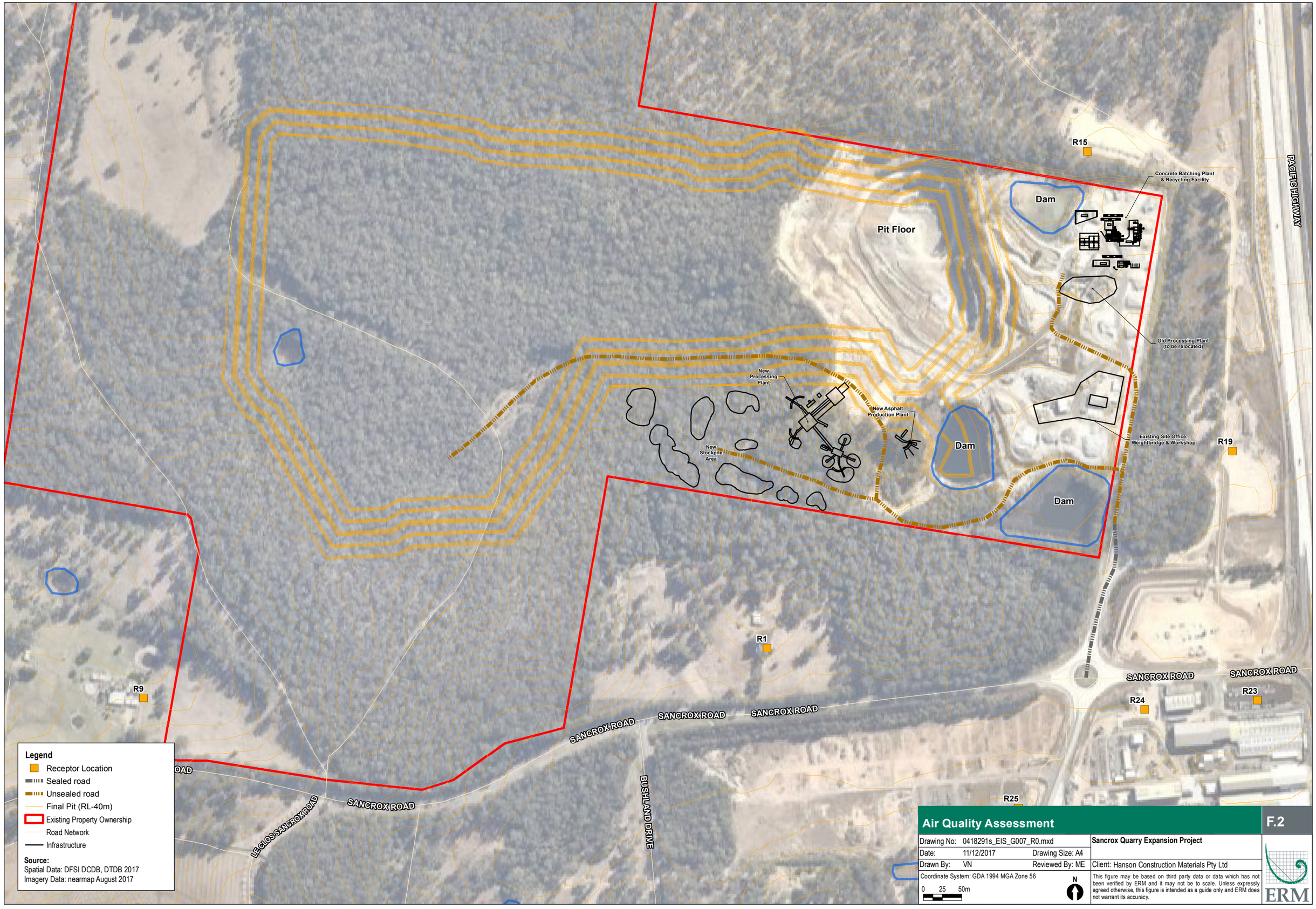
Coordinate System: GDA 1994 MGA Zone 56

0 25 50m

N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM



Air Quality Assessment

F.2

Drawing No:	0418291s_EIS_G007_R0.mxd		Sancrox Quarry Expansion Project
Date:	11/12/2017	Drawing Size: A4	
Drawn By:	VN	Reviewed By: ME	Client: Hanson Construction Materials Pty Ltd

Coordinate System: GDA 1994 MGA Zone 56

0 25 50m

N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

Annex K

Social and Economic Impact Assessment

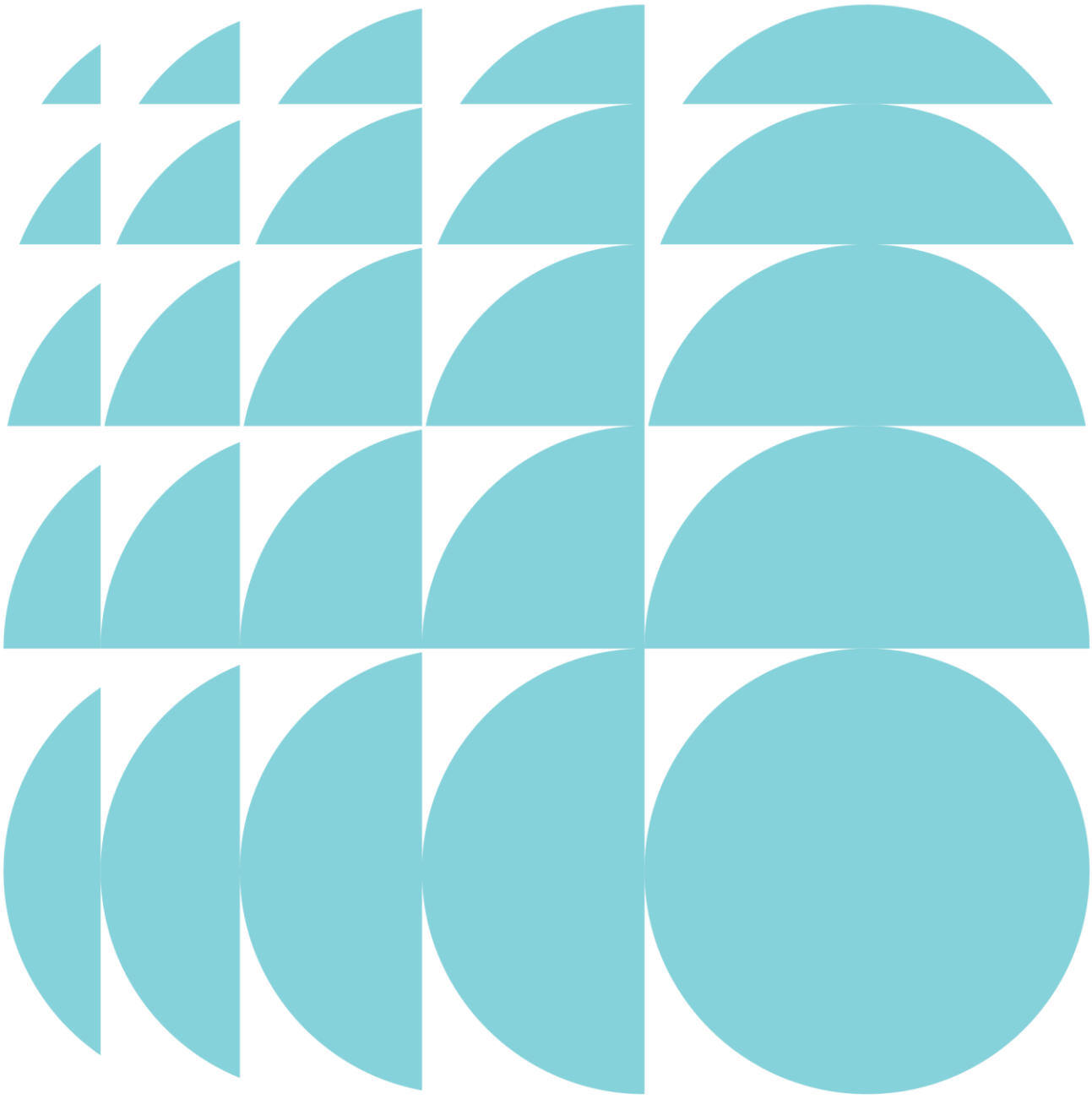
ETHOS URBAN

Social and Economic Impact Assessment

Sancrox Road, Sancrox
Sancrox Quarry Expansion

Submitted to Department of Planning & Environment
On behalf of Hanson Construction Material Pty Ltd.

14 May 2019 | 2190085



CONTACT

Allison Heller	Director	aheller@ethosurban.com	(02) 9956 6962

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This document has been prepared by:		This document has been reviewed by:	
Lucy Fokkema	14.5.2019	Allison Heller	14.5.2019

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VERSION NO.	DATE OF ISSUE	REVISION BY	APPROVED BY

Ethos Urban Pty Ltd
ABN 13 615 087 931.
www.ethosurban.com
173 Sussex Street, Sydney
NSW 2000 t 61 2 9956 6952

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Figures

Tables

Appendices

Executive Summary

This report provides a Social Impact Assessment and an Economic Assessment for the Sancrox Quarry Expansion Project. These assessments have been prepared by Ethos Urban on behalf of Hanson Construction Materials to accompany the Environmental Impact Statement and in relation to proposed land uses.

Hanson Construction Materials Pty Ltd (Hanson) currently operates a hard rock quarry, known as Sancrox Quarry (the site) on Sancrox Road, Sancrox, located approximately 8km west of Port Macquarie. The Sancrox Quarry is within the Port Macquarie Hasting Council (PMHC) local government area on the Mid North Coast of NSW.

The quarry is a significant economic resource for regional and state development. Hanson proposes to extend the life of the quarry by expanding the approved extraction boundary and increasing the annual extraction limit to facilitate the extraction and distribution of high-quality construction materials for the use of civil infrastructure and road construction projects.

To assess the likely social and economic impacts of the proposed expansion of operations at Sancrox Quarry, this report has reviewed the existing social and economic environments, analysed how the proposal will impact the existing and forecast social and economic environment during construction and operation, and developed mitigation responses should an identified social or economic impact occur.

The report includes two components – a Social Impact Assessment, and an Economic Impact Assessment. This report is based on the NSW DPE *Social Impact Assessment Guideline for state significant mining, petroleum production and extractive industry development*, dated September 2017.

This report has considered a range of social impacts arising from the proposed expansion of operations at Sancrox Quarry, including impacts to way of life, community composition and character, culture, health and wellbeing, surroundings, personal and property rights, decision making systems and access to and use of infrastructure. This report has also considered economic impacts arising from the proposed development, including resource significance, demand considerations, cartage cost considerations, employment and other economic considerations.

The proposed development is likely to have a mixed impact on the existing primary study area and surrounding Port Macquarie-Hastings LGA.

- The social impacts of the proposed expansion of operations at Sancrox Quarry are likely to be generally consistent with existing operations at Sancrox Quarry but increased in line with the increased scale of operations – for example impacts associated with the rise in truck movements.
- There are potential negative social impacts associated with increased traffic and heavy vehicle movements, increased noise and vibration, impacts to air and water quality and clearing of bushland, which will need to be appropriately mitigated to prevent impacts to the sense of place and amenity of the surrounding area. However, the quarry has operated at this location for over 20 years and the expansion of operations at this site does not involve a significant change to land uses at this location.
- There are a range of likely positive economic benefits associated with the expansion of Sancrox Quarry at this location including:
    - Employment growth at the quarry and in the broader community – which also brings potential social benefits to the community associated with increased business expenditures and expanded employment opportunities
    - Efficient and cost-effective delivery of product to customers/end users
    - Environmental benefits through the diversion of used concrete from landfill.
- The expansion of the quarry will also support urban growth resource needs, stimulated by ongoing population expansion and the proposed pipeline of major State Government infrastructure investment projects in the area.

Therefore the overall impact of the proposed development at this location is likely to be positive, provided that the localised potential negative social impacts associated with increased traffic and heavy vehicle movements, increased noise and vibration, impacts to air and water quality and clearing of bushland are appropriately mitigated and monitored, as set out in the Environmental Impact Statement (dated October 2018).

1.0 Introduction

This report provides a Social Impact Assessment and an Economic Impact Assessment for the Sancrox Quarry Expansion Project. These assessments have been prepared by Ethos Urban on behalf of Hanson Construction Materials to accompany the Environmental Impact Statement and in relation to proposed land uses.

1.1 Background

Hanson Construction Materials Pty Ltd (Hanson) currently operates a hard rock quarry, known as Sancrox Quarry (the site) on Sancrox Road, Sancrox, located approximately 8km west of Port Macquarie. The Sancrox Quarry is within the Port Macquarie Hasting Council (PMHC) local government area on the Mid North Coast of NSW. The current Sancrox Quarry comprises of Lot 353 DP 754434, Lot 1 DP 720807 and Lot 1 DP 704890.

The quarry is a significant economic resource for regional and state development. Hanson proposes to extend the life of the quarry by expanding the approved extraction boundary and increase the annual extraction limit to facilitate the extraction and distribution of high-quality construction materials for the use of civil infrastructure and road construction projects.

1.2 Purpose, objectives and scope

Social Impact Assessment

The preparation of this SIA has involved a detailed review of the strategic policy context of the proposed development, local demographic and place characteristics; a review of relevant technical reports and community engagement outcomes to date to broadly explore community concerns and aspirations regarding the site and local social context.

The objective of this SIA is to identify, investigate and assess potential impacts to the social environment generated by the Development Application and to recommend mitigation or enhancement responses appropriate to this stage of the land use planning process. To achieve this objective this SIA must:

Social assessment

1. Develop an understanding of the existing community and current social environment;
2. Develop a broad understanding of the future community and potential social environment;
3. Review and analyse responses to the community and stakeholder engagement and consultation;
4. Consider how the proposed development will impact the existing and likely social environment during construction and operation;
5. Consider the cumulative impacts of other proposed and committed projects within the community;
6. Assess the likelihood and severity of impact should an identified social impact occur; and
7. Develop mitigation strategies for identified meaningful negative impacts and/or enhancement strategies for identified meaningful positive impacts generated by the proposed development.

Economic assessment

8. Develop an understanding of the existing economic environment;
9. Develop a broad understanding of the future economic environment;
10. Consider how the proposed development will impact the existing and likely economic environment during construction and operation; and
11. Address SEARS criteria, including assessing economic impacts and net community benefit outcomes arising from the project.

1.3 Assessment framework

This SIA is based on the NSW DPE *Social Impact Assessment Guideline for state significant mining, petroleum production and extractive industry development*, September 2017.

It also draws on guidelines published by the International Association for Impact Assessment (IAIA), *International principles for social impact assessment* (Vanclay 2003), which defines Social Impact Assessment as:

> *"the process of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment"* (2003, p.5).

These detailed frameworks are set out in Section 9, as the basis for this assessment.

1.4 Methodology

As outlined in the IAIA Social Impact Assessment Guideline (2015), social impacts vary in their nature and can be positive or negative, tangible or intangible, quantifiable, partly quantifiable or qualitative. Social impacts can also be experienced or perceived differently by different people and groups within a community.

The following methodology employed to prepare this social impact assessment is designed to ensure that the social environment of communities potentially impacted by the project are best accounted for and recorded, and anticipated impacts are adequately considered and assessed.

Social assessment

1. Review of existing background studies and technical reports;
2. Review of relevant local and state policy frameworks related to the proposed development;
3. Review of the outcomes of previously completed community consultation and engagement with local residents to ascertain broad attitudes, perceptions and aspirations in relation to the local social and place context;
4. Study area definition, including primary and secondary geographic areas likely to be impacted by the Development Application in terms of social impacts to communities – residents, local businesses and other stakeholders;
5. Analysis of current and forecast communities in identified study areas as per the Australian Bureau of Statistics (ABS) Census of Population and Housing and other data sources;
6. Identification of potential social impacts and opportunities for the local community which may result from the Development Application, and
7. Preparation of preliminary analysis of social impacts and recommended responses to address them in the context of this stage of development.

Economic assessment

8. Economic Baseline Study: including economic profile (population and dwelling projections, building approvals, industry structure, occupational structure, business structure and labour market overview) and Sancrox Quarry Operating Overview (production, key markets, competition, employment and local spending); and
9. Economic Impact Assessment: including resource significance, demand outlook, cartage cost considerations, economic benefits (investment, employment, local spending, concrete recycling), tax implication, and macro-economic considerations.

1.5 Information sources and assumptions

Information sources used to prepare this SIA include:

- Sancrox Quarry Expansion Project – Environmental Impact Statement, ERM, prepared on behalf of Hanson Construction Materials, October 2018
- ABS Average Weekly Earnings, Australia Nov 2018

- ABS Census of Population and Housing 2016
- ABS Counts of Australian Business, June 2013 to June 2017
- Community.id
- Economy.id
- Forecast.id
- NSW Budget Papers 2018/19

Assumptions applied to complete this SIA include:

- Socio-economic data for each study area accurately reflects the community demographic profile;
- The key findings of the background studies and technical reports are accurate;
- Outcomes of the community consultation and engagement undertaken to date accurately reflect community views, and
- All potential social impacts to the local community and special interest groups are identified.

2.0 Site context

2.1 The site

The Sancrox Quarry is located on Sancrox Road, Sancrox, approximately 8km west of Port Macquarie. The land is zoned RU1 – Primary Production. The Pacific Highway is approximately 200m to the east of the site, while land to the north, east and south is zoned IN1 – Industrial. Directly south east of the site is an environmental conservation area. The site is within the Port Macquarie Hasting local government area.

Figure 1 The site

Source: ERM

2.2 Site history

Sancrox Quarry has been owned and operated by Hanson since 1998. Hanson currently has ownership of approximately 145ha of the site, of which approximately 12ha is currently used in the extraction, processing and storage of high-quality aggregate materials.

2.2.1 Approval history

Sancrox Quarry operations are currently approved in accordance with three concurrent development consents, which have been modified by Section 4.55 of the *Environment Planning and Assessment Act 1979* (EP&A Act) at various stages, as outlined in the EIS. Conditions exist within the development consents that should be read in conjunction with one another. The current extraction rate of 455,000 tonnes per annum (tpa) was approved a modification to development consent (DA 1995/0193) under section 4.55(2) of the EP&A Act.

2.3 Existing uses

Sancrox Quarry currently operates to the approvals as outlined in **Table 1**, an Environmental Management Plan and Environmental Protection Licence (EPL) (EPL 5298) issued by the Environment Protection Authority (EPA) under the *Protection of the Environment Operations Act 1997*. The current Sancrox Quarry operations are approved in accordance with three concurrent development consents, which have been modified by Section 96 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) at various stages.

The current approval is for extraction of up to 185,000 tpa with a temporary increase of 450,000 tpa via a s96 modification to Council approval in March 2014. This temporary increase concluded in March 2019, with extraction decreasing to the original approval amount of 185,000 tpa.

Table 1 Current Approved Activities & Hours of Operation

Hours	Day	Approved Activity
7am – 5pm	Monday – Friday	Normal operations
7am – 1pm	Saturday	Normal operations
7am – 11pm	Every day of the year	Additional activities, including truck movements into, around and out of the Sancrox Quarry, as well as equipment loading
11pm – 7am	Up to 20 occasions	Additional operations

2.4 Surrounding development and land uses

The environment surrounding the quarry site includes remnant woodland vegetation immediately adjacent to the north, west and south. The Pacific Highway and Cassegrain Winery are located approximately 175m and 210m to the east, respectively. Sancrox Road is located approximately 230m to the south of the site, with a variety of industrial uses beyond.

The closest residence to the site is located approximately 200m to the south-west, along Sancrox Road. A number of rural residential residences are also located along Bushland Drive to the south-west of the site, the closest being approximately 650m to the southwest. A further rural residence is located approximately 1km to the west.

Sancrox Interchange and Pacific Highway

The road infrastructure directly adjacent to the Sancrox Quarry has recently undergone redevelopment and improvement.

The Sancrox Interchange connects to the Pacific Highway which services northern, southern and eastern movements from the quarry and was opened to the public on 30 November 2015. The Interchange was designed to cater for the existing industry and businesses in the area, as well as servicing the area which is planned for development as an industrial precinct.

The Pacific Highway in the vicinity of the quarry has recently been upgraded, as part of the Oxley Highway to Kempsey Pacific Highway Upgrade Project. The Highway is a dual carriageway, 110km/hr Motorway class road.

Sancrox Employment Precinct

To the east of the quarry, construction has commenced on the development of an estate zoned for light industry. The *Greater Sancrox Structure Plan 2014-2034* outlines future development options including rural residential development opportunities to the west of the quarry and south of Sancrox Road.

3.0 Proposed development

This section describes the components of the proposed development that are relevant to the assessment of social impacts. Further details regarding the full project description are included in the Environmental Impact Statement (EIS) prepared for the proposed development.

3.1 Description of proposed development

Hanson proposes to extend the life of the quarry by expanding the approved extraction boundary and increasing the annual extraction limit to facilitate the extraction and distribution of construction materials for the use in civil infrastructure and road construction projects. The proposed extraction limit will increase the current annual maximum extraction limit from approximately 455,000 tonnes per annum (tpa) to 750,000 tpa.

Additionally, the proposed project includes the establishment of a concrete batching plant and recycling facility and an asphalt production plant. The layout of this ancillary development is shown in **Figure 2.**

Figure 2 Location of the ancillary development

Source: ERM

The project proposes to extend the lateral extent of the quarry westwards into Lot 2 DP 574308, which is owned by Hanson. The project site and Hanson owned lots are shown in **Figure 3**.

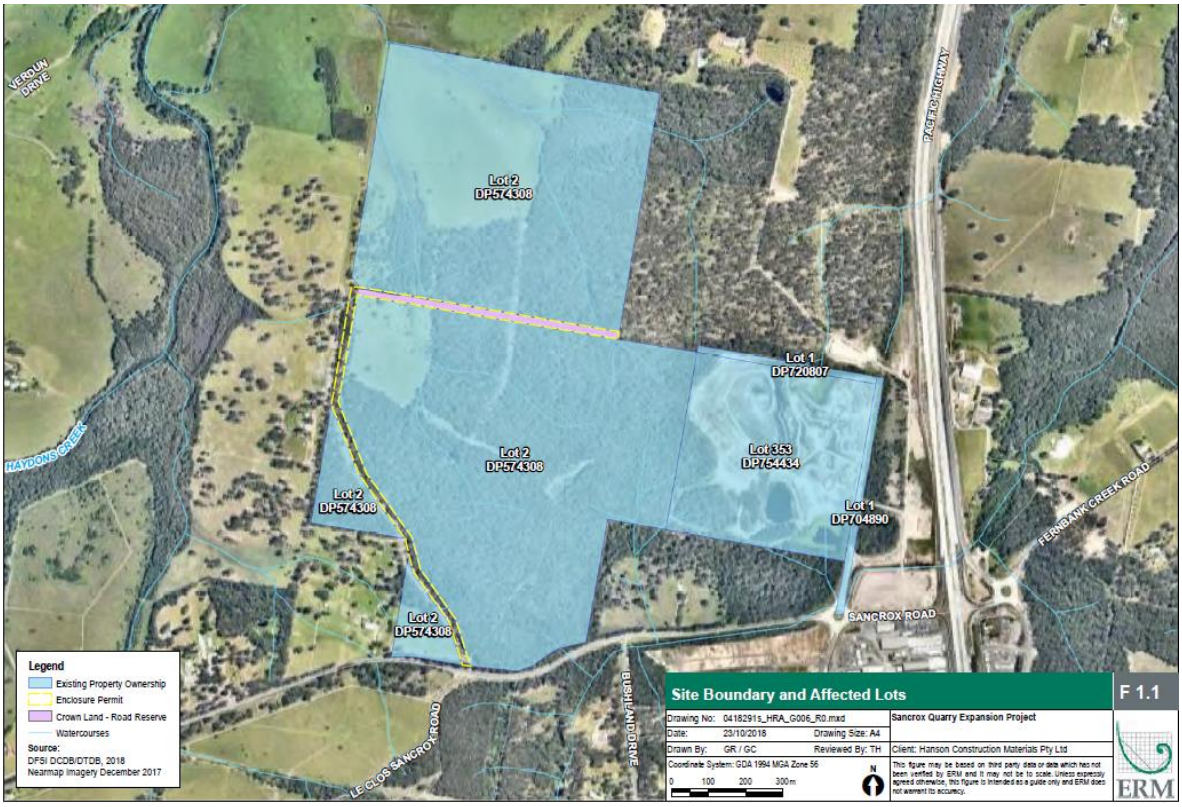

Figure 3 Current lots on site

Source: ERM

3.2 Proposed activity

A project description summary is provided in **Table 2**. The proposed extraction footprint and location of the new concrete batching plant, concrete recycling facility and asphalt production plant and the relocated product processing plant (herein referred to as ancillary infrastructure) are shown in **Figure 2** and **Figure 3**

Table 2 Proposed activity

Project components	Currently approved Sancrox Quarry	Proposed Project
Quarry Life	20 years	30 years
Limits on Production	180,000 tpa (with temporary increase to 450,000tpa between March 2014 and March 2019)	750,000 tpa
Quarry Footprint	17.18ha	48.61ha
Final Quarry Depth	RL – 14 mAHD	RL – 40 mAHD
Product Processing Plant and Stockpile Area	Located in the north-east corner of the site.	To be relocated to the south of the quarry pit.
Site Office, Weigh Bridge and Workshop.	Located near site entrance.	To remain in same location.
Water Holding Dams (WHD)	Two located in the south-east corner of the site.	To remain in same location, additional WHDs will be constructed throughout the various stages of the project to manage sediment.
Concrete Batching Plant	Not currently operating.	20,000tpa, to be located in the north-east corner of the site.

Project components	Currently approved Sancrox Quarry	Proposed Project
Concrete Recycling Facility.	Not currently operating.	20,000 tpa, to be located in the north east corner of the site.
Asphalt Production Plant	Not currently operating.	50,000tpa, to be located south of quarry pit.
Hours of Operation	Quarry operates: • 7am-5pm Monday to Friday. • 7am-1pm Saturday • Truck movements and equipment loading: • 7am-11pm Monday to Friday • 7am-1pm Saturdays, Sundays and Public Holidays Operations are permitted between 11:00pm and 7:00am on maximum of 20 occasions within a year.	Quarry operations (incl. production and maintenance): • 24 hours a day, 7 days a week. Truck movements and equipment loading: • 24 hours a day, 7 days a week. Blasting: • 8am-5pm Monday to Friday.
Employee Numbers	15 full time employees (with casual and contractors on an as needed basis).	25

3.3 Proposed staging

The proposed quarry expansion will be completed in five separate stages, over the 30 year lifetime of the project. Each stage is described below and shown in **Figure 4** The proposed staging of the quarry expansion.

With the exception of Stage 3, all stages will require clearing of vegetation to allow for the development to progress. The cleared vegetation will be mulched and removed from the site where it cannot be beneficially reused on-site for erosion and sediment controls. Clearing will be undertaken by equipment such as a bulldozer, one to two excavators, a mulcher and haul trucks to convey the mulch off site. It is expected that each stage requiring clearing will take three to four weeks to clear and mulch.

Stage 1

Stage 1 involves the expansion of the western side of the quarry into the uncleared area to a depth of RL-14 (AHD). To allow for the construction of ancillary facilities, vegetation clearing, and development of pads will be undertaken during this stage.

Stage 2

Stage 2 will further expand the existing western side of the quarry at the same depth of RL-14 (AHD).

Stage 3

Stage 3 will widen and deepen the benches towards the western extraction boundary. At this stage, there will be up to four benches (dependant on the topography at the pit void), some of which will be active, and others at progressive or final stages of rehabilitation. The quarry pit floor will be lowered from RL-14 (AHD) to RL-40 (AHD).

Stage 4

Stage 4 involves the expansion of operations to the west of the extraction boundary at the same depth of RL-40 (AHD).

Stage 5

The final stage will expand the quarry along the southern extraction boundary at the same depth of RL-40 (AHD).

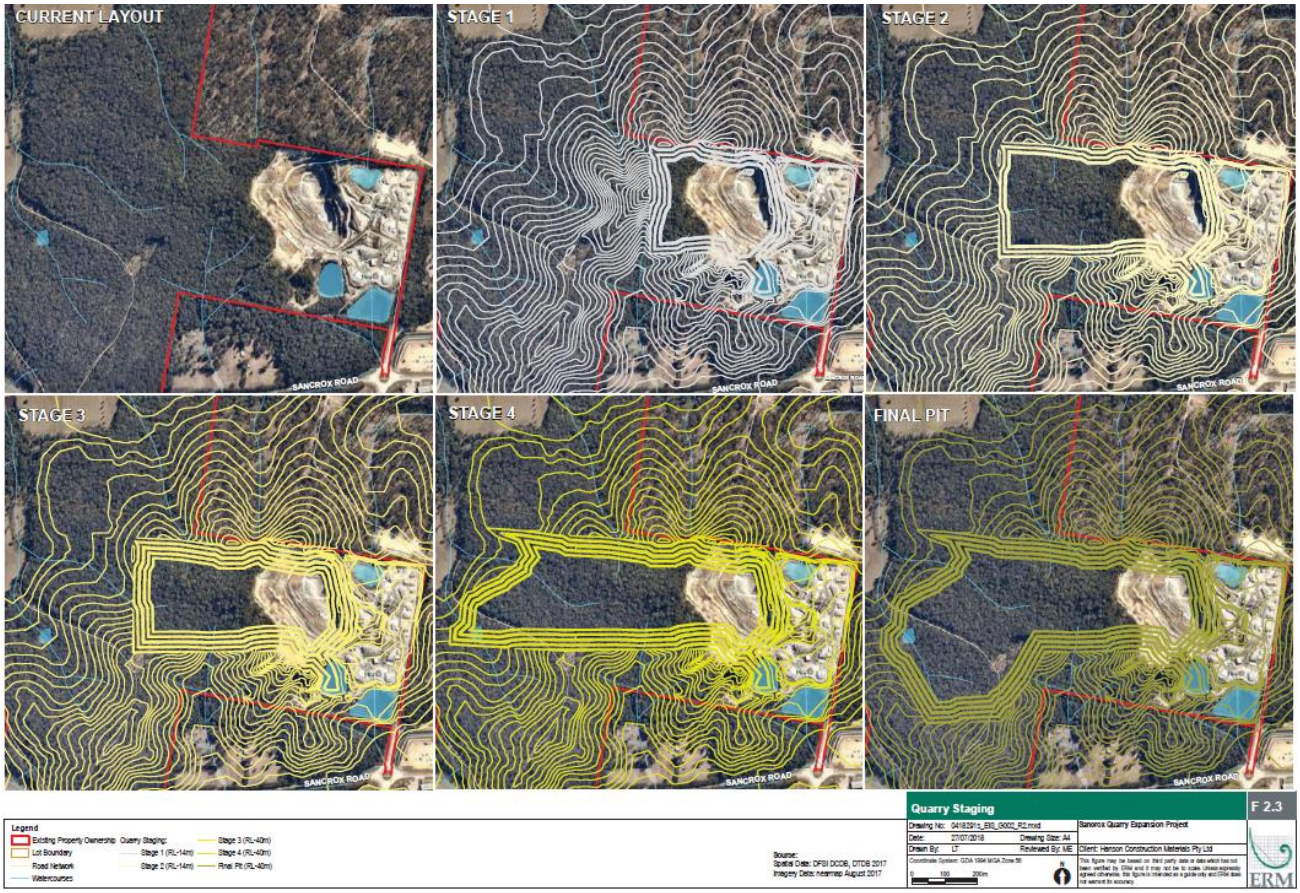

Figure 4 The proposed staging of the quarry expansion

Source: ERM

3.3.1 Traffic movements

The site currently generates an average of 42 heavy vehicle trips per day. The expanded quarry operations will increase average truck volumes to approximately 200 truck trips per day (a 'trip' is two movements – in and out of the site). This is a significant increase of approximately 158 additional heavy vehicle trips per day on Sancrox Road.

Table 3 Traffic movements per day

	Quarried product	Asphalt delivery	Concrete delivery	Collection of waste concrete	Import of concrete constituents	Operational workforce
Vehicle type	Truck and dog (mostly)	Truck	Agitator	Truck	Truck	Light vehicle
Average number of trips / days	127	12	11	8	1 (rounded up as assumed at 3 truck trips / week)	25

Source: ERM, Sancrox EIS, p.183.

The increase in light vehicle trips due to employees will be concentrated around start and finish times of shifts and will have negligible impact due to being a minor input on the overall traffic volume. Light vehicle trips associated with the proposed development will likely coincide with peak times on Sancrox Road, however, will be in the opposite direction of flow to that of other light vehicles utilising the Sancrox Road.

The main markets which the quarry will service are located east of the Pacific Highway, including Port Macquarie and other smaller coastal towns to the north and south. To the west there is considered to be less of a market demand, with the primary location to the west being the township of Wauchope (population of approximately 7,400 residents) and smaller surrounding towns similarly generating little demand.

Access to the Pacific Highway for north and south market locations is provided by the Sancrox Interchange. The northern portion of Port Macquarie can also be accessed by Winery Drive off the north eastern roundabout of the Sancrox Interchange, that links to Hastings River Drive.

Access is provided to the Oxley Highway for east/west movements by the Oxley Highway Interchange to the south. It is predicted that greater than 99% of the product trucks and agitators leaving the Quarry Access Road will travel either south or east at the north western roundabout of the Sancrox Interchange to gain access to these market locations. Trips to the west of the Quarry Access Road on Sancrox Road/Rawdon Island Road are not required due to the more suitable access options provided by the Interchanges and service roads described above. Hence western movements on the Sancrox Road from the Quarry Access Road should be strictly limited to supplying markets within the Sancrox locality, considered to be less than 1% of the total annual truck trips.

Movements on Fernbank Creek Road, east of the north eastern roundabout should be avoided given that the road is narrow and likely of limited structure capacity to receive regular fully loaded truck and dog movements. Similar to Sancrox Road, movements on this road should be strictly limited to local residents requiring product.

3.4 Proposed ancillary development

Hanson proposes to construct an asphalt production plant and relocate the existing processing plant and stockpiles into the Infrastructure Area, south of the existing pit, as shown in **Figure 2**. The concrete batching plant and concrete recycling facility will be constructed in the north eastern portion of Lot 353, DP 754434, as shown in **Figure 2**.

Concrete batching plant and recycling facility

Hanson is seeking consent to construct and operate a concrete batching plant and recycling facility, capable of producing 20,000 tpa of cement and receiving up to 20,000 tpa of concrete material for recycling. The plant will batch wet cement in agitators for use in regional construction projects. The recycled concrete aggregate will be beneficially reused as a substitute for virgin aggregates in products such as road base and drainage materials. Crushing may be required to size recycled concrete aggregates such that it is suitable for the intended use.

It is anticipated that this facility will generate approximately 11 agitator truck trips per day during operation. These agitator trucks will deliver the concrete from the facility to regional construction projects. The recycling facility will generate approximately 8 truck trips per day.

Asphalt production plant

The asphalt production plant will produce asphalt to be used for road construction. The operation of the asphalt production plant requires high quality aggregate and bitumen. The aggregate for asphalt production will be obtained from the rock processed and the processing plant and will be delivered directly to the aggregate storage bins at the asphalt production plant.

The produced asphalt will be loaded into trucks and taken off-site via the weighbridge. The asphalt production is likely to generate approximately 21 truck trips per day.

4.0 Strategic policy context

The following section identifies the key social drivers for this site, based on a review of the key state and local policies and strategies relevant to the proposed development.

Key policy drivers

- It is a state and local priority to enable and encourage vibrant economies and new employment opportunities to support population growth in the Port Macquarie-Hastings LGA.
- In the local area, access to nature and the outstanding natural values of the Port Macquarie landscape are key to community identity. State and local governments have indicated that development needs to be balanced with the natural landscape and consider environmental sustainability and biodiversity.
- It is a state and local priority to ensure that the surrounding community and relevant stakeholders are involved in decision making processes regarding the local area.

4.1 Key themes and drivers

The following section includes a review of state and local policies, strategies and documents that articulate the desired social outcomes for the area. The following documents have been reviewed:

- North Coast Regional Plan (NSW Department of Planning and Environment, 2016)
- Mid North Coast Regional Strategy 2006-2031 (NSW Department of Planning and Environment, 2006)
- Towards 2030: Community Strategic Plan (Port Macquarie Hastings Council)
- Biodiversity Strategy 2017-2030 (Port Macquarie Hastings Council)
- Economic Development Strategy 2017-2021 (Port Macquarie Hastings Council)
- Urban Growth Management Strategy 2017-2036 (Port Macquarie Hastings Council)
- Greater Sancrox Structure Plan 2014-2034 (Port Macquarie Hastings Council)

A comprehensive review of the strategic policy context for the development is available at **Table 4**.

Table 4 Key themes of strategic policy review

Policy theme	Key implications for social impact assessment	Relevant documents
Vibrant economies	• The Port Macquarie Hastings Council (PMHC) area has recently increased its available industrial lands, to diversify possible employment and investment opportunities in the area. The Sancrox Industrial Area was completed in 2011, with the intention to promote industrial activity in the region. The site is included in the Sancrox Industrial area. • The PMHC has recognised that industrial growth in the area is important for larger economic growth in the region. There is strategic policy support for economic growth and development in industrial businesses, including appropriately zoning land and planning precincts effectively to ensure the development of new industries. • Local businesses that employ local people and contribute to local projects are important to the community. Authorities are encouraged to work closely with local business networks to provide appropriate support, emphasising growth and sustainability.	• North Coast Regional Plan 2017-2036 • Mid North Coast Regional Strategy 2014-2034 • Towards 2030 Community Strategic Plan • Urban Growth Management Strategy 2017-2036 • Economic Development Strategy 2017-2036 • Greater Sancrox Structure Plan 2014-2034

Policy theme	Key implications for social impact assessment	Relevant documents
Employment growth	• Employment growth and encouraging increased employment in local centres is a state and local priority in the area. New employment opportunities are required to support forecast population growth in the LGA (20,000 new residents by 2036). • Connectivity between employment centres, including freight and transport networks, is important to ensure accessibility for employees and other business users.	• North Coast Regional Plan 2017-2036 • Urban Growth Management Strategy 2017-2036 • Economic Development Strategy 2017-2036
Natural environment and community identity	• The social identity of the Port Macquarie Hastings LGA is shaped by the natural environment, which is highly valued by local residents and visitors. The natural and built environment is closely linked with the tourism industry of the area, as well as its indigenous heritage. • Development and growth in the Port Macquarie Hastings LGA needs to be balanced with the outstanding natural values of the area. Future development in the Port Macquarie Hastings LGA should be compatible with the natural and built environment, ensuring it aligns with the community's identity. • The natural environment should be protected and restored into the future. Maintaining and improving biodiversity and ecological processes by protecting, rehabilitating and managing important ecological areas is a crucial practice, to ensure the value of these environments is maintained. • Awareness should be raised about the importance of conserving biodiversity and identifying and mitigating threats to the environment. The environmental value of the area has been emphasised in strategic documentation and ensuring that this is communicated in future developments is crucial.	• North Coast Regional Plan 2017-2036 • Towards 2030 Community Strategic Plan • Biodiversity Strategy 2017-2036 • Greater Sancrox Structure Plan 2014-2034
Community participation and engagement	• Involving the community in local democracy and decision making processes is a Council priority. • Creating and maintaining successful relationships with stakeholders in business, industry and government at local, state and federal level is important for the future of the LGA, to ensure the needs of the community and other key stakeholders are considered. This includes working with stakeholders in the implementation of major projects.	• Towards 2030 Community Strategic Plan • Economic Development Strategy 2017-2021

Source: Ethos Urban

5.0 Social baseline study: existing social context

This section provides an overview of the site and the existing social context surrounding the site. It analyses the existing socio-economic characteristics of the community within the identified study areas to better understand the potential characteristics and context of the existing community that may be impacted by the proposed development.

Key current community characteristics

- The demographic profile of the primary study area (PSA) indicates that the local community residents of the PSA are more likely than the Port Macquarie-Hastings LGA average to be working age adults, living in households with children and born in Australia. They are more likely than the Port Macquarie Hastings average to live-in low-density dwellings (separate housing) and have a mortgage, as well as to not have attained a tertiary education. The PSA is growing at a faster rate than the broader Port Macquarie Hastings LGA.
- As is to be expected for a rural and remote quarry site, there is no social infrastructure within walking distance of the site that will be affected by the expansion of quarry operations.
- The site is located in close proximity to major roads, however, as is to be expected for a rural quarry site, there is limited public and active transport accessible to the site.
- Local social issues and trends in the area, including the prevalence of older people and retirees living in the local area, the importance of tourism in the area and the natural values associated with the area, and the development of a Charles Sturt University campus within Port Macquarie.

5.1 Study area definition: area of social and economic influence

The following section defines the study area for the social and economic impact assessment (see **Figure 5**)

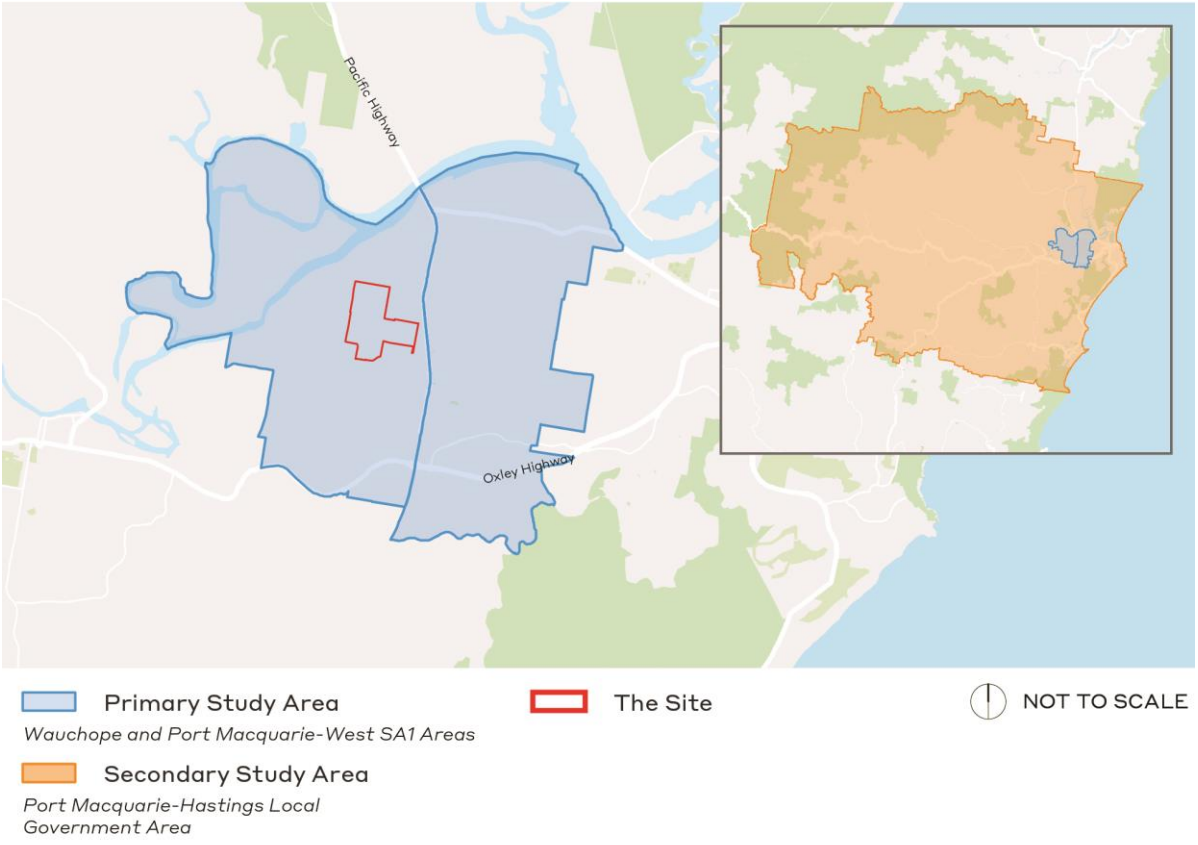

Figure 5 Study area

Source: Ethos Urban.

5.2 Community profile

The following community profile of the primary study area (PSA) uses population and employment data from multiple sources. The results of the 2016 ABS Census of Population and Housing, sourced from ABS Table Builder, have been used to identify key socio-economic and demographic characteristics of the PSA community and broader Port Macquarie-Hastings LGA.

Population and age structure

The PSA and Port Macquarie-Hastings LGA are experiencing modest population growth:

- Between 2011 and 2016, the population increased by around 450 residents, at an average annual growth rate of 16.2%. This was much greater than the average annual growth rate of Port Macquarie-Hastings LGA at 2.6%. This suggests that the area has undergone transformation in recent years, coinciding with development of rural areas to residential.
- As at the 2016 census, the population of the PSA was approximately 1,000 persons. The population of the Port Macquarie-Hastings LGA was around 78,500 persons, which includes the PSA.

The age profile of the PSA is significantly younger than the Port Macquarie-Hastings LGA, with a higher proportion of working age adults:

- This population of PSA was significantly younger than Port Macquarie-Hastings LGA with a median age of 38 compared to 48. However, both have a much higher median age than Greater Sydney's at 36.
- As illustrated in the graph below, the PSA has a high proportion of working age persons at 64%. This was well above the proportion in Port Macquarie-Hastings LGA at 56%. This suggests that the area has a number of people who could find employment opportunities at the site.

The age structure of the PSA and broader LGA is shown in **Figure 6**

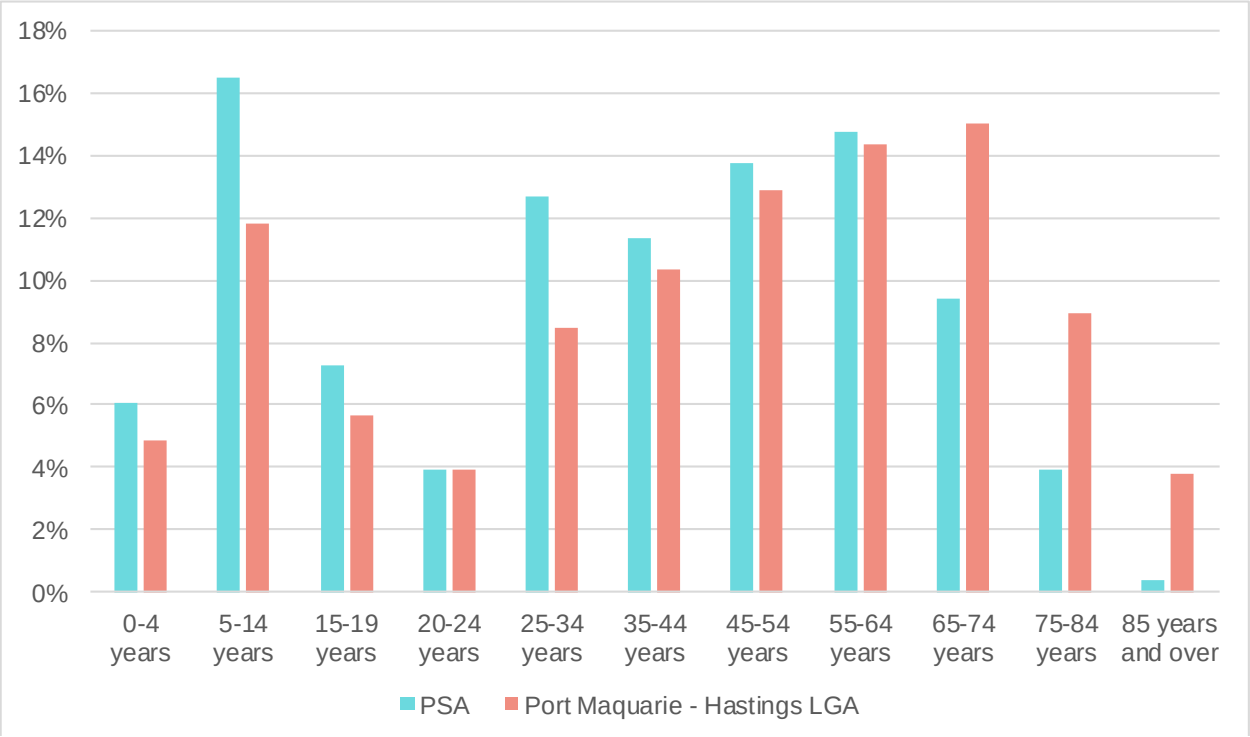

Figure 6 Age structure by five-year age groups, 2016

Source: ABS Census 2016, Ethos Urban

Household and dwelling characteristics

The PSA is characterised by family households and low-density housing:

- In the PSA, there is a high proportion of couple only or couple with children households, accounting for around 83% of all households types, compared with 68% across the LGA. Of the family households, 52% were couple with children. With most of these households located within the locality of Thrumster, to the east of the site.
- The proportion of lone person households in the PSA was quite low at 15%.
- Reflecting the high proportion of family households, the average household size in the PSA was 2.9 persons per dwelling, compared to 2.3 in Port Macquarie-Hastings LGA.
- In the PSA, there were a high number of unoccupied dwellings with the occupancy rate at 82%, which was lower than Port Macquarie-Hastings at 90%. Most of these dwellings were within the new development at Thrumster and a lack of occupation may be explained by dwellings having been recently completed at the time of the 2016 Census collection.
- The PSA is a low-density community, with 97% of households living within a separate house. The remainder of dwellings were medium density. In comparison, across Port Macquarie-Hastings LGA, 74% of occupied dwellings were separate houses, 21% were medium density and 3% were high density.

Tenure and housing costs

The PSA includes new housing developments on the fringe of Port Macquarie, many of which are currently being purchased with a mortgage. There is a comparatively low proportion of renters, which indicates a more established community in the area:

- In the PSA, a majority of dwellings were owned outright (38%) or with a mortgage (49%) with only a small proportion of dwellings being rented (13%). Compared to Port Macquarie-Hastings LGA, the PSA had less dwellings owned outright or being rented, and more dwellings owned with a mortgage. This is due to the new development that is occurring in the area.
- The median monthly mortgage repayment in the PSA was around $2,030, well above the Port Macquarie-Hastings LGA median of $1,380.
- In the PSA, the median weekly rent was $210, which was below the median weekly rent in Port Macquarie-Hastings LGA at $320.

Weekly household income

In comparison to the Port Macquarie-Hastings LGA average, the median weekly household of the PSA is significantly higher:

- In the PSA, the population is relatively wealthier compared to the rest of Port Macquarie-Hastings LGA. The median weekly household income was approximately $1,700, compared to $1,042 in Port Macquarie-Hastings.

Relative socio-economic advantage and disadvantage

The PSA has a higher level of relative socio-economic advantage in comparison with the broader Port Macquarie-Hastings LGA:

- As highlighted in the table below, Port Macquarie-Hastings LGA has a relatively higher level of disadvantage across the four indexes compared with the PSA. Amongst regional NSW LGAs, its score across the four indexes is towards the top third but is considerably lower than the scores of LGAs within Greater Sydney.
- The statistical areas that comprises the PSA all had scores above Port Macquarie-Hastings LGA, suggesting that these areas were relatively less disadvantaged than other areas in Port Macquarie-Hastings LGA.

Table 5 SEIFA Scores in the PSA and Port Macquarie-Hastings

Study Area	Index of Relative Socio-economic Disadvantage	Index of Relative Socio-economic Advantage and Disadvantage	Index of Economic Resources	Index of Education and Occupation
Primary Study Area				
Wauchope	1055	1049	1074	1035
Port Macquarie - West	1078	1064	1124	1031
Port Macquarie-Hastings	996	979	1005	967

Source: ABS, 2018; Ethos Urban

Cultural and linguistic diversity

The majority of residents in the PSA and Port Macquarie-Hastings LGA spoke only English, and were born in Australia:

- In the PSA, a significant proportion of persons spoke only English at home (93%).
- Around 88% of residents in the PSA were born in Australia. This was the same proportion as in Port Macquarie-Hastings LGA.

Aboriginal and Torres Strait Islander residents

There is a significant proportion of Aboriginal and/or Torres Strait Islander residents living in the PSA:

- In the PSA, approximately 40 residents (4%) identified as being of Australian Aboriginal and/or Torres Strait Islander origin, while the proportion was in the LGA was also around 4%.

Educational attainment

There are comparatively low levels of educational attainment in both the PSA and the Port Macquarie-Hastings LGA:

- Overall, there were fairly low levels of tertiary education in both the PSA and LGA. Around 18% of residents in the PSA and 20% of residents in the LGA had attended a technical or further educational institution or university of other tertiary institution. Around 56% of residents in the PSA had non-school qualifications. This was greater than the proportion in the LGA at 47%.
- Around a third of residents in the PSA and LGA had completed secondary school.

Workforce status of residents

In the PSA, the majority of residents were employed in Health Care and Social Assistance (19%) followed by Retail Trade (13%) and construction (9%). The distribution of jobs in the PSA was similar to that of Port Macquarie-Hastings LGA. A very small proportion of residents in the LGA worked in Mining (0.4%).

The majority of residents were employed in white collar occupations (74%) compared to 68% in Port Macquarie-Hastings LGA.

Method of travel to work

Residents within both the PSA and LGA are highly car dependent. Across both the PSA and Port Macquarie-Hastings LGA, a high proportion of residents travelled to work via private vehicle at 73% and 71%, respectively.

5.3 Local community and stakeholder groups

There are a number of businesses, community groups and government agencies that have an interest or could be impacted by the proposed development. Interest groups that have been identified that would have an interest in the proposed development include:

Table 6 Key Stakeholders

Identified interest groups	
Business and landowners	**Local and special interest groups**
• Cassegrain Wines • Nearby landowners and residences	• Local Aboriginal Land Council – Birpai Local Aboriginal Land Council – Birpai Traditional Owners – Yangaay – Norm Archibald • Port Macquarie Chamber of Commerce • Residents Action Network
Government stakeholders	**Other**
• Department of Planning and Environment • Office of Environment and Heritage • Environment Protection Agency • Department of Primary Industries • Roads and Maritime Service • Port Macquarie Hastings Council • NSW Rural Fire Service • North Coast Local Land Services	N/A

5.4 Social infrastructure context

The following section provides an overview of social infrastructure in the area. An overview of the social infrastructure context is provided in order to assess any potential impact on the access and availability of social infrastructure as a result of the proposed development.

As is to be expected for a rural area such as this, there is limited social infrastructure within a walkable catchment of the site (up to 800m). Therefore, this section provides a broader overview of social infrastructure within 5km and 10km of the site, as appropriate to the context. The map at **Figure 7**shows the range of social infrastructure in proximity to the subject site – within 5km and 10km radius of the site.

Public open space

There are 87 parks located within 10km of the site. Sancrox Reserve is located within walking distance of the site.

Emergency services

There are a number of emergency services located within 10km of the site, including two ambulance stations at Wauchope and Port Macquarie and ten fire stations, including the Sancrox-Thrumster Rural Fire Brigade, in close proximity to the site.

Community facilities

There are a range of community facilities within 10km of the site, concentrated in Port Macquarie and Wauchope, including:

- Six clubs
- 20 community facilities (including community halls, surf life saving clubs, and community centres).

Libraries

There are two libraries located within 10km of the site: Wauchope Library and Port Macquarie Library.

Cultural facilities

There are three cultural facilities within 10km of the site – Port Macquarie Regional Gallery, Mid North Coast Maritime Museum and Port Macquarie Historical Society Museum.

Education facilities

There are several schools within 10km of the site, including:

- Two combined primary and secondary schools;
- Two special schools;
- Eight high schools, including St Joseph's Regional College, which is within 5km of the site;
- 12 primary schools;
- Three TAFE campuses at Wauchope and Port Macquarie; and
- Two university campuses (Charles Sturt University and University of Newcastle).

Sports and recreation facilities

There are a range of sports and recreation facilities within 10km of the site, including:

- Three indoor recreation facilities;
- Two swimming pools;
- 13 outdoor courts, including netball, tennis and croquet courts, bowling greens and croquet courts; and
- 28 sports fields, including Tuffin Lane Sports Fields, located within 5km of the site.

Childcare centre

There are three childcare centres within 10km of the site:

- Port Macquarie Community Preschool;
- St Joseph's Preschool and Long Day Care Centre; and
- Fernhill Road Preschool and Long Day Care Centre.

These facilities are not located within walking distance of the site.

Aged care facilities

There are a relatively large number of aged care facilities, nursing homes, retirement villages and hostels located within 10km of the site, including:

- Nine community homes and nursing homes; and
- Thirteen retirement villages.

These facilities are not located within walking distance of the site.

Health facilities

There are two medical centres located within 10km of the site, at Wauchope and Port Macquarie. Port Macquarie Base Hospital is also located within 10km of the site.

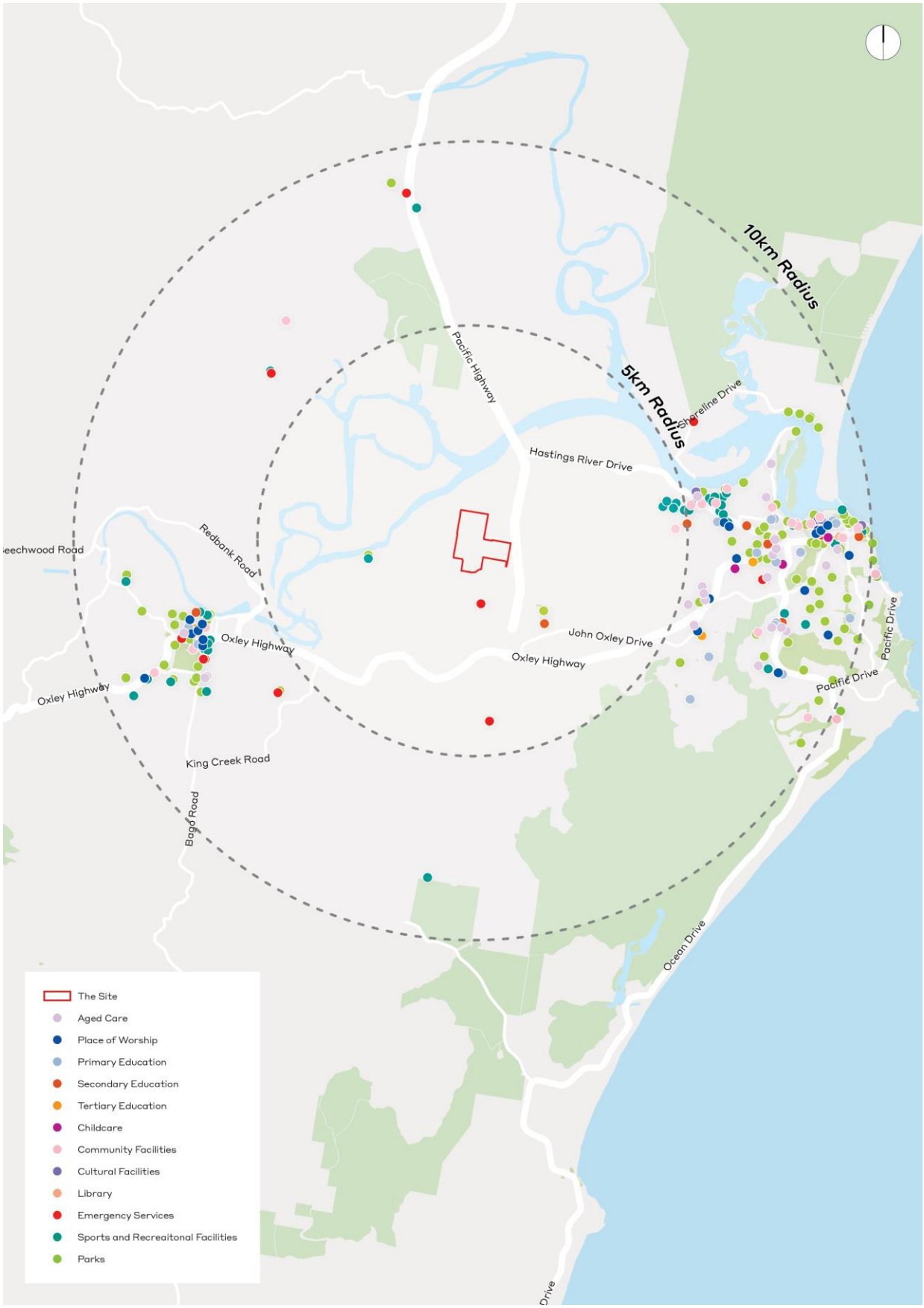

Figure 7 Social infrastructure context

Source: Ethos Urban.

5.5 Transport and access

The following section identifies the provision of active and public transport in proximity to the site, as well as major roads. As is typical of a rural area such as this, there are limited public and active transport options within vicinity of the site. As identified above, the local community of the PSA is highly car dependent and most trips are undertaken by private vehicle.

Rail services

Wauchope Station is the closest station to the site. The station is on the NSW Train Link Regional train and coach service, which links regional centres in NSW. Services from Wauchope run to and from Sydney and Brisbane. A coach service runs between Wauchope Station and Port Macquarie.

There is no rail service at Sancrox.

Bus services

There are a number of bus services in close proximity to the site, including:

- Route 335W – Wauchope to Port Macquarie, which runs along the boundary of the PSA.
- Route 340 – Kempsey to Port Macquarie, which runs close to the northern edge of the PSA.

There are also a number of bus services within Port Macquarie which are accessible to the site:

- Route 322 – Lighthouse Plaza to Port Macquarie via Shelly Beach;
- Route 324 – Lighthouse Plaza to Port Macquarie via Private Hospital;
- Route 325 – The Ruins Way to Port Macquarie;
- Route 327 – The Settlement City Shopping Centre to St Agnes Village (Loop Service);
- Route 328 – Settlement Point to Base Hospital; and
- Route 329 – Settlement City Shopping Centre to Waniora Parkway at Koala St (Loop Service).

Active transport

There is an inter-town bicycle path along the road shoulder of Oxley Highway which connects Wauchope and Port Macquarie, as show in **Figure 8.** There are no publicly available cycle paths which traverse the site.

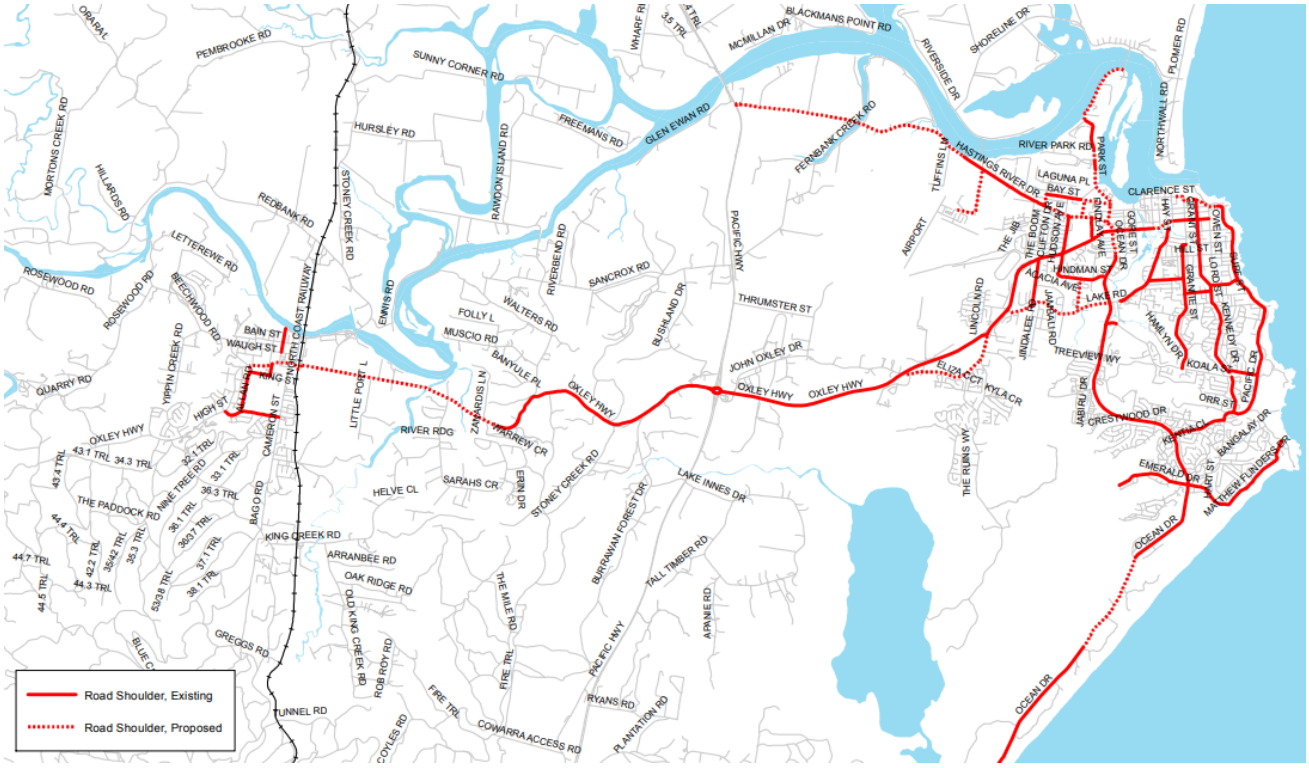

Figure 8 Inter-town bicycle network - North

Source: Port Macquarie Hastings Council, 2015.

5.6 Local social issues and trends

The following section provides a brief overview of the key social issues and trends that impact Port Macquarie-Hastings including the prevalence of sea changers and retirees, as well as Port Macquarie's status as a major tourism destination.

Tourism destination and natural values

Port Macquarie is a well-established tourism and holiday destination, with tourists and visitors attracted by the region's natural values, beaches and attractive climate.

In recent years there has been significant investment in improving facilities that enhance the visitor economy, including the development of the Glasshouse art, cultural and heritage centre, the redevelopment of Port Macquarie Airport and enhancing Council's major events portfolio. According to Port Macquarie-Hastings Council's *Destination Management Plan* the strongest attractions in the Greater Port Macquarie region are: water experiences, nature, heritage and culture and sports.[1]

The majority of visitors to the region come from regional NSW (47%) or Sydney (35%). The majority of visitors travel to the region via car (89%). The domestic family market comprises 33% of all visitors, and 32% of all visitors are travelling as couples without children.

Establishment of CSU Port Macquarie campus

A new Port Macquarie campus of Charles Sturt University has been established, offering courses in accounting, applied science (with a focus on recreation and ecotourism), environmental science management and health services (with a focus on gerontology and healthy ageing).

[1] Port Macquarie-Hastings Council 2017, Port Macquarie Destination Management Plan <https://www.pmhc.nsw.gov.au/Culture-Sport-Leisure/Tourism/Destination-Management-Plan>

Sea changers and retirees

Port Macquarie-Hastings LGA is home to a relatively large number of older people – 48.7% of the resident population of Port Macquarie-Hastings was aged over 50 years in 2016. Many of these older people live in retirement villages and aged care facilities in the local area and have been attracted to the area by the Port Macquarie Base Hospital, which is a major referral hospital and provides the majority of specialist and medical surgical services for the broader region. Some of these older people may be experiencing health and wellbeing challenges.

The Port Macquarie State electorate has an estimated 1,857 residents with dementia, which is the third highest prevalence in NSW. Port Macquarie-Hastings Council is also a “dementia friendly community” that regularly coordinated events and programs to create dementia-friendly activities and build greater awareness, acceptance and understanding of dementia in the community.

6.0 Economic baseline study: existing economic context

6.1 Economic profile

The following section provides a brief overview of the economic profile of the broader Port Macquarie-Hastings LGA.

Building approvals

The value of building approvals in the Port Macquarie-Hastings LGA over the 2017/18 financial year was $315.5 million, which accounts for 0.92% of the total value of building approvals in NSW (Australian economic indicates, .id Consulting). Compared to 2015/16 data, this represents an increase in the value of LGA building approvals from $250.5 million (+$65.0 million) and the NSW share from 0.73% (+0.19%) over the period.

Industry of employment

The largest employment sectors for Port Macquarie-Hastings LGA residents in 2016 were 'Health care and social assistance' and 'Retail trade' representing shares of 17.5% and 11.5% of working residents respectively. A marginal increase in persons employed in the mining industry was observed between the years 2011 and 2016. Over the same period, employment in the following industries declined:

- Manufacturing (-1.6%);
- Retail Trade (-2%);
- Electricity, Gas, Water and Waste Services (-1.3%);
- Wholesale Trade (-0.7%);
- Financial and Insurance Services (-0.4%); and
- Information Media and Telecommunications (-0.2%).

Compared with Regional NSW, the Port Macquarie-Hastings LGA has a higher percentage of residents employed in the following industries:

- Electricity, Gas, Water and Waste Services;
- Construction;
- Retail Trade;
- Accommodation & Food Services;
- Rental, Hiring and Real Estate Services;
- Administrative and Support Services;
- Education and Training;
- Health Care and Social Assistance; and
- 'Other services'

These industries are largely blue collar in nature, although the LGA's share of employment in the mining industry (0.4%) is significantly smaller than the Regional NSW percentage (2.4%). In contrast, Port Macquarie-Hastings LGA has a strong construction base with 10.6% (or 3,150 residents) employed in this sector compared to 8.7% for Regional NSW.

An overview of the 2016 employment by industry data for the Port Macquarie-Hastings LGA is presented in **Table 7.**

Table 7 Port Macquarie-Hastings LGA – Industry of employment, 2016

Industry of Employment	Port Macquarie-Hastings		Regional NSW	
	Number	%	Number	%
Mining	128	0.4%	26,924	2.4%
Information Media and Telecommunications	227	0.8%	9,915	0.9%
Arts and Recreation Services	370	1.2%	13,706	1.2%
Rental, Hiring and Real Estate Services	542	1.8%	15,417	1.4%
Financial and Insurance Services	559	1.9%	22,350	2.0%
Wholesale trade	570	1.9%	22,173	2.0%
Agriculture, Forestry and Fishing	756	2.5%	62,558	5.7%
Electricity, Gas, Water and Waste Services	870	2.9%	14,090	1.3%
Inadequately described or not stated	985	3.3%	42,465	3.8%
Transport, Postal and Warehousing	1,053	3.6%	43,991	4.0%
Administrative and Support Services	1,103	3.7%	35,930	3.3%
Manufacturing	1,116	3.8%	66,323	6.0%
Other Services	1,232	4.2%	43,469	3.9%
Professional, Scientific and Technical Services	1,236	4.2%	50,137	4.5%
Public Administration and Safety	1,620	5.5%	79,528	7.2%
Accommodation and Food Services	2,702	9.1%	86,996	7.9%
Education and Training	2,817	9.5%	99,607	9.0%
Construction	3,153	10.6%	95,768	8.7%
Retail Trade	3,424	11.5%	114,265	10.3%
Health Care and Social Assistance	5,192	17.5%	158,552	14.4%
Total employed persons aged 15+	**29,655**	**100.0%**	**1,104,164**	**100.0%**

Source: Profile id. Employment by Industry (Port Macquarie-Hastings LGA and Regional NSW)

Occupational structure

Port Macquarie-Hastings LGA, in which the project is located, has 9,080 residents occupied in construction-related activities such as trades and technicians, machinery operators and drivers and labourers. As **Table 8**shows, resident workers occupied in construction-related activities account for 31% of the LGA's workforce and this highlights the potential of the project to provide new employment opportunities for local workers, especially in the construction phase of the project.

Table 8 Port Macquarie-Hastings LGA – Occupation of employment, 2016

Occupation	Number	%	Regional NSW %
Managers	3,339	11.3	13.0
Professionals	5,822	19.6	18.1
Technicians and Trades Workers	4,376	14.8	14.8
Community and Personal Service Workers	3,815	12.9	11.9
Clerical and Administrative Workers	3,915	13.2	12.4
Sales Workers	3,239	10.9	9.6

Occupation	Number	%	Regional NSW %
Machinery Operators and Drivers	1,618	5.5	7.1
Labourers	3,081	10.4	11.4
Not stated or inadequately described	441	1.5	1.6
Total employed persons aged 15+	**29,646**	**100.0**	**100.0**

Source: Community id. Occupation of Employment (Port Macquarie-Hastings LGA and Regional NSW)

Business structure

Port Macquarie-Hastings LGA's business structure, which is outlined in **Table 9**highlights the strong construction base that exists across the municipality. The construction sector represents the largest business sector in the LGA, comprising approximately 1,290 businesses or 20.4% of total businesses. Additionally, 310 transport-related businesses (transport, postal and warehousing) are located in the municipality representing a further 4.9% of total businesses. Transportation of products to and from the site will be an important activity during both the construction and operational phases of the project.

Table 9 Port Macquarie-Hastings LGA – Business structure, 2017

Sector	No.	Share
Agriculture, Forestry and Fishing	643	10.2%
Mining	16	0.3%
Manufacturing	229	3.6%
Electricity, Gas, Water and Waste Services	9	0.1%
Construction	1,294	20.4%
Wholesale Trade	132	2.1%
Retail Trade	415	6.6%
Accommodation and Food Services	322	5.1%
Transport, Postal and Warehousing	312	4.9%
Information Media and Telecommunications	29	0.5%
Financial and Insurance Services	520	8.2%
Rental, Hiring and Real Estate Services	650	10.3%
Professional, Scientific and Technical Services	546	8.6%
Administrative and Support Services	209	3.3%
Public Administration and Safety	13	0.2%
Education and Training	84	1.3%
Health Care and Social Assistance	481	7.6%
Arts and Recreation Services	85	1.3%
Other Services	298	4.7%
Currently Unknown	44	0.7%
Total	**6,331**	**100.0%**

Source: ABS Counts of Businesses, 2017

Labour force structure

Port Macquarie-Hastings LGA has a Labour force of 38,270 persons, of which 1,250 persons are unemployed (September 2018). As highlighted in **Table 10**, this represents an unemployment rate of 3.3%, which is significantly

lower than the Regional NSW rate of 5.6%. This relatively buoyant labour market highlights a strong local economy underpinned by a high level of ongoing construction activity (refer to building approvals data above), which is forecast to continue driven by population growth and demand for new dwellings and local infrastructure and services.

Table 10 Port Macquarie-Hastings LGA – Labour force structure, September quarter 2018

	Employed	Unemployed	Labour Force	Unemployment Rate
Port Macquarie Hastings LGA	37,020	1,250	38,270	3.3%
Regional NSW	1,274,100	75,500	1,349,600	5.6%

Source: Department of Employment and Jobs – Small Area Labour Markets, September Quarter 2018
Note: Figures rounded

6.2 Sancrox Quarry operating overview

The following section provides a brief overview of the operations of Sancrox Quarry.

Output

Sancrox Quarry currently provides the following products:

- Concrete grade aggregates
- Fill material
- Manufactured sand
- Pre-coated aggregates
- Road base
- Gabion and armour rock
- Drainage materials

Existing output is estimated at 180,00 tonnes pa, after temporarily increasing to 450,000 tonnes pa due to a Council modification (between March 2014 and March 2019). The existing resource life of the quarry is estimated to be approximately three years, with pit development beyond the current extraction limit required to access higher quality rock.

Key markets

As **Table 11** highlights, products from Sancrox Quarry are extensively used by public and private customers, especially for State/major projects and for commercial development projects. Combined, these two key markets accounted for approximately 70% of product sales in 2018.

Table 11 Sancrox Quarry – Key Customer Markets (by share), 2017 and 2018

Customer	2017	2018
Private developers	30%	35%
State/major projects	31%	33%
Concrete aggregates	15%	15%
Port Macquarie- Hastings LGA	14%	8%
Wholesale/retail	10%	8%
Total	**100%**	**100%**

Source: Sancrox Quarry
Note: Figures rounded

Competition

A number of operating quarries are located in the Port Macquarie-Hastings LGA, and the broader region (e.g. Kempsey LGA and Mid-Coast LGA). These quarries are listed in **Table 12** and identified in **Figure 9.**

While no data is available on the resource capacity at these quarries, in a locational sense it is important to recognise that Sancrox Quarry is the closest facility to Port Macquarie which is the region's major population centre. In this regard, ongoing and increased production from Sancrox Quarry provides an efficient outcome in terms of cartage costs to customers given the facility's proximate location to urban growth areas and its ease of access to major road infrastructure.

Table 12 Location of Quarries in Relation to Port Macquarie

Quarry Name	Location	Distance from Port Macquarie
Hanson Quarries	**Sancrox Road, Sancrox**	**10km**
Coastal Quarry Products	Milligans Road, Wauchope NSW 2446	20km
Hy-tec Concrete and Aggregates	Grant's Head, Ocean Drive, Bonny Hills, NSW 2445	24km
Hy-tec Concrete and Aggregates	Yarrabee Road, Cooperabung, NSW 2441	26km
CTK Quarry	Bago NSW 2446	26Km
Hy-tec Concrete and Aggregates	Lot 132 Diamond Head Rd, Dunbogan, NSW 2443	36km
Boral Quarries	Bulleys Rd, Johns River NSW 2443	47km
Pacific Blue Metal	Farrawells, Pacific Highway, South Kempsey NSW 2440	47km
NSW Quarry Services	Gowing Hills Road, Dondingalong NSW 2440	58km
Pacific Blue Metal	113 Possum Brush Rd, Possum Brush NSW 2430	96km
Boral Quarries	13 Pacific Highway, Way NSW 2447	98km
Holcim Australia	Jandra Quarry, 15284 Pacific Highway, Possum Brush NSW 2430	98km

Source: Sancrox Quarry

Employment

Sancrox Quarry currently employs 14 staff, including 13 full time positions and 1 casual position. Additionally, an estimated 20 drivers are contracted by haulage companies to transfer quarry products from Sancrox to local and regional customers (note, the number of drivers varies and is based on market demand).

Local spending

An estimated $2.1 million pa in quarry operational expenditure is retained in the Port Macquarie-Hastings LGA economy through local wages and on costs ($1.0 million), and suppliers and services ($1.1 million). These figures relate to year ending 2018.

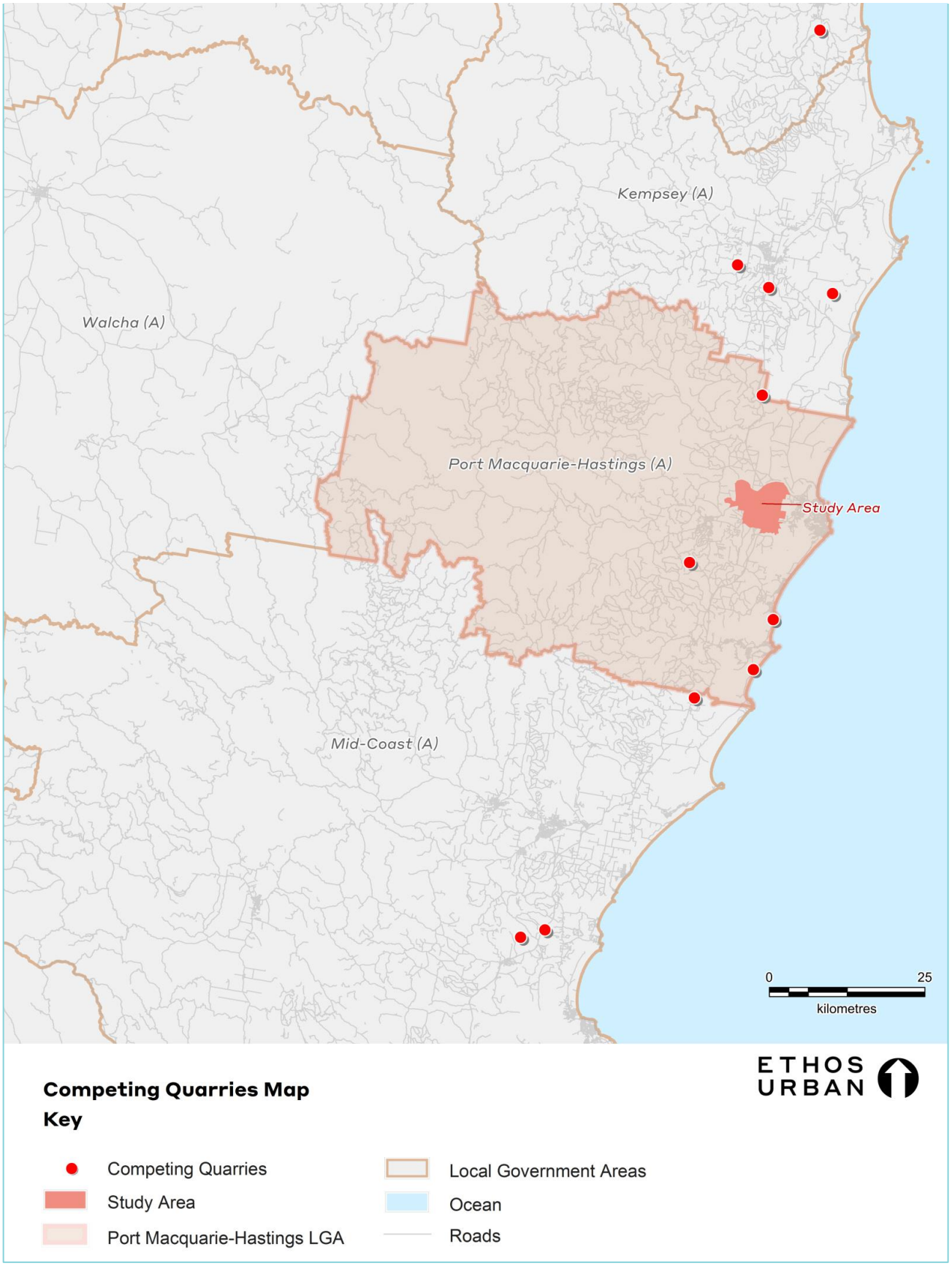

Figure 9 **Location of Competitor Quarries in Relation to Sancrox Quarry**

Source: Sancrox Quarry

7.0 Forecast future social and economic context

Key forecast community characteristics

- The PSA is forecast to undergo significant growth by 2036, predominantly in the locality of Thrumster, to the east of the site. However, the community profile of the area is currently forecast to remain consistent with the existing community in the area.
- The project is expected to broadly support economic growth in the area through the construction and operation phases, and through supplying materials to facilitate construction in the surrounding region.

The following section outlines how the PSA and Port Macquarie-Hastings is forecast to change between 2016 and 2036.

The purpose of this section is to better understand how the social context of the site is expected to change in the future by analysing population and employment forecasts and identifying major developments likely to have an impact on the study area. Examining the future social context of the development helps to identify whether the proposed development will reinforce or hinder forecast change in the social environment.

Due to limitations in availability of population forecast data, the definition of the study area is slightly larger than that of the PSA defined in the section above. The PSA in this section also includes the areas of Lake Innes, Riverside and North Shore. To address this, the projected growth rates have been used and applied to the 2016 figures for the PSA.

7.1 Forecast community profile

The following section describes the forecast community profile for the area, based on both forecasts that do not take account of the proposed, and forecasts that reflect the growth and development associated with the proposed development. The forecast growth rates from are sourced from forecast.id.

Forecast growth and development

The PSA is forecast to undergo significant growth to 2036, generally associated with new development in the locality of Thrumster, in close proximity to the site.

- Between 2016 to 2036, the population of the PSA is forecast to increase by around 9,000 persons to 13,300 persons by 2036. This implies an average annual growth rate of 5.9%, this projected growth rate is much higher than Port Macquarie-Hastings, which is forecast to be 1.3% over this same period. Most of this population growth is forecast to occur within the locality of Thrumster, which is directly south-east of the site.
- In the PSA, the number of dwellings is projected to increase by around 720, to around 1,100 by 2036. The number of households are expected to increase by 700.
- The average household size of the PSA is forecast to increase slightly to 2.84 by 2036. While the average expected household size of the LGA is expected to be 2.61. The increase in average household size is driven by an increase in family households occurring in new developments within the PSA.
- The population of the PSA is expected to age slightly, with an increase in the proportion of persons aged 64 and over. However, this will be offset slightly by an expected increase in persons aged 18 and below. The population of the PSA is expected to age at a greater rate than the LGA.

Change arising from proposed development

There is no population change forecast to arise from the proposed development, as it does not include a residential component. There may be some change to the area's economic profile associated with the proposed development, which is discussed in **Section 7.2.**

Population projections

The population of the Port Macquarie-Hastings LGA is forecast to increase from 79,900 persons in 2016 to 103,990 persons by 2036 (Forecast id. - figures rounded). This represents an increase of +24,090 persons over the 20-year period. Average annual population growth between 2016-2036 is forecast to occur at a rate of 1.3% or +1,200 persons per annum.

Household and dwelling projections

Between 2016 to 2036, the number of households in the Port Macquarie-Hastings LGA is forecast to increase from 34,100 households to 44,80 households (at a growth rate of +1.3% per annum), while the average household size is forecast to remain at 2.31 persons per household over the period.

The number of dwellings in the Port Macquarie-Hastings LGA is forecast to increase from 37,020 dwellings in 2016 to 47,500 dwellings in 2036 representing a dwelling growth rate of 1.3% per annum over the period. The dwelling occupancy rate over the 20-year period is expected to remain constant at 92%, with 10,480 new dwellings required between 2016 to 2036 to meet population growth demand.

7.2 Forecast economic profile

The proposed project will support both business and employment growth in Port Macquarie-Hastings LGA, due to the following factors including:

- Construction phase of the project, which will directly employ local contractors and workers with indirect benefits accumulating through the supply chain some of which will accrue locally.
- Operational phase of the project, which will expand onsite and subcontractor employment; as well as local supply and service purchases which will support business growth.
- Long-term surety of materials supply which will underpin forecast dwelling growth and major infrastructure projects associated with urban growth. This will support construction-related businesses and jobs growth, both directly and indirectly through the supply chain.

These factors are quantified, where possible, Section 10.0 (Economic Impact Assessment).

8.0 Community engagement

Key consultation findings

- To date, a range of engagement methods have been undertaken to gather information from relevant stakeholders, residents and interest groups, including: written correspondence with government and Aboriginal stakeholders and the establishment of a Community Consultative Committee (CCC).
- A Community Consultative Committee has been established and one meeting has to date taken place, at which following issues were raised by community representatives: environmental impacts associated with expanded quarry operations, increased dust, potential land acquisition and the future rehabilitation of the site. A further meeting of the CCC is planned during the exhibition of the EIS (post lodgement), as is the preference of the CCC.

The following section summarises the method and outcomes of community and stakeholder engagement to date, including key issues and aspirations.

Due to the location of the site, and the lack of adjoining communities, there is a limited range of community consultation outcomes.

To date, Hanson has undertaken various consultation activities with the local community and relevant stakeholders. Relevant ongoing consultation and engagement for the Sancrox Quarry and proposed development have included written correspondence with relevant government stakeholders and establishment of a Community Consultation Committee for the project. There activities have enabled Hanson to understand the community's perceptions and values about their environment, their community, Sancrox Quarry and the proposed development.

Consistent with the community consultation objectives of the DP&E's SIA Guideline (Section 2.1) the objective of recent consultation has been to reach a wide variety of stakeholders who are likely to be affected or have an interest in the proposal, increase awareness and understanding of the proposed development, and seek input on issues of concern to guide the ongoing development/refinement of project parameters and inform the impact assessment.

8.1 Engagement methods

To date, a number of methods have been used to gather information from the relevant interest groups, stakeholders and local residents about their attitudes regarding the proposed development. These methods included:

- Written correspondence with relevant government stakeholders, including Department of Planning and Environment, Office of Environment and Heritage, Environmental Protection Authority, Department of Primary Industries, Roads and Maritime Services, Port Macquarie Hastings Council, NSW Rural Fire Service, North Coast Local Land Services.
- Written correspondence with Aboriginal stakeholders
- Phone calls with Aboriginal stakeholders
- Establishment and meetings of a Community Consultation Committee (CCC) for the project, including community representatives, a representation from the Port Macquarie Chamber of Commerce, Council, Residents Action Group Network and representatives from Hanson. CCC members are consulting members of the community, and do not have decision-making powers or act as a regulatory body.

Information gathered by the above methods has helped to identify potential impacts to the social environment from the proposed development and their level of significance to the community and stakeholders. These consultation activities provide a context for a further discussion of the outcomes of the consultation process.

Further community and stakeholder engagement are planned in association with the public exhibition of the Planning Proposal. A further CCC meeting is also planned during the exhibition of the Planning Proposal (after lodgement).

8.2 Engagement outcomes

A desktop review of previous community and stakeholders' consultation processes has been undertaken to inform this Social Impact Assessment.

Outcomes of stakeholder engagement

According to the EIS, no issues were raised by government stakeholders.

Outcomes of community engagement

Community engagement has been coordinated through the establishment of a Community Consultation Committee for the project. Members of the CCC are consulting members of the community, and their discussion around impacts is speculative. It is noted that all mitigation measures that Hanson have agreed to within the EIS mitigate potential impacts explored within the relevant impact assessments.

One meeting has been held on Friday 6 July 2018, and another is planned to be undertaken during the exhibition period for the EIS. The minutes available from this meeting were reviewed, and the following key themes identified:

- Hanson noted that minimal complaints have been received since the Sancrox Quarry was established in 1983. The site has been managed by Hanson since 1996.
- Community representatives raised concerns around the environmental impacts generated by the expanded quarry operations and requested that environmental monitoring requirements be explained regarding air quality, noise, water quality, blasting/fly rock and dust. These issues have also been addressed in the EIS.
- Community representative raised issues regarding potential land acquisition to facilitate the expansion of Sancrox Quarry. Hanson has responded that the project is being planned to prevent land acquisition of surrounding properties.
- Community representatives noted concerns around dust and that residents are concerned with dust generated by the quarry settling on surrounding vegetation and in waterways, and potential impacts on surrounding oyster farms. These issues have been addressed in the EIS.
- Community representatives raised questions regarding rehabilitation of the site and Hanson has invited feedback from the community regarding potential options for future land use at the site.
- Community representatives raised concerns regarding employee safety. Hanson noted that employee safety is highly regulated due to legislation.
- Community representatives requested further information regarding concrete batching plant and concrete recycling plant. Hanson noted that Port Macquarie-Hastings Council already practices concrete recycling, and that the concrete recycling plant on site will not be bringing in demolition waste from beyond the Sancrox Quarry site. Instead, it will recycle waste by-products from the on-site concrete batching plant.

9.0 Social impact assessment

9.1 Social impact assessment framework

This SIA has been prepared on the basis of the NSW DPE *Social Impact Assessment Guideline for state significant mining, petroleum production and extractive industry development* (September 2017). This assesses social impacts in the context of the following factors:

- Way of life including:
  - How people live, e.g. how they get around, access to adequate housing
  - How people work, for example access to adequate employment, working conditions and/or practices
  - How people play (e.g. access to recreational activities)
  - How people interact with one another on a daily basis)
- Community, including its composition, cohesion, character, how it functions and sense of place
- Access to and use of infrastructure, services and facilities, whether provided by local, state, or federal governments, or by for-profit or not-for-profit organisations or volunteer groups
- Culture, including shared beliefs, customs, values and stories, and connections to land, places, and buildings (including Aboriginal culture and connection to country)
- Health and wellbeing, including physical and mental health
- Surroundings, including access to and use of ecosystem services, public safety and security, access to and use of the natural and built environment, and its aesthetic value and/or amenity
- Personal and property rights, including whether their economic livelihoods are affected, and whether they experience personal disadvantage or have their civil liberties affected
- Decision making systems, particularly the extent to which they can have a say in decisions that affect their lives, and have access to complaint, remedy and grievance mechanisms
- Fears and aspirations related to one or a combination of the above, or about the future of their community

This SIA also responds to the intent, objectives and principles outlined in the International Association for Impact Assessment's (IAIA) International Principles for Social Impact Assessment guideline (2003), which defines Social Impact Assessment as:

> *"the process of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment"* (2003, p.5).

As outlined in the IAIA guideline, social impacts vary in their nature and can be positive or negative, tangible or intangible, quantifiable, partly quantifiable or qualitative. Social impacts can also be experienced or perceived differently by different people and groups within a community.

9.2 Scope of this assessment

This social impact analysis assesses the level of potential impact on the community and social environment should the social impacts occur, compared to the baseline scenario of the existing use of the site and future profile of the community.

The purpose of this social impact analysis is to:

- Assess the significance of the identified potential social impacts generated by the proposed development based on the potential frequency and severity of the impact, should it occur;
- Develop social impact mitigation and enhancement options for any identified significant social impacts; and
- Advise Hanson of potential social impact mitigation and enhancement options to help finalise the EIS.

Ultimately there are two main types of social impacts that will arise as a result of the proposed development. First, there are direct impacts caused by the project and which cause changes to occur within the existing community, as measured through the use of social indicators, such as population, health, and employment. Second, there are indirect impacts that are generally less tangible and more commonly relate to matters such as community values, identity and sense of place.

The primary focus of this assessment is the primary study area, which is expected to experience social impacts associated with the proposed development most directly. Impacts to the broader locality will likely to be less pronounced or are likely to involve a particular issue that will also be present within the surrounding site context.

9.3 Impact assessment matters and responses

The following section sets out the assessment of social impacts arising from the proposed development and recommended responses, including measures to enhance social benefits and mitigate potentially negative impacts. It includes a risk assessment of the degree of significance of risk, including the envisaged duration, extent, and potential to mitigate/enhance and likelihood of each identified impact. It also sets out recommended mitigation, management and monitoring measures for each identified matter.

Some of the social impacts identified in the DP&E's SIA Guideline are more pertinent to the proposed development than others and have been discussed in greater detail below.

9.3.1 Way of life

DP&E's SIA Guideline defines "way of life" as comprising:

- How people live, for example, how they get around, access to adequate housing;
- How people work, for example, access to adequate employment, working conditions and/or practices;
- How people play, for example, access to recreational activities, and
- How people interact with one another on a daily basis

The proposed development may result in changes to the local population and their way of life due to:

- Increased employment opportunities associated with the construction and operation phases of the project, and
- Increased traffic associated with increased truck movements due.

There is no social infrastructure within walking distance of the site that is likely to be impacted by the expansion of the quarry.

Sancrox Quarry currently employs 14 staff, including 13 full time positions and 1 casual position. Additionally, an estimated 20 drivers are contracted by haulage companies to transfer quarry products from Sancrox to local and regional customers (note, the number of drivers varies and is based on market demand).

The construction workforce for the proposed development is anticipated to be locally sourced from contractors and contracting businesses within the Port Macquarie-Hastings LGA. The local sourcing of construction employees would provide a temporary increase in employment opportunities for businesses in the region, and should the proposed development successfully source future employees locally, there will be no expected increase in local population induced by the project. There would therefore be unlikely to be substantial changes to the demographics of the local community as a result of the project.

The economic baseline assessment also identifies that a high proportion of workers in the Port Macquarie-Hastings LGA are employed in construction-related industries, and it is therefore likely that the workforce skills required during construction are available in the area.

Sancrox Quarry has been operating at this location for over 20 years, and the proposed development would provide continued employment for a further ten years. Should the proposed development not proceed, the resource life of the quarry will end in approximately three years.

Potential impacts

The proposed development may have the following potential social impacts with relation to way of life in the PSA and broader locality:

- Increased employment opportunities associated with expanded operations at the quarry. Preliminary modelling has suggested that the proposed development will generate 10 new jobs in the PSA. Sancrox Quarry currently employs 14 staff, including 13 full time positions and 1 casual position. Additionally, an estimated 20 drivers are contracted by haulage companies to transfer quarry products from Sancrox to local and regional customers (note, the number of drivers varies and is based on market demand). The strategic policy context has identified that it is a state and local government priority to develop vibrant economies and enhance employment opportunities within the local area, and over a third of resident workers within the Port Macquarie-Hastings LGA are employed in construction related employment.
- Increased diversity of employment opportunities. Currently the economic profile of the area indicates that the largest sectors of industry employment for residents in the area construction, agriculture, fishing and forestry. This proposal is likely to generate new employment opportunities in the mining and resource extraction industry.
- Potential impacts to the way people move through the PSA and surrounding areas due to increased traffic and congestion associated with increased truck movements due to the construction phase and expansion of quarry operations, including both increases in light vehicles delivering construction staff to site and heavy vehicles. During operation, typical daily traffic movements are likely to include:
  - Light vehicle trips transporting staff to and from site concentrated at the start and end times of shifts,
  - Truck trips delivering quarried product and asphalt,
  - Concrete agitator trips to deliver concrete to construction sites,
  - Import of concrete constituents (sand and cement) and
  - Truck trips delivering waste concrete to site for recycling.

  The proposed development proposes truck movements and equipment loading 24 hours a day, 365 days a year. If approval is granted, operational traffic associated with the proposed development can take place outside of the daytime period, thus reducing the cumulative impact on traffic during higher volume periods.

  The local community of the PSA is highly car dependents and most trips are made by private vehicle – a significant increase in truck and vehicle movements associated with the proposed development may have an impact on residents' ability to access daily living needs, such as local schools, shops and employment centres.
- Demographic change and housing shortages associated with an increased number of workers associated with the expanded quarry operations. This is unlikely due to the limited number of jobs likely to be generated by the development.
- Potential negative social impacts associated with loss of employment at closure of quarry if it is closed within three years – as the existing resource life of the quarry is estimated to be approximately three years, with pit development beyond the current extraction limit required to access higher quality rock.

Responses / mitigation measures

- Maximise positive social impacts of increased employment opportunities within the PSA through practices that encourage the employment of local residents within the PSA, such as training programs to ensure that local residents have the skills required to take advantage of new employment opportunities.
- The Traffic and Access Assessment completed by ERM identifies that the design capacity, intersection types and standards of the recently completed Sancrox Interchange and Pacific Highway is sufficient to accommodate existing traffic on Sancrox Road (including quarry product delivery trucks that will continue during construction) and the short-term increase traffic associated with the construction phase.
- The Traffic and Access Assessment completed by ERM also identifies that the proposed development will result in an increase in light and heavy vehicle movements during the operational phase, but these trips will be spread over a longer period and so reduce the cumulative impact on traffic during higher volume periods.

- Employment generation opportunities associated with the proposed development are to be realised in line with the recommendations in Section 10.0- Economic Impact Assessment.

Summary	
Overall impact	Mixed
Likelihood	Very high
Duration	Long – over the life of the project
Extent	PSA / Surrounding locality
Severity	Low
Sensitivity	Low
Potential to mitigate/enhance	Medium

9.3.2 Community, including its composition, cohesion, character, how it functions and sense of place

The local residents of the PSA have a consistent demographic profile. Residents of the PSA are more likely than the Port Macquarie-Hastings LGA average to be working age adults, living in households with children and born in Australia. They are more likely than the Port Macquarie Hastings average to live-in low-density dwellings (separate housing) and have a mortgage, as well as to not have attained a tertiary education. There is a comparatively low proportion of renting households in the PSA, indicating that many residents in the area are established and unlikely to move away from the area in the short term.

The local area is transitioning from a predominantly rural area to a more residential area. Between 2011 and 2016, the PSA grew significantly (16.2%) in comparison with the broader Port Macquarie-Hastings LGA. New development in the area will be concentrated within the Thrumster neighbourhood. It is likely that the new community moving into this area will share many characteristics with the demographic profile of the existing residents of the PSA. As the proposed development does not include a residential component, it is unlikely to significantly impact the composition, cohesion or character of the local community as it does not comprise a residential component and is likely to generate a limited number of additional jobs in the local area (10 new jobs in total).

Sancrox Quarry has operated at this location for over 20 years; it is an established part of the existing community and land use in the area. The proposed development enables the expansion of existing operations significantly but will not change the character or land use of the site. The proposed development also does not create an access barrier between existing communities. Therefore, it is unlikely to significantly affect how the local community functions.

Expanded quarry operations will result in increased dust, noise, truck movements and other disruptions to the natural landscape that may impact sense of place. New ancillary development is also proposed in association with the expansion of quarry operations, including a new concrete batching and recycling facility, and an asphalt production plant. This has the potential to impact on the sense of place of the area, which is closely tied to the local community's relationship to nature and the natural landscape surrounding the Port Macquarie area.

A number of measures have been taken to limit impacts to the environment, and consequently, sense of place in the study area. Specialist technical assessments have been completed for all key impacts associated with the proposed development against current NSW assessment standards and requirements to ensure that the environmental impacts of the proposal can be managed within acceptable limits so as not to pose unacceptable risks or impacts to surrounding receivers. In addition, a range of mitigation measures and management responses have been proposed as part of the technical assessments to manage the environmental impacts of the proposal. These mitigation measures are outlined in detail within the EIS.

New employment opportunities at the site generated through the proposed development have the potential to attract new workers with a different demographic profile into the PSA, however, there are likely to only be ten new jobs generated by this proposed development, which is unlikely to have a significant impact on the community composition of the area.

During the CCC meeting held on 6 July 2018, community representatives raised the issue of the rehabilitation of the site when operations have ceased. Hanson responded that community feedback on the rehabilitation of the site is

welcome. The future rehabilitation of the site has the potential to enhance the community's sense of place associated with the site.

Potential impacts

The proposed development may have the following potential social impacts with relation to community composition, cohesion, character and sense of place in the PSA and broader locality:

- Potential positive impacts associated with the ongoing operation of the quarry would include the continuation of Hanson's contribution towards the community via ongoing employment opportunities and economic contribution to the broader Port Macquarie-Hastings LGA and region.
- Potential negative impacts to existing residents' "sense of place". The strategic policy review highlighted that residents' sense of place is closely tied to the natural beauty of the Port Macquarie area. The loss of bushland and natural landscapes at the site, the establishment of new surface infrastructure and increased dust, noise and pollution associated with expanded operations at the site, has the potential to disrupt this sense of place. It is a state and local priority to ensure that future development in the local area is balanced with environmental sustainability and biodiversity.

  However, it is noted that the Sancrox Quarry has operated at this location for over twenty years and is an established part of the existing community and land use in the area. Although the proposed development will involve increased operations and new infrastructure over a larger site area, it is not a significant change to land use at the site.

Responses / mitigation measures

- Plan community engagement to specifically address sense of place within the local community, to assist in defining sense of place to be reflected in future planning stages. For example, a community survey, or specific discussion of sense of place with the Community Consultative Committee established for the project.
- Confirm ongoing operation of the Community Consultative Committee as a conduit between the broader community and Hanson.
- Maintain the existing complaints register to continue to monitor issues raised by the community related to community composition, cohesion, character, how it functions and sense of place.
- Actively engage the CCC and broader community to develop a plan for the rehabilitation of the site to maximise community

Summary	
Overall impact	Mixed
Likelihood	Low
Duration	Long
Severity	Low
Sensitivity	Low
Extent	Port Macquarie-Hastings LGS
Potential to mitigate/enhance	Medium

9.3.3 Culture, including shared beliefs, customs, values and stories, and connections to land, places, and buildings

ERM was engaged by Hanson to undertake a Heritage Assessment to inform the EIS for the Project, which considered both Aboriginal and non-Aboriginal historic heritage values. The Heritage Assessment provides a combined assessment of the tangible and intangible heritage values relating to the site, as identified during desk-based assessment and field surveys undertaken in November 2017. The Assessment aims to meet the requirements of the SEARs, the Heritage Council of NSW and the NSW Office of Environment and Heritage.

The assessment was undertaken using desktop analysis, archival research, field survey and Aboriginal stakeholder consultation. The assessment was undertaken in accordance with relevant legislative requirements and guidelines as listed in the assessment.

Searches of the local and state heritage registers were conducted in order to identify any historic heritage sites located within the site. A search of the Aboriginal Heritage Information Management System (AHIMS) site register was also conducted, to determine the location of any Aboriginal heritage sites within or surrounding the site.

Based on the desktop assessment, any surviving sites and features of non-Indigenous cultural heritage value within the site would be limited to portable domestic and rural artefacts, or features associated with grazing and timber extraction activities.

The archaeological survey did not result in the identification or recording of Aboriginal archaeological or cultural sites within the proposed extraction area, except for one potential scar tree located to the north of a small farm dam at the western extent.

Potential impacts

The proposed development may have the following potential social impacts with relation to culture, including shared beliefs, customs, values and stories, and connections to land, places, and buildings (including Aboriginal culture and connection to country):

- Potential negative impacts associated with the unexpected disruption of Aboriginal heritage sites within or surrounding the site. The Heritage Assessment completed by ERM did not result in the identification of any Aboriginal archaeological or cultural sites within the proposed extraction area, apart from one potential scar tree located to the north of the site.
- Potential negative impacts associated with the unexpected disruption of non-Aboriginal heritage sites within or surrounding the site. The Heritage Assessment did not identify any non-Aboriginal historic heritage values associated with the site.

Responses / mitigation measures

The Heritage Assessment report identifies mitigation measures and responses to the potential impacts outlined above. These mitigation measures have been summarised in the EIS and include:

- In the unlikely event that historic or Aboriginal heritage items are found during works, the Unexpected Finds Protocol outlined in the EIS should be followed.
- In order to comply with best practice principles, all employees and subcontractors will undergo environmental awareness training as part of the site induction to ensure they understand their obligations and responsibilities.

Summary

Overall impact	Mixed
Likelihood	Low
Duration	Long
Severity	Low
Sensitivity	Low
Extent	PSA
Potential to mitigate/enhance	High

9.3.4 Health and wellbeing

Expanded quarry operations at the Sancrox Quarry have the potential to impact the health and wellbeing of residents of the PSA and broader locality through increased environmental emissions associated with the development, including air quality (particulates and odour), noise and water quality. These impacts also have the potential to raise concerns and anxiety within the community regarding health impacts (actual and perceived).

Specialist technical assessments have been completed for all key impacts associated with the proposed development against current NSW assessment standards and requirements to ensure that the environmental impacts of the proposal can be managed within acceptable limits so as not to pose unacceptable risks or impacts to surrounding receivers. In addition, a range of mitigation measures and management responses have been proposed as part of the technical assessments to manage the environmental impacts of the proposal. These mitigation measures are outlined in detail within the EIS.

During the CCC meeting held on 6 July 2018, community representatives raised concerns around the environmental impacts generated by the expanded quarry operations and requested that environmental monitoring requirements be explained regarding: air quality, noise, water quality, blasting/fly rock and dust.

Noise and air quality emissions and surface water discharge from the proposed development would be managed in accordance with regulatory limits placed on the site.

Ongoing consultation and engagement would be carried out to keep the community up to date with activities and management measures at the mine to alleviate and respond to concerns.

Potential impacts

The proposed development may have the following potential social impacts with relation to health and wellbeing, including physical and mental health:

- Potential negative impacts to health and wellbeing associated with increased anxiety around perceived and health impacts associated with air quality, noise and water quality impacts.
- Potential negative impacts to health and wellbeing associated with increased dust associated with the expansion of quarry operations, the establishment of a concrete batching plant and recycling facility. The Air Quality and Greenhouse Gas Assessment prepared by ERM has identified the potential for ambient air quality impacts and greenhouse gas emissions from the construction and operation phases. If unmitigated, this has the potential to impact respiratory health of residents and visitors surrounding the site. Additionally, during the 6 July 2018 meeting, the CCC raised concerns that increased dust may also settle on vegetation and waterways in the area.
- Potential negative impacts to health and wellbeing associated with increased noise and vibration associated with the expansion of quarry operations, the establishment of a concrete batching plant and recycling facility and increased construction road traffic. Increased noise and vibration has the potential to create annoyance, interfere with daily activities, interfere with concentration and memory particularly with regard to children's school performance and business activity that depends on quiet surroundings, disrupt sleep and rest patterns and create or exacerbate health concerns such as hearing impairments and cardiovascular health (elevated blood pressure).The assessment completed by ERM identified that without suitable mitigation, "both construction and operational noise levels have the potential to exceed the applicable criteria, limits and thresholds of the INP and ICNG if they are not suitably mitigated. The assessment also identified the blasting overpressure and vibration levels have only a limited potential to exceed the applicable AS2187 criteria and thresholds, as long as normal blast design planning and consideration for potential environmental impacts occurs" (p.xvi). A range of mitigation measures have therefore been identified and are summarised below.
- Potential negative health and wellbeing impacts associated with employee safety during the operation of the quarry, e.g. risk of injury.

Responses / mitigation measures

- Water quality – A Hydrology Assessment was conducted by ERM to inform the EIS and identified the potential soil and water impacts related to the proposed development and design predominant mitigation measures, including to manage sediment-laden run-off generated by the site.

A surface water monitoring program has been prepared and the site EPL will need to be varied to incorporate the proposed revision to current water monitoring. The program outlines the proposed surface water monitoring regime for the sediment basins that will be installed as the staged expansion progresses. The EIS notes that "with the implementation of sediment basins, the utilisation of mitigation measures and the development on a SWMP and PESCPs, the potential soil and water impacts of the Project can be effectively managed so that there is no significant, negative impact to the environment." (p.ix).

Monitoring requirements will also be developed to manage the potential impacts to groundwater, and a groundwater monitoring plan should be developed.

- Air quality – An Air Quality and Greenhouse Gas Assessment has been prepared to support the EIS, which considers all reasonable and feasible mitigation measures to minimise the emissions from the proposed activities at the site, including a range of mitigation measures identified in Section 11 of the EIS.
- Construction noise – The EIS identifies that construction noise impacts may not be reduced to imperceptible or negligible levels for all receptors during all construction activities. However, the recommendations presented in Section 10.5 of the EIS will minimise residual construction noise impacts.
- Operational noise – The EIS identifies that operational noise levels are predicted to exceed the applicable INP operational noise criteria and limits. Therefore, noise reduction and mitigation measures have been established to assist in achieving compliance with relevant guidelines. These measures are outlined in Section 10.5 of the EIS.

Summary	
Overall impact	Negative
Likelihood	Low
Duration	Long
Severity	Low
Sensitivity	Low
Extent	PSA and surrounding locality
Potential to mitigate/enhance	High

9.3.5 Surroundings – amenity

Amenity refers to the way a community experiences a place, including its appearance and is connected to a community's identity and its sense of place. Aesthetic qualities are an important part of amenity, but the broader concept of amenity is determined also by the physical design of a place and the human activity that takes place within it.

Amenity impacts include any factors that affect local residents' and visitors experience of their homes and daily activities, for example, noise, vibration, changes to views or changes to air quality. Changes in amenity may also conflict with community values, contributing to a loss of or change in a community's sense of place, and subsequently a community's perceived identity.

The proposed development has the potential to affect social amenity as a result of changes to the following factors:

- Noise and vibration,
- Air quality and odour,
- Visual impacts,
- Traffic and congestion,
- Biodiversity,
- Water quality, and
- Rehabilitation of the site.

There is only a relatively small residential population associated with the PSA, however, this has grown significantly between 2011 and 2016 as the area transitions from rural to residential. New development in the area will be concentrated within the Thrumster neighbourhood. New residents moving into this area have the potential to be affected by amenity impacts over the stages of the project.

The existing Sancrox Quarry operations form part of the surroundings for the proposed development, as the area has been operating as a quarry for over 20 years. There are no negative social impacts associated with changes to land use at the site, as the proposed development will not result in changes to the land use of the area.

Potential impacts

The proposed development may have the following potential social impacts with relation to surroundings, including access to and use of ecosystem services, public safety and security, access to and use of the natural and built environment, and its aesthetic value and/or amenity:

- Potential negative social impacts associated with increased operational and construction noise. Increased noise and vibration has the potential to create annoyance, interfere with daily activities, interfere with concentration and memory particularly with regard to children's school performance and business activity that depends on quiet surroundings, disrupt sleep and rest patterns and create or exacerbate health concerns such as hearing impairments and cardiovascular health (elevated blood pressure).The assessment completed by ERM identified that "both construction and operational noise levels have the potential to exceed the applicable criteria, limits and thresholds of the INP and ICNG if they are not suitably mitigated. The assessment also identified the blasting overpressure and vibration levels have only a limited potential to exceed the applicable AS2187 criteria and thresholds, as long as normal blast design planning and consideration for potential environmental impacts occurs" (p.xvi). Increases to existing noise is likely to be perceived negatively by the surrounding community.
- Potential negative social impacts associated with reduced air quality due to expanded quarry operations, the establishment of a concrete batching plant and recycling facility. If unmitigated, this has the potential to impact respiratory health of residents and visitors surrounding the site. Additionally, increased dust may also settle on vegetation and waterways in the area, as identified by the CCC during the 6 July 2018 meeting. This is likely to reduce the overall amenity of the area.
- Potential negative social impacts associated with visual impacts related to the proposed development:

  - Existing landforms and vegetation will continue to screen the project site from the views of rural residential properties located to the north, south and west of the proposed development, resulting in no change to visual amenity.
  - Nearby commercial and industrial areas to the east of the site have the potential to be affected due to the removal of a vegetative buffer to the east of the site, which will result in greater exposure of the site to passing traffic along the Pacific Highway and Cassegrain Wintery. However, the EIS identifies that the speed of traffic and interrupted view across the highway is unlikely to result in substantial change to visual amenity in the area.
- Potential negative social impacts associated with increased traffic associated with both the construction and operational phases. The site currently generates an average of 42 heavy vehicle trips per day. The expanded quarry operations will increase average truck volumes to approximately 200 truck trips per day (a 'trip' is two movements – in and out of the site). This is a significant increase of approximately 158 additional heavy vehicle trips per day on Sancrox Road. It is noted that surrounding road upgrades have assisted in transport managements, but increased traffic and congestion is likely to have an impact on the surrounding area.
- Potential negative social impacts associated with loss of biodiversity at the site due to the clearing of 48 hectares of bushland.
- Potential negative social impacts associated with pollution of surface and ground water associated with the site, if unmitigated.
- Potential negative social impacts associated with the inappropriate rehabilitation of the site when operations have ceased.

Responses / mitigation measures

- Air quality – An Air Quality and Greenhouse Gas Assessment has been prepared to support the EIS, which considers all reasonable and feasible mitigation measures to minimise the emissions from the proposed activities at the site, including a range of mitigation measures identified in Section 11 of the EIS.
- Construction noise – The EIS identifies that construction noise impacts may not be reduced to imperceptible or negligible levels for all receptors during all construction activities. However, the recommendations presented in Section 10.5 of the EIS will minimise residual construction noise impacts.
- Operational noise – The EIS identifies that operational noise levels are predicted to exceed the applicable INP operational noise criteria and limits. Therefore, noise reduction and mitigation measures have been established to assist in achieving compliance with relevant guidelines. These measures are outlined in Section 10.5 of the EIS.
- Undertake consultation with the CCC and broader community regarding options for the potential future rehabilitation of the site when operations have ceased, to maximise the positive social benefits to the local community.
- During operation, the above potential impacts will be managed at the site via the following management plans: Air Quality Management Plan, Noise and Blast Management Plan, Site Water Management Plan and Rehabilitation Management Plan.

Summary	
Overall impact	Negative
Likelihood	Medium
Duration	Long
Severity	Low
Sensitivity	Medium
Extent	PSA
Potential to mitigate/enhance	Medium

9.3.6 Personal and property rights

Impacts associated with personal and property rights, including whether economic livelihoods are affected, and whether they experience personal disadvantage or have their civil liberties affected will be minimal.

The possibility of land acquisition being triggered by the proposed development was raised by the CCC, and Hanson has responded that the project is being specifically engineered to avoid this possibility.

These impacts are considered to be possible but minimal in consequence.

Potential impacts

The proposed development may have the following potential social impacts with relation to personal and property rights, including whether their economic livelihoods are affected, and whether they experience personal disadvantage or have their civil liberties affected:

- Potential impacts to surrounding businesses and residents associated with increased congestion and traffic movements due to expanded operations.
- Potential environmental impacts related to water quality, noise and vibration and air quality that may affect surrounding landowners.

Responses / mitigation measures

- As discussed in Section 9.0 above, the above impacts would be managed in accordance with regulatory requirements to ensure acceptable limits are met at nearest receptors.

Summary	
Overall impact	Negative
Likelihood	Medium
Duration	Long
Severity	Low
Sensitivity	Low
Extent	PSA

9.3.7 Decision making systems

Impacts associated with decision making systems, and the extent to which stakeholders and the community can have a say in decisions that affect their lives, and have access to complaint, remedy and grievance mechanisms are limited. Environmental regulation at the quarry would be governed by its development consent and associated management framework, including complaint handling mechanisms to address and remedy issues raised by the community.

Hanson will continue to engage with the community and affected stakeholders via the Community Consultative Committee and other mechanisms to ensure that stakeholders are aware of their rights under the development consent and have the opportunity to provide feedback on the project during construction and operational phases.

Impacts to individual's decision-making capacity and systems are considered possible but minimal in consequence.

Potential impacts

The proposed development may have the following potential social impacts with relation to decision making systems, particularly the extent to which they can have a say in decisions that affect their lives, and have access to complaint, remedy and grievance mechanisms:

- Potential impacts associated with residents and stakeholders being unaware of their rights and/or anxiety associated with feeling they are unable to provide feedback on the proposed development.

Responses / mitigation measures

- Ongoing operation of the Community Consultative Committee throughout the life of the project.

Summary	
Overall impact	Mixed
Likelihood	Low
Duration	Medium
Severity	Low
Sensitivity	Low
Extent	PSA and Port Macquarie Hastings LGA
Potential to mitigate/enhance	High

9.3.8 Access to and use of infrastructure, services and facilities

As is to be expected with a quarry site located in a rural area, the proposed development is not within walking distance to any social infrastructure. There are a limited number of social infrastructure assets within 5km of the site, including emergency services, reserves and sports fields. These facilities will not be affected by expanded operations at Sancrox Quarry.

Potential impacts

The proposed development may have the following potential social impacts with relation to access to and use of infrastructure, services and facilities within the surrounding locality, whether provided by local, state, or federal governments, or by for-profit or not-for-profit organisations or volunteer groups include:

- Potential negative impacts associated with increased traffic and congestion for residents seeking to access social infrastructure in the surrounding locality.

Responses / mitigation measures

- The Traffic and Access Assessment completed by ERM identifies that the design capacity, intersection types and standards of the recently completed Sancrox Interchange and Pacific Highway is sufficient to

accommodate existing traffic on Sancrox Road (including quarry product delivery trucks that will continue during construction) and the short-term increase traffic associated with the construction phase.

- The Traffic and Access Assessment completed by ERM also identifies that the proposed development will result in an increase in light and heavy vehicle movements during the operational phase, but that these trips will be spread over a longer period and thus reduce the cumulative impact on traffic during higher volume periods.

Summary	
Overall impact	Mixed
Likelihood	Low
Duration	Medium
Severity	Low
Sensitivity	Low
Extent	PSA and Port Macquarie Hastings LGA
Potential to mitigate/enhance	High

9.3.9 Fears and aspirations

The proposed development has the potential to result in impacts related to fears and aspirations regarding one or a combination of the above social impacts, as outlined in **Sections 9.3.1** to **9.3.8** or about the future of the community.

Potential impacts

The proposed development may have the following potential social impacts with relation to fears and aspirations about social impacts or about the future of the community, including:

- Potential negative impacts associated with community opposition to extractive industry projects in general (e.g. related to greenhouse gas and climate change impacts) and concern regarding the cumulative impacts of extractive industries on the broader Port Macquarie-Hastings LGA landscape.

Responses / mitigation measures

- The EIS outlines a number of management and mitigation measures related to the above social impacts and aims to minimise these issues, as discussed above.

Summary	
Overall impact	Mixed
Likelihood	Low
Duration	Medium
Severity	Low
Sensitivity	Low
Extent	PSA and Port Macquarie Hastings LGA
Potential to mitigate/enhance	High

10.0 Economic impact assessment

10.1.1 Resource significance

The expansion of Sancrox Quarry, as per the proposed project, will increase resource supply considerably at the facility over the coming years. While actual annual production levels will be subject to market conditions, Hanson estimate:

- Production of concrete grade aggregates, fill material, manufactured sand, pre-coated aggregates, road base, gabion and armour rock, drainage materials etc of up to 750,000 tonnes pa
- Asphalt production of up to 50,000 tonnes pa
- Recycled concrete production of up to 20,000 tonnes pa
- Gross market value of available resource is estimated at approximately $24 million pa (2019 dollars), based on annual production of 750,000 tonnes.

These resources will be important in supporting strong urban and infrastructure growth forecast in the Port-Macquarie-Hastings LGA and broader region over the coming decades. The role of Sancrox Quarry in supporting major projects is highlighted by the product provided for the now completed Sancrox Interchange and Oxley Highway to Kempsey Pacific Highway Upgrade projects.

10.1.2 Demand considerations

Resource demand will be driven by increased sub-divisions for residential and industrial developments across the Mid-North Coast region, and major infrastructure projects (e.g. roads). This will include concrete aggregate supply to Port Macquarie and Taree Concrete plants for construction, as well as road base and fill material.

Examples of development and potential development are as follows:

- Port Macquarie: Ascot Park, Thrumster, Sovereign Hills, Ocean Drive upgrade, Port Macquarie Ring Road, Lake Cathie, Bonny Hills, Rainbow Beach development, Lakewood.
- Sancrox: Expressway, Spares industrial development, Le Clos and Freeman residential developments
- Wauchope: Crosslands and Beechwood residential developments, road developments to Walcha.

Additional production capability will provide improved efficiencies and allow Sancrox Quarry to support developments beyond Taree and Kempsey, with an estimated range of 100km.

10.1.3 Cartage costs considerations

The central location of Sancrox Quarry to major urban development, transportation infrastructure and customers allows for distribution of product in an efficient and cost-effective manner. Should the proposed project not proceed, and the existing resources were to be exhausted, this would likely lead to a scenario where similar resources would need to be sourced from more distant locations leading to an increase in cartage costs, which would generally be passed on to the end customer (e.g. Council, developers, wholesalers etc).

10.1.4 Benefit Assessment

Project investment

Project investment of $12.5 million will be required to complete the expansion of Sancrox Quarry, with this investment likely to benefit the regional economy in terms of employment, business contracts and supply chain impacts. This is evidenced by the strong construction-related business and workforce base available in Port Macquarie-Hastings LGA to service the project (refer to Chapter 6).

Based on similar projects undertaken by Hanson, the project has the potential to be 70%-90% locally sourced (90% represents a local company securing the contract to build and design the plant, using domestic steel).

Employment generation

Employment generation will occur during both the construction and operational phases of the project, which is estimated as follows:

- Construction employment of 80 direct Full Time Equivalent (FTE) jobs over the development phase. This is based on allocating 50% of investment on labour and applying an average of $80,000 per FTE construction job (ABS Average Weekly Earnings, Australia Nov 2018). In addition to direct employment, 130 further FTE jobs will be supported in the wider economy through the employment multiplier effect (based on the ABS multiplier for 'other construction' of 2.6). In total 210 FTE jobs will be generated through the construction phase of the project on a direct and indirect basis.
- Operational employment of +10 new FTE jobs (compared to the existing situation), comprising:
  - Shift supervisor: 1 FTE Job
  - Operators: 5 FTE jobs
  - Truck drivers: 2 FTE jobs
  - Weighbridge operator: 1 FTE job
  - Fitter: 1 FTE job

In addition to direct employment, 35 further FTE jobs (rounded) will be supported in the wider economy through the employment multiplier effect (based on the ABS multiplier for 'other mining' of 4.3). It total 45 FTE jobs will be generated through the operational phase of the project on a direct and indirect basis.

Local spending stimulus

The additional employment generation associated with the operations of the expanded quarry, represents a 75% uplift in labour (from 13 jobs to 23 jobs) which will have a flow on stimulus impact to the Port Macquarie-Hastings economy (assuming these new employees are resident workers). Additionally, increased local purchases of goods and services are likely to occur due to the expanded operations.

Based on existing wage/purchase stimulus of $2.1 million pa (refer to Section 6.2) and applying a 75% uplift, an additional $1.6 million pa (2019 dollars) will be generated in local stimulus through the operational phase of the project.

Concrete recycling

The expansion of Sancrox Quarry will include the development of a recycled concrete processing plant which has the capacity to produce up to 20,000 tonnes of concrete pa. The concrete recycling facility will therefore contribute to positive environmental benefits by diverting concrete waste product from landfill.

Tax implications

Sancrox Quarry will be liable for higher State land taxes once the operational phase of the expanded quarry commences. The uplift in land taxes will be based on the higher extraction levels from the site.

Additional revenues may also be payable to Council associated with increased road maintenance costs for the local road network due to higher truck volumes to and from the quarry.

Macro-economic considerations

As with all commodities, macro-economic factors such as economic growth, changes in market prices and movements in interest rates can affect demand for product.

With regard to the types of product to be sourced from the expanded Sancrox Quarry, it is unlikely demand for these products will be impacted significantly by such macro-economic factors for the following reasons.

- Products from the expanded quarry will be focused entirely on the domestic market (principally local/regional markets); therefore, output will not be subject to the type of volatility often associated with export-focused commodities (e.g. metals, coal)

- Population and dwelling growth forecasts remain strong at a local and regional level (refer to section 6.1), underpinning significant demand for quarry resources into the future – which includes infrastructure projects which support urban growth.
- NSW economic growth remains strong, with the 2018-19 NSW Budget noting:

  '" The New South Wales economy has been exceptionally strong over the last few years with the outlook for growth to remain above trend this year and for the next two years".

  The more recent 2018/19 NSW Budget Half-Yearly Review, forecasts employment to increase at between 1.25% to 1.50% pa to 2021/22, while unemployment is expected to remain at approximately 4.5%. Gross State Product (GSP) is projected to remain steady (and above long-term trends) at 2.50% between 2018/19 and 2021/22. The Half-Yearly Review also notes the State Government's infrastructure investment pipeline is $89.7 billion over the next four years, which represents an upward revision of $2.5 billion since the Budget.
- Interest rates have been at historical lows and stable for some time, with the Reserve Bank of Australia's official cash rate pegged at 1.5% since August 2016. The RBA's outlook indicates further stability, with only minor movements in the base rate (up or down) likely in the short-medium term.

11.0 Concluding comments

This report has considered a range of social impacts arising from the proposed expansion of operations at Sancrox Quarry, including impacts to way of life, community composition and character, culture, health and wellbeing, surroundings, personal and property rights, decision making systems and access to and use of infrastructure. This report has also considered economic impacts arising from the proposed development, including resource significance, demand considerations, cartage cost considerations, employment and other economic considerations.

As identified in Section 9.0 and Section 10.0, the proposed development is likely to have a mixed impact on the existing primary study area and surrounding Port Macquarie-Hastings LGA.

- The social impacts of the proposed expansion of operations at Sancrox Quarry are likely to be generally consistent with existing operations at Sancrox Quarry but increased in line with the increased scale of operations – for example impacts associated with the rise in truck movements.
- There are potential negative social impacts associated with increased traffic and heavy vehicle movements, increased noise and vibration, impacts to air and water quality and clearing of bushland, which will need to be appropriately mitigated to prevent impacts to the sense of place and amenity of the surrounding area. However, the quarry has operated at this location for over 20 years and the expansion of operations at this site does not involve a significant change to land uses at this location.
- There are a range of likely positive economic benefits associated with the expansion of Sancrox Quarry at this location including:
  - Employment growth at the quarry and in the broader community – which also brings potential social benefits to the community associated with increased business expenditures and expanded employment opportunities
  - Efficient and cost-effective delivery of product to customers/end users
  - Environmental benefits through the diversion of used concrete from landfill.
- The expansion of the quarry will also support urban growth resource needs, stimulated by ongoing population expansion and the proposed pipeline of major State Government infrastructure investment projects in the area.

Therefore the overall impact of the proposed development at this location is likely to be positive, provided that the localised potential negative social impacts associated with increased traffic and heavy vehicle movements, increased noise and vibration, impacts to air and water quality and clearing of bushland are appropriately mitigated and monitored, as set out in the Environmental Impact Statement (dated October 2018).

Appendix A. Strategic Policy Context

North Coast Regional Plan 2036	
NSW Department of Planning and Environment	
Purpose and vision	The Department of Planning and Environment's *North Coast Regional Plan 2036* identifies a high-level vision for the North Coast region. The plan intends to make the North Coast of NSW the *"best region in Australia to live, work and play thanks to its spectacular environment and vibrant communities".* The purpose of the plan is to provide a strategic overview of the future of the North Coast region, which will in turn inform more specific and local strategic plans. The plan recognises the importance of Port Macquarie as a significant regional centre of the North Coast, which provides a primary anchor for growth, new jobs and more diverse housing and services. Furthermore, this plan intends to support and upgrade infrastructure, such as the Pacific Highway, connecting Port Macquarie to the rest of the North Coast Region and other major cities. The North Coast Regional Plan identifies that the area is likely to experience significant growth in population and construction, and that the associated infrastructure necessary to support this growth needs to be well planned and staged. The plan also emphasises a variety of regional priorities for the Port Macquarie area. These are: • Manage and support growth in Port Macquarie; • Deliver housing and job opportunities in Port Macquarie, Wauchope, Lake Cathie, Bonny Hills and Camden Haven; • Protect environmental assets and important farmland areas that sustain the agricultural and tourism industries; • Maximise opportunities associated with growth in the Hunter region and the increased connectivity provided by the Pacific Highway upgrade and digital technology.
Key actions	The following key actions of the North Coast Regional Plan are relevant to the proposed development: *Goal 1: The most stunning environment in NSW* • *Direction 1: deliver environmentally sustainable growth,* *Goal 2: A thriving interconnected economy* • *Direction 6: Develop successful centres of employment* • *Direction 9: Strengthen regionally significant transport corridors* • *Direction 13: Sustainably manage natural resources* *Goal 3: Vibrant and engaged communities* • *Direction 21: Coordinate local infrastructure delivery*

Mid North Coast Regional Strategy 2006-2031	
NSW Department of Planning and Environment	
Purpose and vision	• The *Mid North Coast Regional Strategy 2006-2031* was prepared by the NSW Department of Planning and Environment to provide an outline for the future of the Mid North Coast region of NSW. • The strategy intends to continue and protect the environment, cater to increased housing and employment land demand, encourage the growth of regional centres in the area, and protect the character and community on the Mid North Coast. • The plan emphasises the need to capitalise on the opportunities and prosperity of the communities, while promoting healthy and sustainable communities and environments.
Key actions	The following actions from the Mid North Coast Regional Strategy 2006-2031 directly relate to the proposal: • *Ensure an adequate supply of land exists to support economic growth and the capacity for an additional 48,500 jobs in the Region by protecting existing commercial and employment areas and securing sufficient land to support new employment opportunities.* • *Encourage the growth and redevelopment of the Region's four major regional centres and six major towns as a means of protecting sensitive coastal and natural environments and strengthening the economic and administrative functions of these centres as well as meeting increased housing density targets.*

Towards 2030: Community Strategic Plan	
Port Macquarie Hastings Council	
Purpose and vision	*Towards 2030* is Port Macquarie Hasting Council's Community Strategic Plan (CSP), setting out the community's vision for the area over the next 10 years, and identifies key strategies and goals to achieve this vision. The CSP is based on extensive community consultation undertaken in 2008 and 2009. By 2030, this plan envisages that the community will be engaged with local democracy, accessing quality infrastructure, benefiting from well designed and connected urban areas and enjoying economic prosperity and adequate educational resources and training. This CSP informs the operational and development plan implemented by the Port Macquarie Hastings Council. In turn, the operational and development plan are updated annually to ensure the CSP continues to be implemented within the given timeframe and budget.
Key actions	The following key actions of the *Towards 2030 CSP* are relevant to the proposed development: *Theme 1: Leadership and Governance* • *1.1 Maintain strong partnerships between all stakeholders – local, state and federal – so that they are effective advocates for the community* • *1.4 Use innovative, efficient and sustainable practices* *Theme 2: Your Community Life*

Towards 2030: Community Strategic Plan	
	• *2.4 Empower the community through encouraging active involvement in projects, volunteering and events* • *2.5 Promote a creative and culturally rich community* *Theme 3: Your Business and Industry* • *3.1 Embrace business and stronger economy* • *3.2 Create vibrant and desirable places* • *3.3 Embrace opportunity and attract investment to support the wealth and growth of the community* • *3.4 Partner for success with key stakeholders in business, industry, government, education and the community.* *Theme 4: Your Natural and Built Environment* • *4.3 Facilitate development that is compatible with the natural and built environment* • *4.6 Restore and protect natural areas* • *4.8 Increase awareness of issues affecting our environment, including the preservation of flora and fauna*

Urban Growth Management Strategy	
Port Macquarie Hastings Council	
Purpose and vision	The Urban Growth Management Strategy was prepared by the Port Macquarie Hastings Council to provide a plan that identifies opportunities for new economic development and housing that will meet future needs of the growing Port Macquarie Community. Specifically, this strategy aims to provide a framework for decisions related to business, housing and infrastructure. The plan identifies some key areas for growth, including housing supply and type, economic development and employment, health and education opportunities, tourism and infrastructure.
Key actions	The following key actions of the *Urban Growth Management Plan* are relevant to the proposed development: *Principles for economic growth* • *Principle 5 – Connectivity: Promote connectivity between employment centres, accessibility for the users of business and employment areas and take advantage of freight and transport networks.* • *Principle 6 – Industry: Provide a generous supply of industrial land to cater for a range of industry types to meet the forecast needs of the Port Macquarie-Hastings community to 2036.*

Economic Development Strategy	
Port Macquarie Hastings Council	
Purpose and vision	The Economic Development Strategy prepared by Port Macquarie Hastings Council envisages the region to be “a successful place that has a vibrant, diversified and resilient regional economy for people to live, learn, work, play and invest.” The plan

Economic Development Strategy	
	aims to “lead, create and proactively support an environment that simulates sustainable industry, business and investment growth”. This plan also outlines key actions for council and their role in meeting the plan’s objectives. The plan has five outcomes to reflect the strategic objectives of the plan: • Embracing business and a strong economy; • Providing the foundations; • Creating vibrant and desirable places; • Driving opportunity; and • Partnering for success.
Key actions	The following key actions of the *Economic Development Plan* are relevant to the proposed development: *Embracing business and a stronger economy* • *2. Economic considerations are central to the activities of Council.* *Providing the foundations* • *5. Ensure appropriately zoned land and precinct planning to encourage business investment and the development of new industries* • *6. Prioritise, advocate and provide leadership in the delivery of infrastructure projects that will make Port Macquarie-Hastings the premier place to live, learn, work, play and invest on the North Coast* • *7. Work with key stakeholders to implement major capital works projects.* *Driving Opportunities* • *16. Plan for current and future workforce needs* • *17 Identify and secure grant funding to support economic development initiatives* *Partnering for Success* • *19. Provide timely support to existing and emerging industries in a partnership capacity to encourage growth and sustainability.* • *20. Work closely with local business networks and organisations to build their capacity and facilitate the growth of existing enterprises.*

Biodiversity Strategy 2017-2030	
Port Macquarie Hastings Council	
Purpose and vision	The *Biodiversity Strategy 2017-2030* was prepared by Port Macquarie Hastings Council, and aims to address the environmental concerns within the Towards 2030 CSP. This strategy identifies the most important biological areas in the LGA and identifies key linkages and connections between these areas. Furthermore, the plan categorizes the threats to biodiversity, and defines actions that need to be undertaken to protect priority areas.

Biodiversity Strategy 2017-2030	
	The *Biodiversity Strategy 2017-2030* directly links to the key goals outlined in the *Towards 2030 Community Strategic Plan,* including: • Goal 4.6 Restore and Protect Natural Areas • Goal 4.3 Facilitate development that is compatible with the natural and built environment • Goal 4.8 Increase awareness of issues affecting our environment including preservation of flora and fauna
Key actions	The following actions from the *Biodiversity Strategy 2017-2030* relate to the proposal. *Objectives of the Strategy* • *1. Maintain and improve biodiversity and ecological processes by protecting, rehabilitating and managing native vegetation across all land tenures, particularly those area with high biological value.* • *3. Contribute to identifying and mitigating threats acting on biodiversity values.* • *6. Work cooperatively with regional, state and federal stakeholders on biodiversity conservation initiatives.*

Greater Sancrox Structure Plan 2014-2034	
Port Macquarie Hastings Council	
Purpose and vision	• The *Greater Sancrox Structure Plan 2014-2034* was prepared by the Port Macquarie Hastings Council to investigate and plan for the future desired character of the area. It intends to provide a coordinated direction for land use, environmental management and service infrastructure planning for the area at a strategic level. • The key objective of the plan is to ensure adequate land is made available to facilitate growth for urban/residential, rural/residential, employment/residential and tourist development in the Port Macquarie-Hastings LGA to 2031 in a planned and sustainable manner. • The plan envisages that the Greater Sancrox Area will be set within a network of vegetation and habitat linkages, while land use and development will maintain the area's important biodiversity and waterways. Furthermore, the area is serviced by an effective road network that provides adequate connectivity.
Key actions	The following objectives of the *Greater Sancrox Structure Plan 2014-2034* directly relate to the proposal: *Environment* • *Protect, maintain and enhance significant vegetation communities and fauna, habitat areas and wildlife corridors* • *Ensure environmental hazards are avoided and adequately managed* *Social* • *Minimise potential for future land use conflict* • *Ensure adequate access and connectivity is provided to the future users of the GSA* *Economic* • *Ensure land use does not restrict or prohibit the development potential of extractive resources* • *Ensure a suitable supply of future rural-residential, urban and employment lands which complement the future growth plans for the Port Macquarie-Hastings region*

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