Appendix C Surface and Groundwater Assessment

Newman Quarrying Pty Ltd

Proposed Sandstone Quarry Expansion at Tullymorgan-Jackybulbin Road, Mororo, NSW

Surface and Groundwater Assessment

May 2015

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1. Introduction

1.1 Background

GHD Pty Ltd (GHD) was engaged by Newman Quarrying Pty Ltd (Newman Quarrying) to prepare a Surface Water and Groundwater Impact Assessment report to address the potential surface water and groundwater impacts from the proposed expansion of a sandstone quarry at Lot 2 DP 1055044, Tullymorgan-Jackybulbin Road, Mororo, known as Sly's Quarry.

The proposal involves the expansion of the existing sandstone quarry by 11.1 hectares and an increase in the extraction rate up to 500,000 tonnes per annum. The primary purpose of the quarry would be to supply substantial quantities of quarry materials required for current and proposed Pacific Highway works, and for supply to Clarence Valley Council (CVC) and local contractors.

It is estimated that the quarry would have an available resource of about 7 million tonnes which would allow extraction for a period of between 30 and 40 years, depending on demand.

1.2 Aim

This assessment considers surface and groundwater impacts associated with the proposal. The assessment provides management approaches on how any potential impacts could be avoided or minimised.

1.3 Scope

The scope of the assessment included:

- An assessment, review and description of the existing hydrological conditions, both related to surface and ground water.
- An assessment of potential surface and groundwater quantity/ quality impacts associated with the proposed works, including an annual site water balance and water budget. In addition, local and regional flood conveyance matters are considered.
- Nomination of management measures to mitigate any potential impacts associated with the proposed works, which may arise.

1.4 Limitations

This report has been prepared by GHD for Newman Quarrying Pty Ltd and may only be used and relied on by Newman Quarrying Pty Ltd for the purpose agreed between GHD and the Newman Quarrying Pty Ltd.

GHD otherwise disclaims responsibility to any person other than Newman Quarrying Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

GHD has prepared this report on the basis of information provided by Newman Quarrying Pty Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

2. Secretaries environmental assessment requirements

The Secretary's Environmental Assessment Requirements (SEARs) in relation to surface water and groundwater are shown in Table 2-1, along with where they are addressed in this report.

Table 2-1 Surface water and Groundwater SEARs

	Conditions (Summarised)	Where addressed in this report
The EIS must address the following:	An assessment of the likely impacts of the development on the quantity and quality of the region's groundwater resources, having regard to the EPA's and DPI's requirements.	Section 7.2
	An assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users	Section 6.2 and 7.2
NSW Office of Water		
It is recommended that the EIS be required to include:	Details of water proposed to be taken (including through inflow and seepage) from each surface and groundwater source as defined by the relevant water sharing plan.	Section 3.1.2
	Assessment of any volumetric water licencing requirements (including those for ongoing water take following completion of the project).	Section 7.2
	A detailed assessment against the NSW Aquifer Interference Policy (2012) using the NSW Office of Water's assessment framework.	Section 7.2
	Assessment of impacts on surface and ground water 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.	Section 6.2 and 7.2
	Full technical details and data of all surface and groundwater modelling and an independent peer review.	Section 6.5
	Proposed surface and groundwater monitoring activities and methodologies.	Section 7.3
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).	Section 6.5
	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.	Section 3.1.2 and 6.5
	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.)	NA
	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 licencing.	Section 7.1.4 and 7.3
The EIS needs to include	Works likely to intercept, connect with or infiltrate the groundwater sources.	Section 7.2

	Conditions (Summarised)	Where addressed in this report
adequate details to assess the impact of the project on all groundwater sources including:	Any proposed groundwater extraction, including purpose and location and construction details of all proposed bores and expected annual extraction volumes	Section 7.3
	Bore construction information is to be supplied to the Office of Water by submitting a "Form A" template. The Office of 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.	Section 7.3
	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).	Section 7.1
	Sufficient baseline monitoring for groundwater quantity and quality for all aquifers and GDEs to establish a baseline incorporating typical temporal and spatial variations.	Section 7.1.4
	The predicted impacts of any final landform on the groundwater regime	Section 7.2
	The existing groundwater users within the area (including the environment), any potential impacts on these users and safeguard measures to mitigate impacts.	Section 7.1.5 and 7.2
	An assessment of groundwater quality, its beneficial use classification and prediction of any impacts on groundwater quality.	Section 7.1.4 and 7.1.5
	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).	Section 7.3.2
	Measures proposed to protect groundwater quality, both in the short and long term.	Section 7.3.2
	Measures for preventing groundwater pollution so remediation is not required.	Section 7.3.2
	Protective measures for any groundwater dependant ecosystems (GDEs).	Section 7.3
	Proposed methods for the disposal of waste water and approval from the relevant authority.	Section 6.5
	The result of any models or predictive tools used.	Section 6.5
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	Section 7.2
	The potential to adversely affect the water quality of the underlying groundwater system and adjoining groundwater systems in hydraulic connections; and	Section 7.2
	The effect of the function of GDEs (habitat, groundwater levels, conductivity).	Section 7.2
	Provide safeguard measures for any GDEs.	Section 7.3
The Environmental Impact Statement	Detailed modelling of potential groundwater volume, flow and quality impacts of the presence of a final void (where relevant) on identified receptors specifically considering those environmental systems that are likely to be groundwater dependent	Section 7.2

	Conditions (Summarised)	Where addressed in this report
report should include:	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.	Section 7.3

3. Legislation and policy

3.1 Legislation

3.1.1 Water Act 1912

The *Water Act 1912* governs access, trading and allocation of licences associated with both surface and underground water for water sources where a Water Sharing Plan (WSP) has not been put in place. The elements to which the Water Act 1912 applies include extraction of water from a river, extraction of water from underground sources, aquifer interference and capture of surface runoff in dams.

At this point in time, the *Water Act 1912* applies to groundwater interference, bore installation and extraction of groundwater within the Project Application Area. Currently the site does not have a licence to extract groundwater under the *Water Act 1912*. Any interference and/or removal of groundwater as a result of the Project will need to be licenced under the *Water Act 1912*.

3.1.2 Water Management Act 2000

The *Water Management Act 2000* (WM Act) is intended to ensure that water resources are conserved and properly managed for sustainable use benefitting both present and future generations. It is also intended to provide formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses as well as to provide for protection of catchment conditions.

The Project Application Area is not currently covered by a WSP, although a draft WSP for the North Coast Fractured and Porous Rock Groundwater Sources is currently being prepared by NSW Office of Water (NOW) and will regulate extraction and interference of groundwater from the fractured and porous rock groundwater source within the WSP boundary. This WSP will include the Project Application Area and is anticipated to commence in July 2015. Additionally a draft WSP for the Clarence Unregulated and Alluvial Water Sources is currently being prepared by NOW and will regulate extraction and interference of groundwater from the alluvial groundwater source within the WSP boundary. This WSP will cover alluvial sediments within the Project Application Area and is expected to commence in 2015.

In the vicinity of the Project Application Area; the granting of new licences for extraction of groundwater from alluvial sediments is currently embargoed for areas regulated by the WM Act and the *Water Act 1912.*

At this point in time any interference and extraction of fractured and porous rock groundwater throughout the Project Application Area will generally not require a Water Access Licence (WAL) under the WM Act. Groundwater licences granted under the *Water Act 1912* will be converted to licences under the WM Act once the relevant WSP commences.

3.2 Policy

3.2.1 NSW Aquifer Interference Policy

The NSW Aquifer Interference Policy (AIP) was finalised in September 2012 and clarifies the water licencing and approval requirements for aquifer interference activities in NSW, including the taking of water from an aquifer in the course of carrying out mining. Many aspects of this Policy will be given legal effect in the future through an Aquifer Interference Regulation. Stage 1 of the Aquifer Interference Regulation commenced on 30 June 2011.

This Policy outlines the water licensing requirements under the Water Act 1912 and WM Act. A WAL is required whether water is taken for consumptive use or whether it is taken incidentally by the aquifer interference activity (such as groundwater filling a void) even where that water is not being used consumptively as part of the activity's operation. Under the WM Act, a WAL gives its holder a share of the total entitlement available for extraction from the groundwater source. The WAL must hold sufficient share component and water allocation to account for the take of water from the relevant water source at all times.

Sufficient access licences must be held to account for all water taken from a groundwater or surface water source as a result of an aquifer interference activity, both for the life of the activity and after the activity has ceased. Many mining operations continue to take water from groundwater sources after operations have ceased. This take of water continues until an aquifer system reaches equilibrium and must be licensed.

The NSW AIP requires that potential impacts on groundwater sources, including their users and GDEs, be assessed against minimal impact considerations, outlined in Table 1 of the Policy. If the predicted impacts are less than the Level 1 minimal impact considerations, then these impacts will be considered as acceptable.

The level 1 minimal impact considerations for Less Productive Fractured and Porous and Fractured Rock Groundwater Sources have been adopted for this groundwater impact assessment and are as follows:

- Water table: less than or equal to 10% cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, at a distance of 40 m from any high priority groundwater dependent ecosystem or high priority culturally significant site listed in the schedule of the relevant WSP. A maximum of a 2 m water table decline cumulatively at any water supply work.
  - If more than 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any high priority groundwater dependent ecosystem; or high priority culturally significant site; listed in the schedule of the relevant water sharing plan then appropriate studies (including the hydrogeology, ecological condition and cultural function) will need to demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than 2 m decline cumulatively at any water supply work then make good provisions should apply.
- Water pressure: a cumulative pressure head decline of not more than a 2 m decline at any water supply work.
  - If the predicted pressure head decline is greater than the requirement above, then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline will not prevent the long-term viability of the affected water supply works unless make good provisions apply.
- Water quality: Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.
  - If any change in groundwater quality lowers the beneficial use category beyond 40 m of the activity then 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, significant site or affected water supply works.

3.2.2 NSW State Groundwater Policy

The objective of the NSW State Groundwater Policy Framework Document (NSW Government 1997) is to manage the State's groundwater resources so that they can sustain environmental, social and economic uses for the people of NSW. NSW groundwater policy has three component parts:

- NSW Groundwater Quantity Protection Policy.
- NSW Groundwater Quality Protection Policy.
- NSW Groundwater Dependent Ecosystems Policy.

NSW Groundwater Quantity Protection Policy

The principles of this policy include:

- Maintain total groundwater use within the sustainable yield of the aquifer from which it is withdrawn.
- Groundwater extraction shall be managed to prevent unacceptable local impacts.

All groundwater extraction for water supply is to be licensed. Transfers of licensed entitlements may be allowed depending on the physical constraints of the groundwater system.

NSW Groundwater Quality Protection Policy

The objective of this policy is the ecologically sustainable management of the State's groundwater resources so as to:

- Slow and halt, or reverse any degradation in groundwater resources.
- Direct potentially polluting activities to the most appropriate local geological setting so as to minimise the risk to groundwater.
- Establish a methodology for reviewing new developments with respect to their potential impact on water resources that will provide protection to the resource commensurate with both the threat that the development poses and the value of the resource.
- Establish triggers for the use of more advanced groundwater protection tools such as groundwater vulnerability maps or groundwater protection zones.

NSW Groundwater Dependent Ecosystems Policy

This policy was designed to protect ecosystems which rely on groundwater for survival so that, wherever possible, the ecological processes and biodiversity of these dependent ecosystems are maintained or restored for the benefit of present and future generations.

4. Site description

4.1 Location

The Quarry is located on land with frontage to the Tullymorgan-Jackybulbin Road, about 2 km west of its intersection with the Pacific Highway, Mororo NSW. The land on which Sly's Quarry is located is Lot 2 in DP 1055044. Slys Road is located along the eastern boundary of the site which forms the watershed. The quarry is operated by Newman Quarrying Pty Ltd.

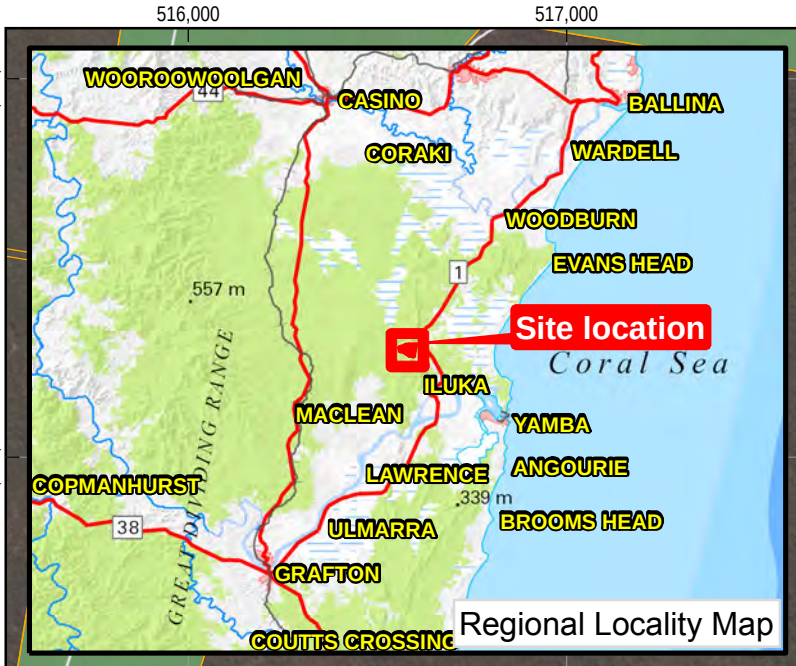
4.2 Climate

The region is considered to be sub-tropical with warm, wet summers and dry, mild winters.

Using the Evans Head RAAF Bombing Range Weather Station (BOM 058212) as a reference, mean summer temperatures range from a maximum of approximately 29°C and a minimum of approximately 20°C. Mean winter temperatures range from a maximum of approximately 20 °C and a minimum of approximately 10 °C. The mean annual rainfall is 1472mm, and Table 4-1 below lists typical rainfall data. Rainfall falls relatively evenly for the first four calendar months, with March having the highest mean monthly rainfall of 171 mm. Rainfall then eases during May to September (with exception of June) before slowly increasing again from October onwards. Evaporation at the site is estimated at 730mm per annum.

Table 4-1 Typical rainfall data (after BOM 058212)

Description	Rainfall (mm)
Average	1464.8
Typical dry rainfall year (2002)	903.8
Typical wet rainfall year (1999)	2080.2
Typical average rainfall year (2012)	1554.0



BUNDJALUNG NationalPark

SLYS ROAD

PACIFIC HIGHWAY

TULLYMORGAN-JACKYBULBIN ROAD

TABBIMOBLE CREEK

MCMAHONS TRAIL

MORORO STATE FOREST

GIBBERAGEE STATE FOREST

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

516,000 517,000 518,000 519,000 520,000 521,000

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LEGEND

- Subject site
- Lot 2 DP 1055044
- cadastre
- roads
- Waterways
- Waterbody
- Natural Parks
- State Forest

Paper Size A3

0 95 190 380 570 760

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Newman Quarrying
Sly's Quarry Environmental Impact Statement
Biodiversity Assessment

Job Number	22-17528
Revision	A
Date	18 Feb 2015

Site location

Figure 4-1

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Level 15, 133 Castlereagh Street Sydney NSW 2000 Australia T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com W www.ghd.com

Data Source: NSW Department of Lands: Cadastre - Jan 2014; Geoscience Australia: 250k Data - Jan 2014; NSW Department od Primary Industry - Jan 2014; ESRI image Jan 2014. Created by: qjchung

4.3 Topography

The natural topography of the site falls in a south westerly direction, and has been altered by the existing quarry activities. This site catchment is located within the southern foothills of Mount Doubleduke.

A ridgeline runs along the northern and eastern boundary of the site. The ridgeline starts at the northern end of the site at an elevation of about 100 m Australian Height Datum (AHD) and falls towards the southern extent of the site to about 42 m AHD. The existing quarry floor is relatively level at 44 m AHD.

A number of unnamed ephemeral tributaries drain around the site, being diverted around the works area, and discharge to Tabbimoble Creek. Tabbimoble Creek drains via the Bundjalung National Park marshes to the Clarence River near Iluka

In the centre of the site the existing quarry has altered the natural topography by excavating the rock from the southern slopes of Mount Doubleduke.

4.4 Geology and soils

The site area generally has poor soils of sandy composition mostly derived from the underlying sandstone. In lower-lying areas, soils may be derived from stream deposition. It is located in the southern end of the Clarence-Moreton Basin in northern NSW includes extensive deposits of quartzose sandstone. The sandstone exists in the Kangaroo Creek Formation and related geological structures. In the locality of the quarry, these sandstone deposits are generally well-exposed and quite accessible. They are easily worked to produce a principal product of medium- to coarse-grained siliceous sandstone that is used in a number of engineering applications, particularly road works.

The Kangaroo Creek sandstone is estimated to range in thickness from 150 m to 500 m. At the existing quarry face, the sandstone exists in a series of beds ranging in thickness from less than 1 m to up to 3 m (Newman, 2014). The site falls entirely within the Euroka soil landscape (Atkinson, 1999), which is characteristic of much of the low hills south of the Macleay River floodplain. Soils within the Euroka landscape are typically shallow (100cm) comprising of Red, Yellow and Brown Podzolic soils. The soils generally have low permeability and can be susceptible to water logging.

4.5 Surrounding land use

The quarry site is largely screened from view in every direction by its location, the topography and/or the forest cover. Maintenance of the roadside vegetative buffer mostly screens the quarry operation from view on the Tullymorgan-Jackybulbin Road.

The lower slopes of Lot 2 north of Tullymorgan-Jackybulbin Road have been extensively cleared of vegetation although there is a substantial treed buffer of dry schlerophyl forest along most of the road frontage. The clearing may have resulted from a long history of selective logging on the site and in the area. It is also associated with the sand extraction and quarrying activities approved for Lot 2 in the past (Newman, 2014).

The higher slopes of the quarry site retain extensive vegetation cover of open dry schlerophyl forest that includes dense under storey and many large native trees dominated by blackbutt, angophora and syncarpia species. Vegetation arising from a wetter microclimate lies along the lines of watercourses (Newman, 2014).

5. Project description

Plans of the existing and proposed expansion works are provided in Appendix A. The quarry operation would be carried out in stages and in response to demand. It is therefore difficult to predict exactly how the extraction would progress. In general, the extraction is proposed to move north and east initially, to the extent of the currently approved quarry. The eastern extent of the excavation would remain 10 m from the road reserve located along the eastern boundary. The excavation would be to the current floor level of 44 m AHD.

Stage 1 would cover an area of 6.9 hectares and extract approximately 2.3 million tonnes.

Stage 2 would involve expanding the quarry to the north and south and to a depth of 44 m AHD. This would expand the quarry by 5.7 hectares and involve the extraction of approximately 2.8 million tonnes of material. Stage 2 (south) would be exhausted prior to Stage 2 (north) being developed.

Stage 3 would be the final stage and would expand the quarry further north and south. Stage 3 would involve an expansion of 5.4 hectares to a depth of 44 m AHD. This would involve extracting approximately 1.8 million tonnes of material. Stage 3 (south) would be exhausted prior to Stage 3 (north) being developed.

The extraction of all stages would progress in 10 m by 10 m benches to a final depth of 44m AHD. Following extraction, the material would be crushed, screened and where necessary blended with other materials from the quarry, or material imported to the quarry. The materials would be stockpiled on the quarry floor in numbered stockpiles of approximately 4,000 tonnes each. Samples from each stockpile would be analysed for compliance with RMS specifications before being transported offsite. This process takes approximately 20 days.

The proposed sequence of operations for each stage would generally be:

- Establish the sediment and erosion control measures and other environmental safeguards.
- Clearing vegetation, if necessary. The bulk of cleared vegetative wastes would be piled in a suitable location, clear of adjacent vegetated areas and mulched for future revegetation works.
- Topsoil would be stripped, stockpiled and protected against erosion for use in revegetation works.
- Excavation of the weathered rock material, where possible. The deeper layers would be excavated in a similar manner but would also include blasting. Blasting is anticipated to be carried out at a frequency of between two blasts per month to one blast per year, depending on demand and the material encountered. The blasting would be undertaken by a specialist contractor in accordance with regulatory requirements.
- If the rock is too large, a rock hammering, where required to break large rocks into smaller pieces.
- The rock is collected by an excavator and feed into a jaw crusher. The crusher produces an output of various sizes of fill or aggregate which are separated by a screening machine into various piles based on size. Sand is also produced in this process. The crusher and screener are moved around the quarry floor as necessary to be close to the quarry face and accumulated, excavated stone.
- Loading of the material directly from the stockpile onto trucks for removal from site.

- The excavation continues, as described above, within each stage until it reaches the ultimate depth of 44m AHD. During the excavation, 10 m high by 10 m wide benches are established at the quarry face. At the top of each bench, a safety bund/wall is constructed to prevent people or machinery falling over the bench. The benches and quarry floor would be graded to the sediment basin located in the south-western end of the quarry area.
- Once the extraction is complete, topsoil would be respread on the disturbed areas and revegetated, where possible. The established erosion and water control measures would be maintained until the rehabilitated surface is adequately stabilised.

Other details relating to quarry operations include:

- If there is a special order for large boulders, for example for breakwater or river or sea wall repair or construction, these are set aside and transported as such.
- Occasionally, in order to comply with RMS specifications, materials won from the quarry would be blended with other materials won from the quarry, or with imported materials (eg, sand, clay), prior to being stockpiled on the floor of the quarry.
- Some sand is transported to the onsite wash plant for processing.

6. Surface water

6.1 Existing conditions

The site is located within the Clarence River catchment with unnamed ephemeral drainage lines flowing in a southwest direction to Tabbimoble Creek. Tabbimoble Creek drains via the Bundjalung National Park marshes to the Clarence River near Iluka. On Tabbimoble Creek, about 1 km to the east of the Pacific Highway, is the SEPP 14 Coastal Wetland No. 153a. The Woolgoolga to Ballina Pacific Highway Upgrade EIS (RMS, 2014) determined that the Tabbimoble Creek is key fish habitat with the potential for threatened species habitat, although it has not been mapped as such or found to contain Oxleyan Pygmy Perch.

The ephemeral drainage lines in the vicinity of the site are diverted around the works area and bypass the site water dams, discharging to Tabbimoble Creek under Tullymorgan-Jackybulbin Road.

Within the works area, the pit floor and stockpiled areas discharge to an initial sediment pond (approx.. 2.4 ML), this overflows to the main sediment basin (7m deep, appox.12.6 ML). The main sediment basin is the discharge point from the site. The site office, weighbridges, wash plant and other outbuildings along the site discharge to three smaller sediment basins (total approx. 0.55 ML). These basins discharge to the main sediment basin.

6.1.1 Water quality

Limited water quality information is available, however RMS (2014) notes that existing data indicates that the majority of the waterways in the area have a history of water quality problems, with conditions commonly found to be below the standards required for protection of aquatic ecosystems. The occurrence of poor water quality can be attributed to a number of factors, including modification of channel structure, macrophyte and weed growth, soil erosion, acid sulfate soils and nutrient enrichment as a result of runoff from agricultural land. Samples taken from Tabbimoble Creek in 2009 failed to meet the ANZECC guidelines for electrical conductivity and dissolved oxygen (RTA, 2010). Furthermore, Tabbimoble Creek was found to have high concentrations of aluminium, which could be a result of aluminium leaching from soils due to the effects of acid sulfate soils.

Some grab samples were collected as part of the EPL requirements of the existing quarry operation. The samples were collected from the main sediment basin before it exits the site and analysed at Environmental Analysis Laboratory, Southern Cross University. The results are presented in Table 6-1 along with the ANZECC (2000) guidelines for upland rivers and the preceding 48 hours of rainfall. This shows the water quality is fresh, with neutral pH and low to moderate suspended solids.

Table 6-1 Water quality results

Parameter	ANZECC	18/04/2013	20/06/2014	21/08/2014
48 hour rainfall (mm)*		2.2	4.4	4.6
pH	6.5-7.5	6.89	7.3	7.0
Total Suspended Solids (mg/L)	50**	28	14	18
Turbidity (NTU)	2-25			25
Electrical Conductivity (µS/m)	30-350			740
Oil & Grease	Not visible*			<2
Total Phosphorus (mg/L)	0.05	Not Tested	Not Tested	Not Tested
Total Nitrogen (mg/L)	0.50	Not Tested	Not Tested	Not Tested

* BOM New Italy Station 58097
http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=136&p_display_type=dailyDataFile&p_startYear=2013&p_c=-675071962&p_stn_num=058097

** EPA Requirements

6.2 Impact assessment

In order to assess the potential impacts on water quality and quantity discharging from the site due to the proposed works, a MUSIC stormwater model was developed to assess the pre-development and post-development conditions at the site. While this model is best used to manage stormwater from urban developments, it can be applied to assess runoff and Total Suspended Solids impacts associated with the proposal.

6.2.1 Modelling Parameters

MUSIC node parameters were adopted from the Draft NSW MUSIC Modelling Guidelines in order to best represent the surface types and conditions present on the site.

For the purpose of this assessment, parameters adopted are based on the site being rural in nature, with the majority of surfaces best described as unsealed road and eroding gullies. The parameters adopted are shown in the tables below.

Table 6-2 Adopted Music Node Parameters (Source Nodes > 10Ha)

Parameters	Value (Mean Annual Rainfall > 1000mm)
Impervious Area Parameters	
- Daily Rainfall Threshold Values (mm)	1.5
Pervious Area Parameters	
- Soil Storage Capacity (mm)	175
- Initial Storage (% of capacity)	30
- Field Capacity (mm)	55
- Infiltration Capacity Coefficient – a	215
- Infiltration Capacity Coefficient - b	2.4
Groundwater Properties	
- Initial Depth (mm)	10
- Daily Recharge Rate (%)	55
- Daily Base Flow Rate (%)	10
- Daily Deep Seepage Rate (%)	0

Table 6-3 Adopted Music Node Pollutant Parameters (mg/L –$\log_{10}$)

	TSS		TP		TN	
	Mean	**St. Dev**	**Mean**	**St. Dev**	**Mean**	**St. Dev**
Unsealed Roads & Disturbed Gullies						
Base Flow	1.20	0.17	-0.85	0.19	0.11	0.12
Storm Flow	3.00	0.32	-0.30	0.25	0.34	0.19
Forest/ Natural vegetation						
Base Flow	0.78	0.13	-1.52	0.13	-0.52	0.13
Storm Flow	1.60	0.20	-1.10	0.22	-0.05	0.24

6.2.2 Catchment characteristics

Under existing conditions surface runoff from a natural catchment area (17.36 Ha) upstream of site is diverted around the quarry area and discharges into the downstream receiving waterway, bypassing the existing large sediment basin on site.

The proposed works will expand the quarry footprint to include some of these upstream areas which will become part of the operating quarry footprint. These areas will then discharge to the the existing large sediment basin on site, instead of bypassing the basin. In order to mitigate the expected increase inflow from the proposed larger catchment under developed conditions, the existing large sediment basin is proposed to be expanded. The expansion would require doubling the existing basin volume in order to manage runoff volumes discharging from the site. Catchment characteristics are summarised below in Table 6-4.

To model the existing and proposed scenarios, both the existing and developed quarry footprints are assumed to have limited hardstand areas, however a portion of the quarry footprint is likely to be impervious exposed sandstone and therefore some impervious surfaces would be present within the quarry. The existing large sediment basin was included in the model for both scenarios, however in the proposed scenario the basin volume was doubled. The basin configuration details were based on findings from site inspections, details provided by existing quarry operators and the basin footprint area calculated from aerial imagery.

Table 6-4 Catchment Characteristics

	Existing Scenario	Developed Scenario
Catchment Area (Ha)	12.73 (+17.36 Ha undeveloped)	30.08
Impervious Area (%)	15	15
Basin footprint (m^2)	2,700	5,700
Estimated Basin Capacity (m^3)	12,590	25,000
Basin Depth (m)	7	7
Basin outlet (diam.)	N/A	N/A
Basin weir length (m)	20	20

6.2.3 MUSIC Modelling Results

The MUSIC model was simulated over a period of 10-years from 2000 to 2010 as per recommendations in the Draft NSW MUSIC Modelling Guidelines. Water quality and quantity results from the MUSIC modelling for the existing and proposed scenarios are shown below in Table 6-5. The results show that the increased runoff is effectively managed through the enlargement of the existing sediment basin. While the TSS is likely to increase slightly under post development conditions, the concentrations are well below the EPL criteria of 50mg/L.

TP and TN are simulated to exceed ANZECC guidelines for both pre- and post- development scenarios, however it is noted that water quality results for this area documented in the Woolgoolga to Ballina Pacific Highway Upgrade EIS indicate that the majority of the waterways tested (including Tabbimoble Creek) have a history of water quality problems, with conditions commonly found to be below the standards required for the protection of aquatic ecosystems. In addition, in considering the MUSIC model applicability to urban stormwater, it is argued that these values need to be treated with caution, when applied to a quarry operation. It is further noted that while the largest of the sediment basins has been modelled in MUSIC, other on-site treatment measures and management practices are likely to provide an additional level of control of site runoff above that considered in this MUSIC model assessment.

Table 6-5 MUSIC Modelling Results

	ANZECC	Discharge from Site	
		Pre-Development	Post-Development
Flow (ML/yr)		92	90
TSS Mean Concentration (mg/L)	50*	15.5	21.1
TP Mean Concentration (mg/L)	0.05	0.09	0.13
TN Mean Concentration (mg/L)	0.5	0.97	1.41

* EPA Requirements

6.2.4 Discussion

The proposed quarry expansion could potentially have the following impacts on surface water:

- The proposed works would alter the local topography at the site, which would affect the drainage of surface water. It is likely that surface water from beyond the proposed works area would be diverted around the works, which could lead to a concentration and discharge of flows rather than distributed discharges. The impact of this could be increased risk of erosion and sedimentation if not adequately managed.
- Day to day operations would require the handling of chemicals or hydrocarbons, and other contaminates. If management practices are not adequately implemented, then risk of accidental spillage with potential contamination of surface water could exist.
- The proposed operation would potentially expose a larger proportion of rock areas and other impervious areas compared with the existing site. This could lead to increased runoff volumes during rain events and larger runoff peaks during storm events.
- Surface water quantity has been assessed for the existing and developed scenarios. The proposed increase in sediment basin volume is expected to adequately manage the increased runoff from the expanded quarry footprint, resulting in marginally less flow being discharged from the site on an annual basis. The volume of water captured by the sediment basins is expected to be more than sufficient to meet the water demand of the site.
- Surface water quality has been assessed for both the existing and developed scenarios. The results indicate that the mean concentrations are unlikely to change substantially. The downstream sediment basin appears adequately to treat TSS runoff from the site for both the existing and developed cases, with the TSS discharge from the site remaining below the trigger values outlined in the current EPL for the site.
- TP and TN mean concentrations appear to exceed the ANZECC trigger values under both the existing and developed cases., however it is noted that water quality results for this area documented in the Woolgoolga to Ballina Pacific Highway Upgrade EIS indicate that the majority of the waterways tested (including Tabbimoble Creek) have a history of water quality problems, with conditions commonly found to be below the standards required for the protection of aquatic ecosystems. In addition, in considering the MUSIC model applicability to urban stormwater, it is argued that these values need to be treated with caution, when applied to a quarry operation. It is further noted that while the largest of the sediment basins has been modelled in MUSIC, other on-site treatment measures and management practices are likely to provide an additional level of control of site runoff above that considered in this MUSIC model assessment.

6.3 Management measures

6.3.1 General

- An environmental protection licence will be obtained for the quarry. All relevant conditions relating to soil and water management will be implemented as required by the licence.
- An Environmental Management Plan will be compiled for the works which will contain a Soil and Erosion Management Plan. Training will be provided to all quarry staff including relevant sub-contractors on erosion and sediment control practices and the requirements of the Plans through inductions, toolboxes and targeted training.

- If any works encroach within the riparian zone of the unnamed ephemeral drainage line (in accordance with the Water Management Act 2000) consideration of a controlled activity approval would be required.
- Where available, and of appropriate quality, the quarry operation will use recycled runoff for quarry activities. A site water balance has been undertaken, with estimates of operational water requirements (amenities, road/site dust control and crushers) provided in Table 6-6. The extraction rates are based on an annual extraction of 500,000 t/year achieved under maximum production and average production over a full year. The latter requiring significantly more water for dust control over a longer time frame.

  The results in Table 6-6 show that sufficient runoff would be generated from the quarry operational area to meet operational water requirements. In addition, surplus water captured in the settling basin on site will need to be discharged to remove excess runoff.

Table 6-6 Quarry operational site water balance

Extraction Rate	Runoff from proposed quarry operational area	Water Demand
4000 t/day (maximum production i.e. 125 days operation)	159 ML/year (average year) 30.2 ML/year (dry year)	4.05 ML/year
1500 t/day (production over a full year)	330 ML/year (wet year)	6.81 ML/year

6.3.2 Erosion and sedimentation control

Erosion and sediment controls are to be implemented in accordance with *Managing Urban Stormwater Soils and Construction – Volume 2e Mines and quarries* (DECC, 2008) and include, as a minimum:

- Quarry activities will be programed to minimise the extent and duration of disturbance to vegetation. This will include leaving clearing and initial earthworks in future quarrying areas, until extraction is about to commence.
- Catchment and construction/operational areas runoff will be separated to avoid contamination. This will be achieved by diverting catchment runoff drains around the operational area. The operational exposed areas will be minimised and all operational runoff will be treated before discharge from site.
- Runoff from construction/operational areas will be collected and treated in a similar manner as per the current operation. For the future works area the main sediment and other basins provide sufficient storage. Runoff collected in the basin will be used for onsite purposes (dust suppression and operational water) in the first instance. Any additional water will be pumped and discharged to the unnamed ephemeral drainage line after appropriate treatment.
- Catch drains, contour and diversion drains across exposed areas will be installed, immediately following clearing, and maintained until the site is stabilised. Key areas of flow concentration will be provided with rock protection to prevent erosion.
- The active work areas and access roads will be stabilised and maintained. Runoff from these areas will be directed to drains that lead to buffer strips. Loose rock, soil, debris etc. will be removed from road surfaces (including sweeping of the road), when required.

- Long term soil stockpiles e.g. those not accessed for greater than 30 days, access tracks, disturbed areas will be protected from erosion by the implementation of appropriate measures including, but not limited to:
  - Seeding with cover crops.
  - Covering with tarp or similar.
- Hardstand material, rumble grids or similar will be provided at exit points to minimise the tracking of soil and particulates by vehicles.
- Disturbed areas where work has been completed will be rehabilitated, as soon as possible.

6.3.3 Basins, drainage lines and flooding

- The volume of the existing sediment basin would need to be doubled.
- Drainage lines will be stabilised against erosion by appropriate selection of channel dimensions, slope and lining, and the inclusion of drop structures and energy dissipaters, as necessary. Drainage lines will incorporate check dams or native vegetation to act as a sediment control.
- The works areas may require bunding at a number of locations around the perimeter of the works area, to prevent overflow from the adjacent unnamed ephemeral drainage line during severe rainfall events.

6.3.4 Material storage and management

- Designated impervious bunded facilities will be provided for cleaning and/or maintenance of vehicles, plant or equipment. These facilities will be located at least 20 metres away from natural and built drainage lines.
- All chemicals and fuels associated with the quarry will be stored in roofed and bunded areas. Spill kits will be provided at all chemical storage facilities/compound sites.
- Where refuelling on site is required, the following management practices will be implemented:
  - Refuelling will be undertaken on level ground and at least 20 metres from drainage lines, waterways and/or environmentally sensitive areas
  - Refuelling will be undertaken within the designated refuelling areas with appropriate bunding and/or absorbent material
  - Refuelling will be via a designated refuelling truck
  - Will be attended at all times
  - Spill kits will be readily available and personnel trained in their use. A spill kit will be kept on the refuelling truck at all times
  - Hand tools will be refuelled within lined trays of site vehicles wherever possible
  - An emergency spill kit (such as oil absorbent material) will be available on site at all times to contain and clean up any accidental hydrocarbon spill
  - Any contaminated material will be disposed at an appropriately licensed facility and used spill kit materials replaced
- Regular checks of vehicles working at the quarry will be conducted to ensure that no oils or fuels are leaking.

6.3.5 Monitoring

- Erosion and sediment controls will be inspected at least weekly (with maintenance and/or modifications made as necessary). Inspections and/or maintenance during wet-weather may be increased where necessary. All sediment basin discharge points will be clearly identified and access made available at all times for inspections or management. A typical monitoring program is provided in Table 6-7.

Table 6-7 Typical monitoring program

Aspect	Frequency	Details	Responsibility
Erosion and sediment controls	Following rain	Erosion and sediment controls are to be monitored following rain events and maintained, as required.	Site Manager
Sediment basin	Following rain	The volume of water in the sediment basin is to be monitored following rain.	Site Manager
Basin capacity	Following rain	The volume of sediment is to be monitored (e.g. via a permanent stake in the dam with a mark showing depth of sediment) and removed to maintain an 80% capacity.	Site Manager
Spill kit	Monthly	The spill kit is to be checked and any missing materials to be replaced.	Site Manager

7. Groundwater

7.1 Existing conditions

The primary aquifers in the vicinity of the site are the Quaternary alluvial / colluvial groundwater source and the porous and fractured rock groundwater source.

7.1.1 Alluvial water groundwater sources

The alluvial / colluvial groundwater source in the site forms a shallow unconfined aquifer with reported thickness up to 17 metres to the east of the site, as shown in Figure 7-1.

Bores located to the east of the site within the alluvial groundwater source indicate that depth to groundwater is in the order of 2 m below ground level (bgl). Based on a review of topographic data, natural surface levels in the vicinity of these bores is approximately 25 m AHD indicating that groundwater elevation in the alluvial aquifer is approximately 23 m AHD. These bores are located down gradient of the site and therefore alluvial / colluvial groundwater would be anticipated to be slightly higher in the vicinity of the site.

7.1.2 Porous and fractured rock groundwater sources

Porous and fractured rock aquifer underlies the alluvial /colluvial aquifer and outcrops across the site.

Based on the results of the search of the NSW Bore Database, water bearing zones of bores within the porous and fractured rock aquifer to the east of the site are typically in the order of 25 mbgl. Based on a review of topographic data, natural surface levels in the vicinity of these bores is approximately 25 m AHD.

Groundwater levels would be expected to be approximately 0 m AHD near the coast. Regional groundwater flows are anticipated to be towards the coast. Therefore, based on the available information regarding groundwater levels and flow direction, groundwater levels in the porous and fractured groundwater source in the vicinity of the site are expected to be slightly greater than 0 m AHD.

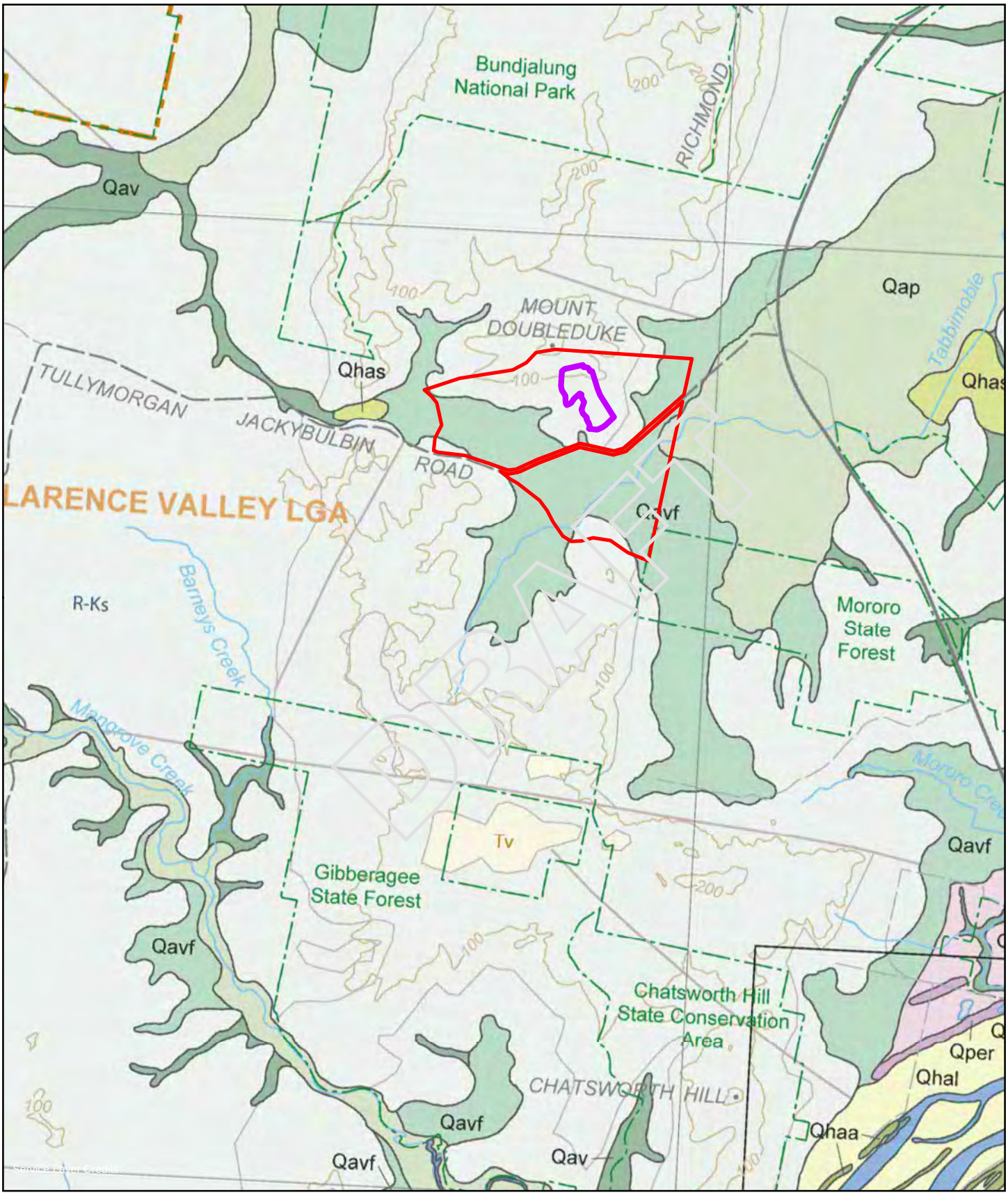
The level of extraction in the existing quarry pit has reached a level of 44 m AHD and the quarry has reportedly remained free from groundwater inflows. This indicates that the water table is below a level of 44 m AHD.

7.1.3 Aquifer connectivity

The Richmond River Area Unregulated, Regulated and Alluvial Water Sources WSP – *Background Document* (NOW, 2010) states that there is a significant connection between surface water and alluvial groundwater and that there is a low to moderate connection between surface flows and porous and fractured groundwater. The estimated travel time between surface water to alluvial groundwater is days to months while the estimated travel time between surface water and groundwater in the fractured and porous aquifer is years to decades (NOW, 2010). This indicates that there is a low connection between alluvial groundwater and the fractured and porous rock aquifer.

7.1.4 Existing groundwater monitoring

Groundwater quality monitoring has been undertaken from two groundwater monitoring bores which are located south west of the existing sediment basin. It is assumed that these bores are screening the alluvial groundwater source associated with the adjacent ephemeral drainage line. The location of these bores is shown in Figure 7-2.



LEGEND

- Subject site
- Study Area

Paper Size A4

0 200 400 800 1,200 1,600

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Newman Quarrying

Sly's Quarry Environmental Impact Statement
Biodiversity Assessment

Quaternary Geological Mapping

Job Number	22-17528
Revision	A
Date	02 Apr 2015

Figure 7-1

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

N:\AU\Coffs Harbour\Projects\22\17528\GIS\Maps\Deliverables\22_17528_Z012_Quaternary_Mapping.mxd

Data source: LDP:DTDB, 2012. NSW Geological Survey: Geological Mapping, 2008. ESRI: Aerial Imagery, 2014. Newman: Study Area. Created by: smacdonald

A summary of groundwater monitoring results is shown in Table 7-1. The results suggest the groundwater has a neutral pH and is relatively fresh.

Table 7-1 Groundwater monitoring results

Date	pH	EC (µS/cm)
8/10/2014	7.4	591

7.1.5 NSW Bore Database Search

A search of the NSW Groundwater Bore Database was undertaken to identify registered bores within a 5 km radius of the site. The search identified six bores, with three bores being registered as domestic stock or stock, two bores registered as monitoring bores and one bore registered for oil exploration. Approximate bore locations are shown in Figure 7-3 and bore details are shown in Table 7-2.

Two of the bores registered as domestic stock or stock were located to the south east of the site with the third being located to the west. Of these bores, all extracted groundwater from the porous and fractured rock aquifer and all had yields less than 1 L/s.

The monitoring and exploration bores were located to the east of the site in the vicinity of the Pacific Highway. None of these bores had yields reported.

Overall, the search of the NSW Groundwater Bore Database indicated that there is limited groundwater reliance and usage of the porous and fractured rock aquifer for domestic and stock purposes in the vicinity of the site. Based on the low yields reported, the porous and fractured rock aquifer is considered to be a less productive groundwater source under the NSW AIP.

Table 7-2 Results of NSW Bore Database Search

Name	Licence No.	Use	Depth (m)	WBZ	SWL	Salinity	Yield (L/s)	Aquifer
GW306470	30BL185061	Monitoring Bore	23.3	2.1-16				Clayey Sand, Sand
GW053996		Oil Exploration	358.7	28-31, 44-46, 50-52, 103-106, 137, 150, 174, 334				Sandstone, Light Grey Shale, Silty Sandstone, Light Grey Sandstone, Siltstone, Lithic
GW306469	30BL185061	Monitoring Bore	14.87	1.25-6.50	2			Sand, Silty Sand
GW016816	30BL007221	Stock	26.5	25.3	15.2	Sweet	0.32	Soft Rock
GW306232	30BL184382	Domestic Stock	79	34-38, 72-77	18	1745, 1520	0.25, 0.76	Fractured Sandstone
GW065285	30BL138302	Domestic Stock	47	5-25, 41-44	16		0.1, 0.4	Soft Sandstone

LEGEND

- Lot 2 DP 1055044
- Road
- Lot
- Groundwater Wells
- Stockpiles
- Sediment ponds
- Waterways
- Open Drain

Paper Size A3

0 25 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Newman Quarrying
Sly's Quarry Environmental Impact Statement

Job Number 22-17528
Revision A
Date 18 Feb 2015

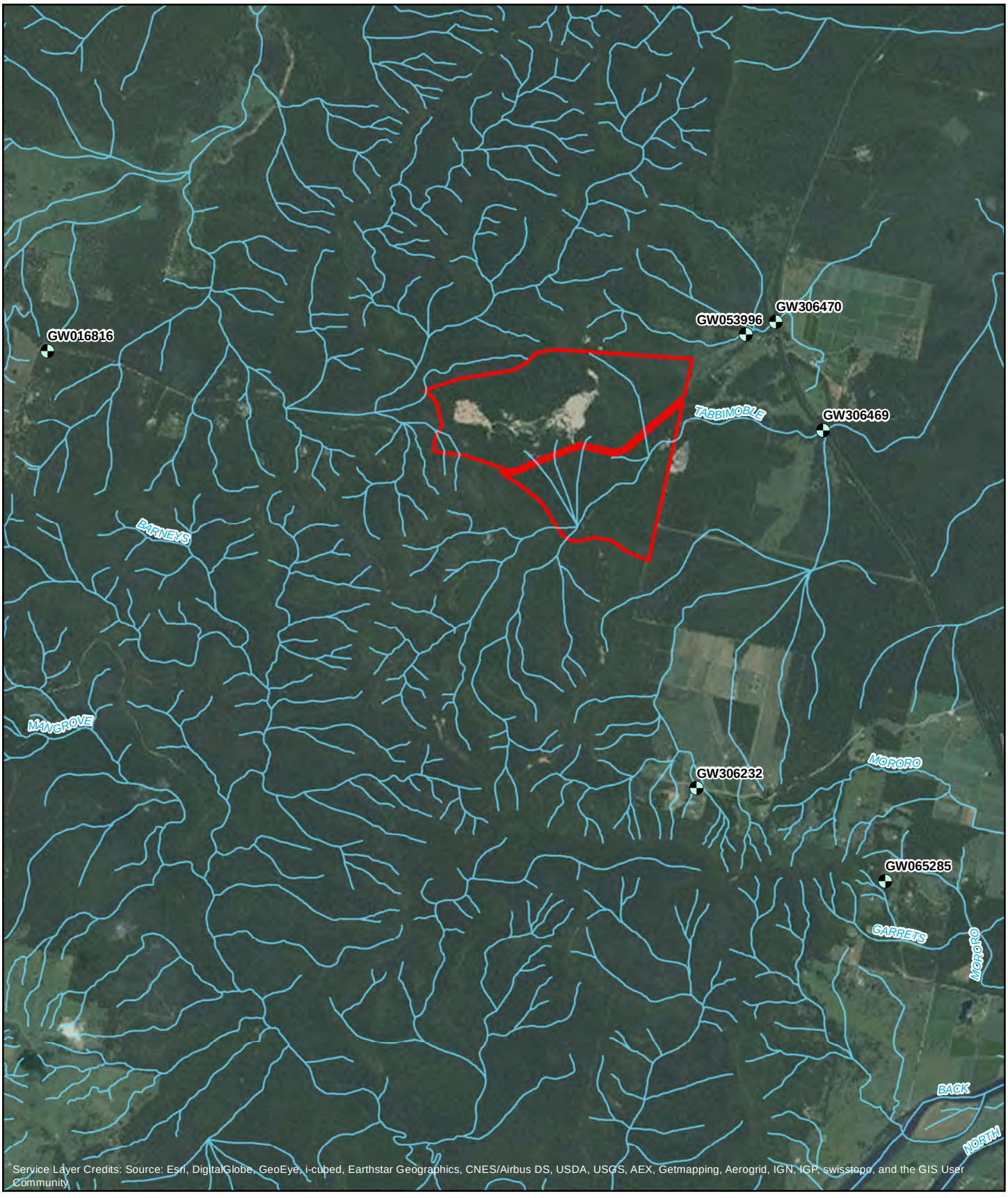
Figure 7-2

Groundwater Monitoring Locations

N:\AU\Coffs Harbour\Projects\22\17528\GIS\Maps\Deliverables\22_17528_Z007_Lot2_Quarry_Area.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 Australia **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com **W** www.ghd.com

Data Source: NSW Department of Lands: Cadastre - Jan 2014; Geoscience Australia: 250k Data - Jan 2014; NSW Department od Primary Industry - Jan 2014; ESRI imagery Jan 2014. Created by: qjchung



LEGEND

- Groundwater Bore
- HydroLine_LPI_DTDB_2012
- Study Area

Paper Size A4

0 200 400 800 1,200 1,600

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Newman Quarrying

Sly's Quarry Environmental Impact Statement
Biodiversity Assessment

Job Number	XX-12345
Revision	A
Date	27 Nov 2014

Groundwater Bore Database Search **Figure 7-3**

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

N:\AU\Coffs Harbour\Projects\22\17528\GIS\Maps\Deliverables\22_17528_Z003_Groundwater_Bore_Search.mxd

Data source: LDP:DTDB, 2012. NSW Department of Natural Resources: Groundwater Bore, 2014. ESRI: Aerial Imagery, 2014. Newman: Study Area. Created by: smacdonald

7.1.6 Groundwater dependant ecosystems

The potential vegetation GDEs within the vicinity of the site have been mapped in the Groundwater Dependant Ecosystem Atlas (BOM, 2014). Potential GDEs in the vicinity of the site include vegetation communities including:

- Northern Open Grassy Blackbutt
- Coastal Range Bloodwood-Mahagony
- Paperbark
- Narrowleaved White Mahogany - Red Mahogany - Grey Ironbark - Grey Gum
- Needlebark Stringybark
- Foothill Grey Gum-Ironbark-Spotted Gum
- Swamp Oak
- Grey Gum - Grey Ironbark - White Mahogany
- Blackbutt - Spotted Gum
- Blackbutt - Bloodwood / Apple
- Scribbly Gum – Bloodwood
- Lowlands Scribbly Gum
- Stringybark – Bloodwood
- Clarence Lowlands Spotted Gum
- Lowland Red Gum winter flowering

7.2 Potential groundwater impacts

The proposed quarry will extract to a level of 44 m AHD. As outlined in Section 7.1.2 groundwater is expected to remain below this level. The project is not anticipated to intercept groundwater. A cross section of the quarry and the predicted water table is shown in Figure 7-4.

The review of geological mapping indicates that the proposed extraction footprint does not extend to the alluvial sediments. The extraction footprint will come within approximately 60 metres of areas mapped as alluvial sediments to the south and south west. Assuming the proposed extraction does not enter alluvial sediments; it is predicted that the proposed extraction will have no impact on alluvial groundwater.

As alluvial groundwater is embargoed under the Water Act 1912 and the WM Act it is recommended that, in order to ascertain the potential presence of groundwater, a shallow standpipe monitoring bore be drilled to the south west of the proposed extraction footprint. It is recommended that the monitoring bore be drilled down to the sandstone bedrock.

There will be no change to access routes, buildings or facilities as part of the project. Therefore it is assumed that there will be minimal impact on recharge due to any change in impervious area. There may be a slight increase in recharge in the fractured and porous aquifer due to removal of overlying rock strata.

As the project is not anticipated to intercept groundwater, the project will not require any groundwater licences under the *Water Act 1912.*

The project is not anticipated to intercept groundwater and therefore it is expected that the quarry will not intercept contaminated groundwater.

7.3 Management measures

7.3.1 Groundwater monitoring

As outlined in Section 7.2 it is recommended that a monitoring bore be constructed in the mapped alluvial aquifer to the south west of the proposed quarry footprint, in a similar location as the existing monitoring wells.

All new monitoring bores are to be constructed in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (NUDLC, 2011).

New and existing monitoring bores should be monitored quarterly throughout the life of the project for groundwater level, pH and EC. All new and existing monitoring bores require licencing under Part 5 of the *Water Act 1912.* It is recommended that existing monitoring bores are capped to attempt to prevent the ingress of rainfall.

As specified in DIPNR (2003), groundwater monitoring should be undertaken in general accordance with '*A Practical Guide for Groundwater Sampling'* (Jiwan & Gates, 1992). Low flow sampling techniques will be used where practical for purging and sampling of bores (rather than using bailers or submersible pumps) to minimise aquifer disturbance and reduce the volume of groundwater extracted during sampling.

In general, the groundwater monitoring methodology is as follows:

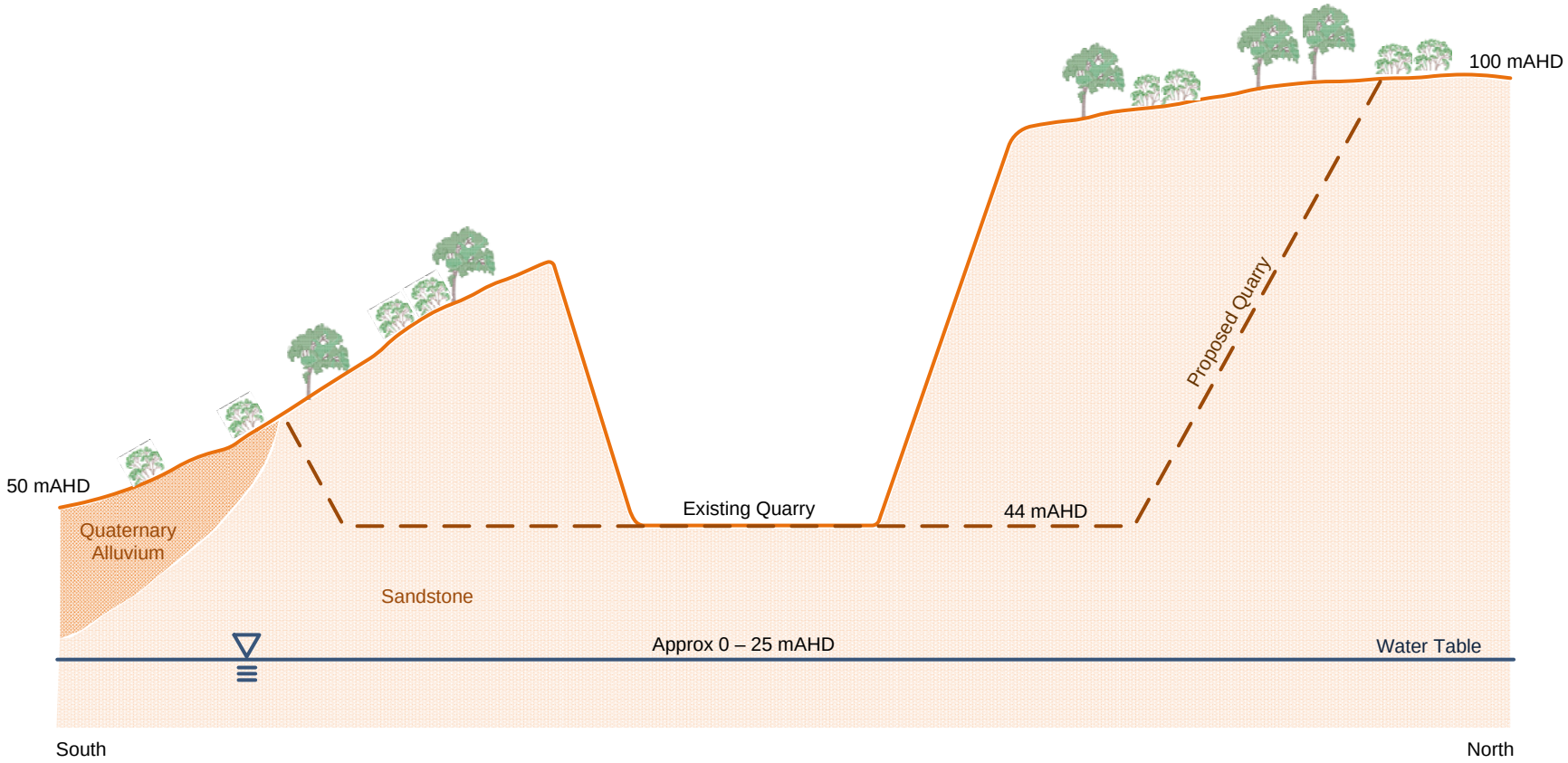
- Gauging of groundwater levels prior to purging.
- Purging of monitoring bores using a low flow peristaltic pump or Micropurge system. To limit the disturbance of possible sediments in the base of each bore, the sample tubing at each bore should be lowered to approximately the middle of the screened interval for purging and sample collection.
- Measurement of groundwater field parameters (pH, EC) using a calibrated water quality meter and a flow cell during purging. pH and EC readings should be recorded in the field once they have stabilised.
- Decontamination of all non-dedicated sampling equipment between monitoring locations.

If a bore is too deep and low flow sampling cannot be undertaken with available pumping equipment, bailing is acceptable for sample collection provided that there is sufficient removal of stagnant water in the bore prior to sampling so that the sample is representative of the aquifer.

If an unexpected change in groundwater level or quality is recorded, that is outside natural variability, then an investigation should be undertaken to determine if the change in level or quality is due to the quarry operations.

7.3.2 Storage of fuels

All fuels stored on site must be appropriately stored. Storage of fuels will require bunding around storage containers and any locations where refuelling occurs.



LOCATION	Sly's Quarry
DRAWN	SM
CHECKED	IG
APPROVED	BL
SCALE	NTS

Quarry Cross Section

NEWMAN QUARRYING PTY LTD

DATE Nov 2014

Figure 7-4

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8. Summary and conclusion

- GHD has been engaged by Newman Quarrying to undertake a surface and groundwater assessment for the proposed sandstone quarry expansion at Tullymorgan-Jackybulbin Road, Mororo, NSW, known as Sly's Quarry. The proposal is to expand the existing sandstone quarry by 18.3 hectares and increase the extraction rate up to 500,000 tonnes per annum.
- The site is located within the Clarence River catchment with unnamed ephemeral drainage lines flowing in a southwest direction to Tabbimoble Creek around the site. Tabbimoble Creek drains via the Bundjalung National Park marshes to the Clarence River near Iluka.
- The ephemeral drainage lines are diverted around the works area and bypass the site water dams, discharging to Tabbimoble creek under Tullymorgan Jackybulbin Road. Within the works area, the pit floor and stockpiled areas discharge to an initial sediment pond, this overflows to the main sediment basin. The main sediment basin is the discharge point from the site. The site office, weighbridges, wash plant and other outbuildings along the site discharge to 3 smaller sediment basins. These basins discharge to the main sediment basin.
- Information from nearby bores and a borehole on site suggest the groundwater level is below the final extraction depth of the quarry and the rock has a relatively low permeability.
- The proposed quarry expansion could potentially have the following key impacts on surface water:
  - Altering the local topography at the site, which could increase the risk of erosion and sedimentation if not adequately managed.
  - Surface water discharging from the works areas could entrain sediment from disturbed areas resulting in decreased water quality entering waterways. The sediment could include dust generated from the operations and sediment tracked by vehicular movements on the site.
  - The proposed operation would potentially expose a larger proportion of rock areas and other impervious areas compared with the existing site leading to increased runoff volumes during rain events and larger runoff peaks during storm events.
  - The unnamed ephemeral drainage line could experience elevated water levels during severe storm events. If these are not managed adequately, flood waters could ingress into the works areas.
  - Day to day operations would require the handling of chemicals or hydrocarbons, and other contaminates. If management practices are not adequately implemented, then risk of accidental spillage with potential contamination of surface water could exist.
- The quarry is not expected to intercept the groundwater aquifer and is unlikely to affect sensitive receptors or water quality.
- A number of management measures will be implemented to avoid potential impacts associated with the proposed quarry expansion. These will include amongst others:
  - Compiling and operating under an Environmental Management Plan with associated Soil and Erosion Management Plan and training all quarry staff. If any works encroach the riparian zone of the unnamed ephemeral drainage line (in accordance with the Water Management Act 2000) a controlled activity approval would be required.

- Doubling the sediment basin volume to manage surface water discharges from the site.
- Using recycled runoff for dust suppression and operational water. The site water balance has shown that there is sufficient runoff to meet demand, with any surplus water disposed offsite, after treatment.
- Quarry activities will be programed to minimise the extent and duration of disturbance, and catchment and construction/operational areas runoff will be separated to avoid contamination. Runoff from construction/operational areas will be collected and treated in the main sediment basin.
- Bunding at a number of locations around the perimeter of the works area, to prevent overflow from the adjacent unnamed ephemeral drainage line.
- Designated impervious bunded facilities will be provided for cleaning and/or maintenance of vehicles, plant or equipment and all chemicals and fuels associated with construction will be stored in roofed and bunded areas.
- Regular monitoring of erosion and sediment controls to ensure that management facilities are operating in accordance with specifications.

- It is recommended that a monitoring bore be constructed in a similar location to the existing monitoring well in accordance with the *Minimum Construction Requirements for Water Bores in Australia* and regularly monitored.

On the basis of implementing the management measures, it is considered that any impacts to surface water and groundwater from the proposed quarry extension, would be adequately mitigated.

9. References

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Appendices

Appendix A – Quarry Plans

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date

GHD
Level 8, 180 Lonsdale Street, Melbourne VIC 3000 Australia
T 61 3 8687 8000 F 61 3 8687 8111
E melmail@ghd.com.au W www.ghd.com

DO NOT SCALE

Drawn	S. Verhellen	Designer	
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client	Newman Quarrying
Project	Slys Quarry
Title	Proposed Quarry Expansion
Original Size	A1
Drawing No:	22-17528-001
Rev:	

GHD

230 Harbour Drive
Coffs Harbour NSW 2450
T: (02) 6650 5600 F: (02) 6650 5601 E: cfsmail@ghd.com

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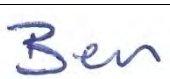
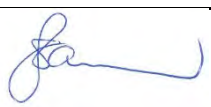
Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	R Berg – Surface Water I Gilmore - Groundwater	Ben Luffman		S Lawer		March 15
1	S Douglas/R Berg	Ben Luffman		S Lawer		01/05/2015

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