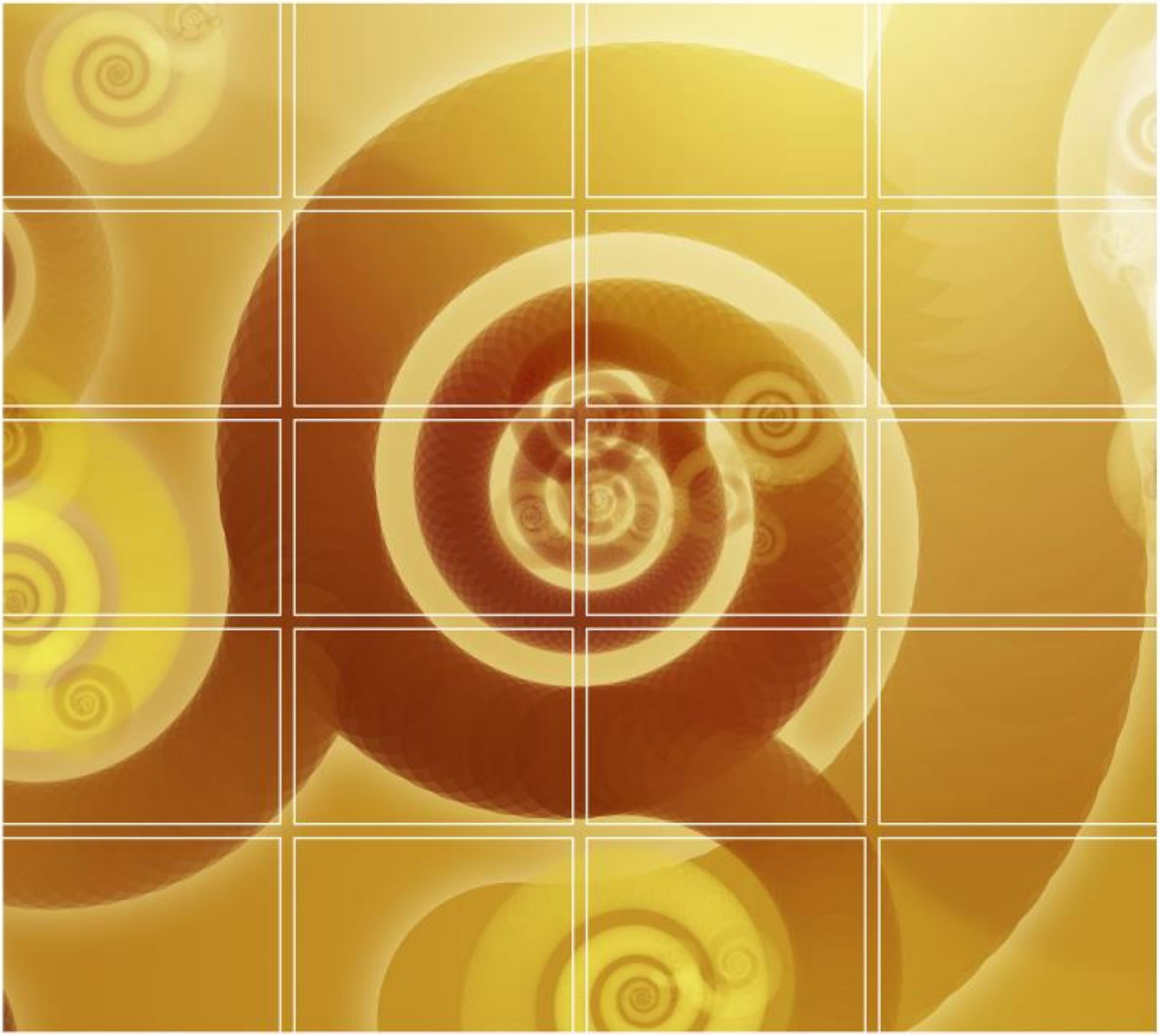
Annex E

Hydrology Assessment



Sancrox Quarry Expansion
Hydrology Assessment

Hanson Construction Materials Pty Ltd

August 2019

0418291_Final

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ERM

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Environmental Resources Management Australia Pty Ltd

Sancrox Quarry Expansion

Hydrology Assessment

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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.

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		Sancrox Quarry Expansion Project Hydrology Assessment Report
Date:	19/07/2018	Drawing Size: A4	
Drawn By:	VN / LT	Reviewed By: ME	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

Ancillary Infrastructure F 1.2

Drawing No: 0418291s_HRA_G002_R3.mxd
Date: 30/09/2019 Drawing Size: A4
Drawn By: GC Reviewed By: ME
Coordinate System: GDA 1994 MGA Zone 56

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

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.

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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 27.7ºC. The coolest month is July with a mean daily minimum temperature of 6.4ºC.

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 km^2 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*

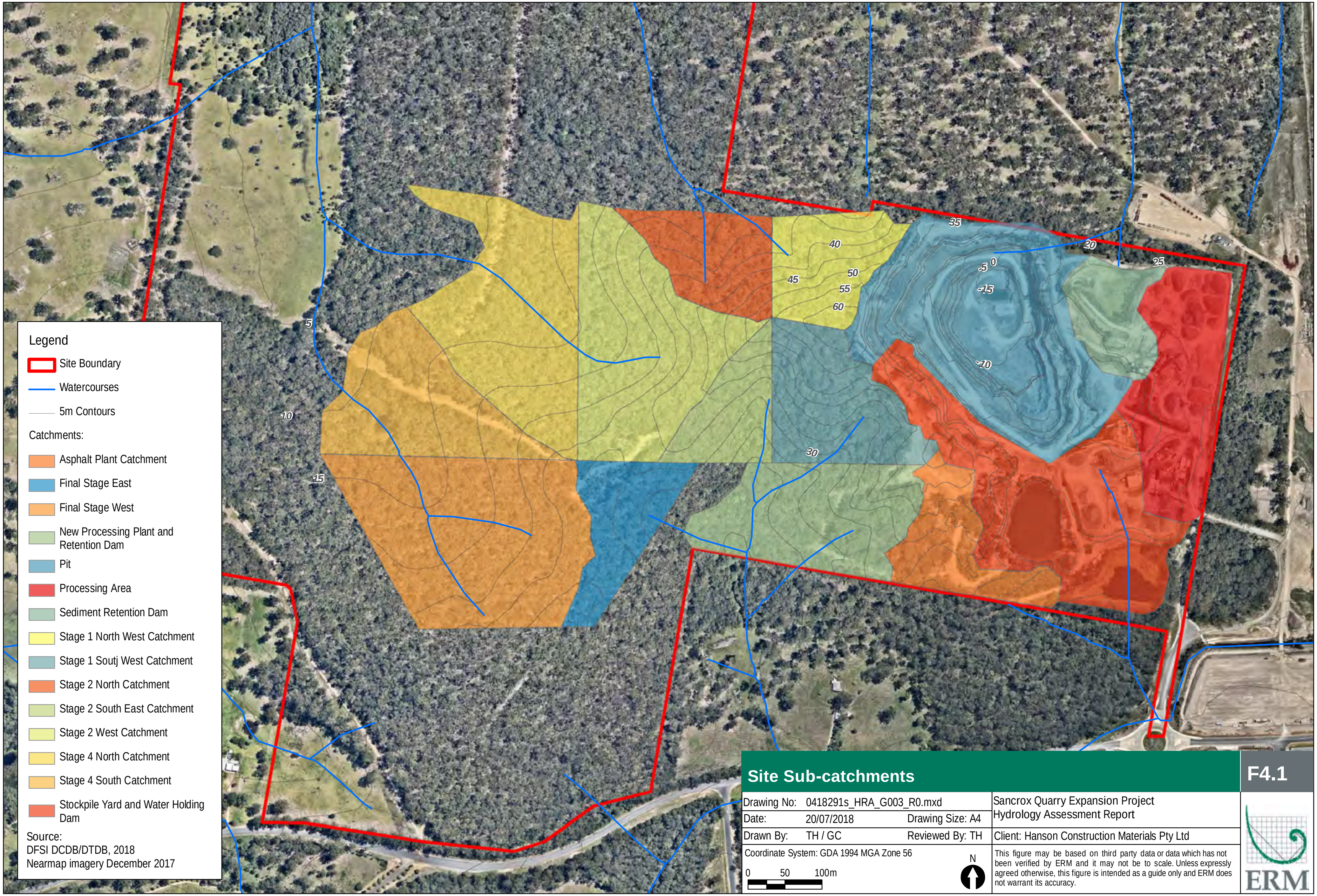
Table 4.1 Site Stormwater Sub-catchments

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.


Legend
Site Boundary
Watercourses
5m Contours
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
Site Sub-catchments
F4.1
Drawing No: 0418291s_HRA_G003_R0.mxd
Date: 20/07/2018
Drawing Size: A4
Drawn By: TH / GC
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Sancrox Quarry Expansion Project
Hydrology Assessment Report
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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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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.

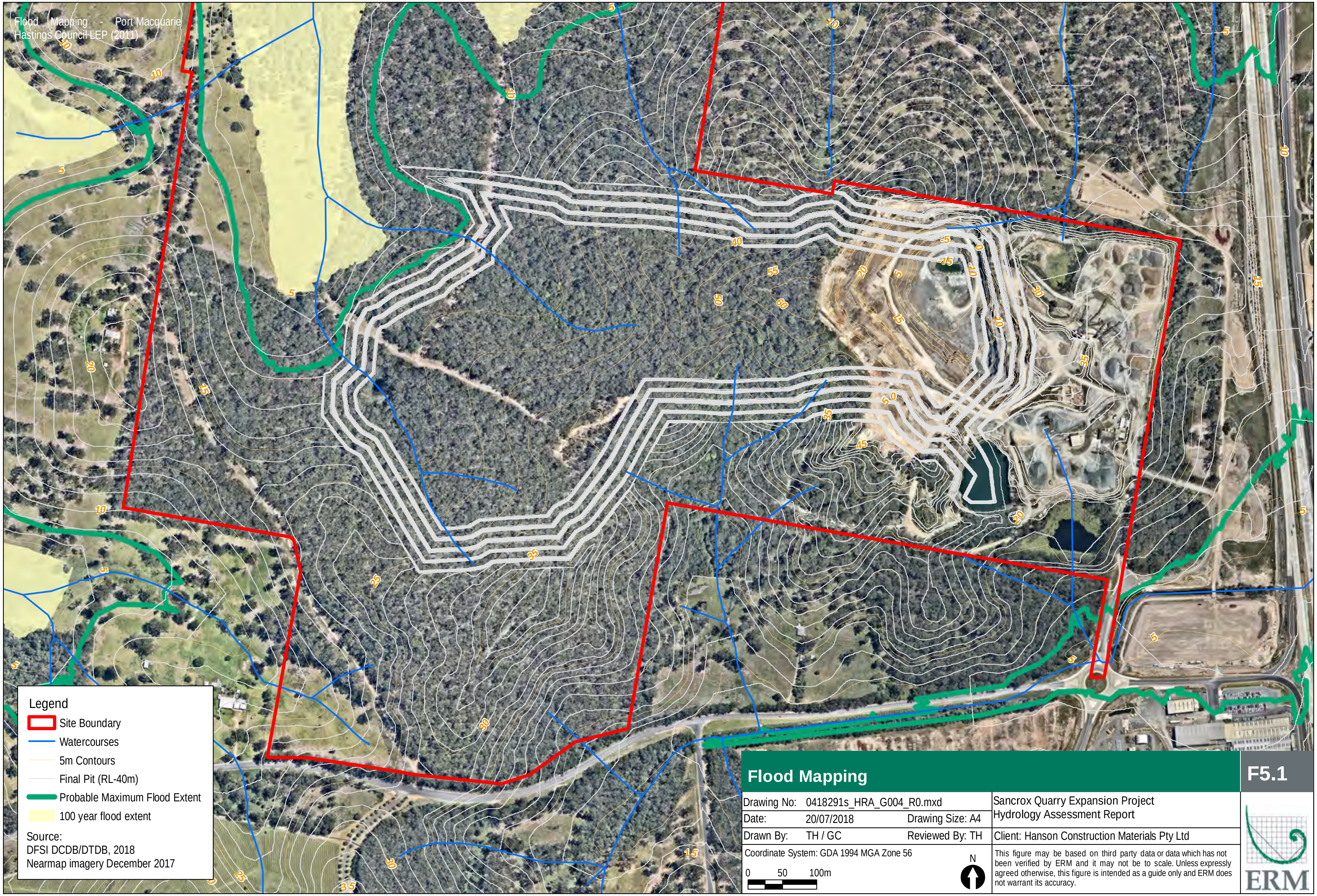
5.2 FLOODING POTENTIAL

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 - Port Macquarie Hastings Council LEP (2011)
Legend
Site Boundary
Watercourses
5m Contours
Final Pit (RL-40m)
Probable Maximum Flood Extent
100 year flood extent
Source:
DFSI DCDB/DTDB, 2018
Nearmap imagery December 2017
Flood Mapping
F5.1
Drawing No: 0418291s_HRA_G004_R0.mxd
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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.

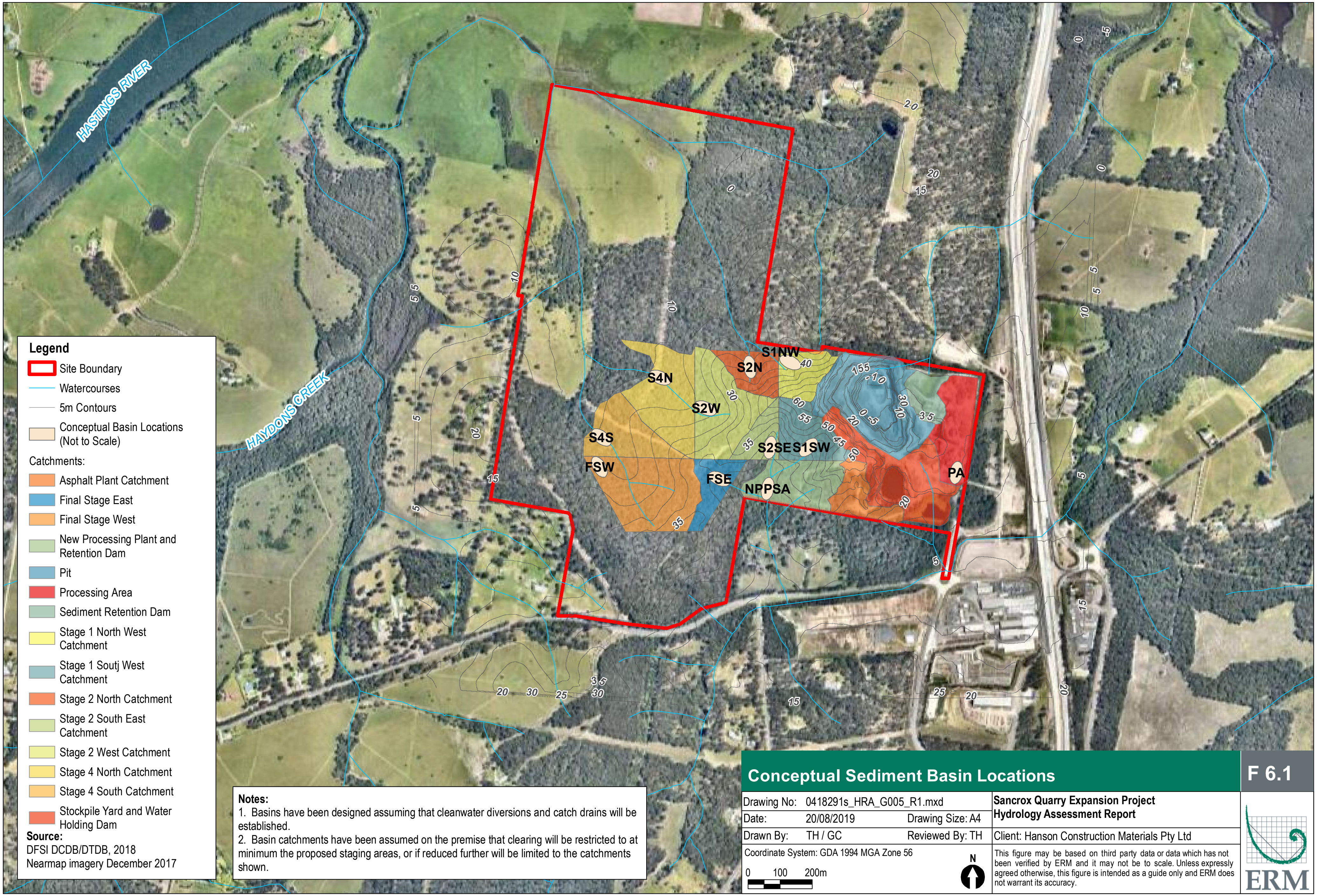
Where rainfall events exceed the design storm, basins will overflow via the designed spillways. DECC (2008) outlines that a basin designed to the 80th percentile storm event typically will overflow at a frequency of six to eight times per year.

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*.



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		**Sancrox Quarry Expansion Project Hydrology Assessment Report**
Date: 20/08/2019	Drawing Size: A4	
Drawn By: TH / GC	Reviewed By: TH	Client: Hanson Construction Materials Pty Ltd
Coordinate System: GDA 1994 MGA Zone 56	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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Table 6.1 Conceptual Basin Sizing

Basin Catchment	Basin Name	Total Catchment Area (ha)	Sediment Storage zone (m³)	Settling Zone Volume (m³)	Total Basin Volume (m³)	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 m³. No new basin required.
Stockpile Yard and WHD	SYWH	6.22	674	1247	1921	Current volume of two dams is approximately 14,051 m³
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 m³, well in excess of the 1,921 m³ 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)

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	RUSLE LS factor calculated for a high rill/interrill ratio.
Slope length (m)	80	80	80		80	80	
Slope gradient (%)	6	7	9		13	10	
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

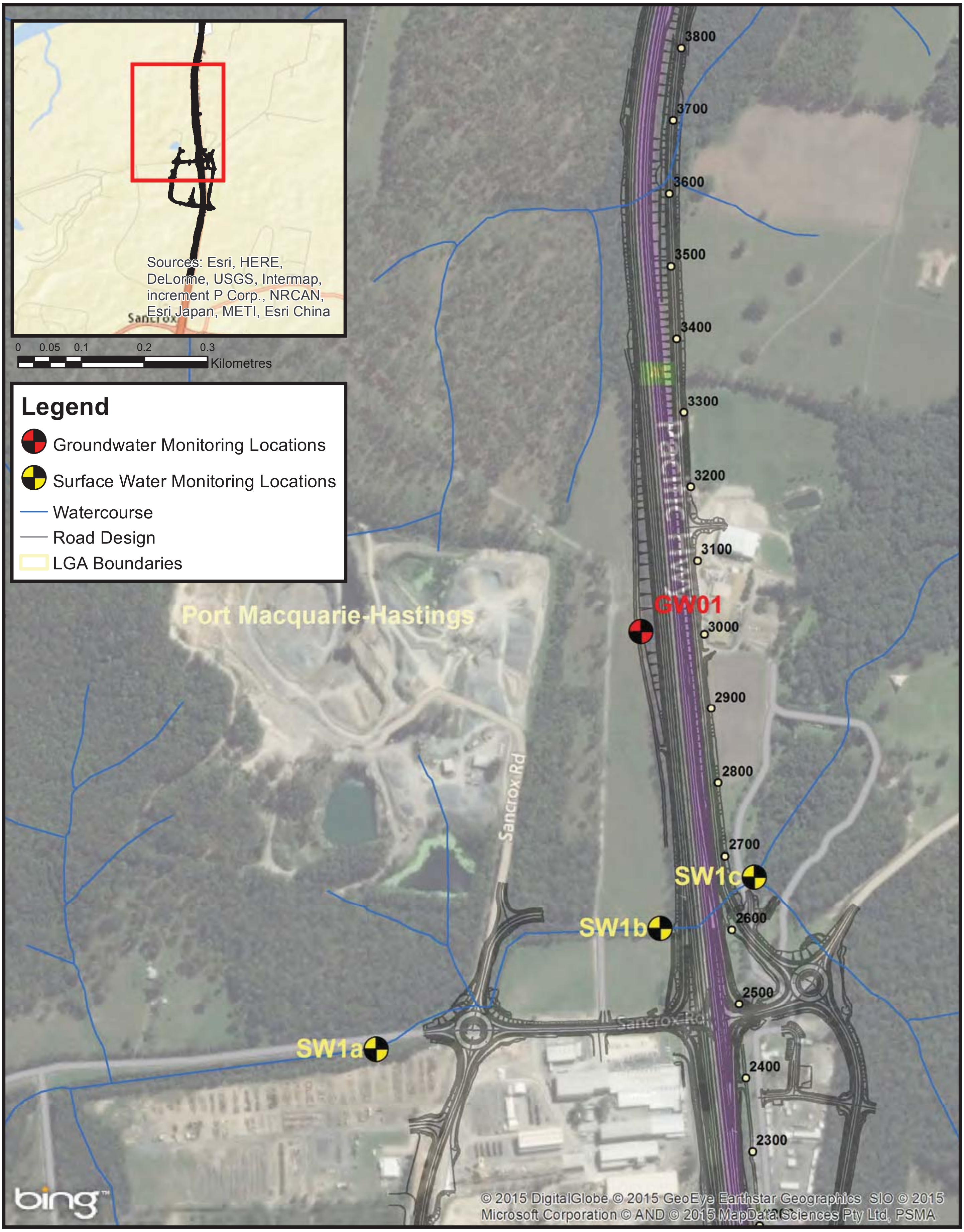
Monitoring Bore	Date	pH	EC (µS/cm)	TDS[1] (mg/L)	ORP (mV)	DO (mg/L)	Temperature (°C)
Seep	30/11/2017	7.6	2161	1405	185	6.44	28.5
Quarry Sump	30/11/2017	7.0	2694	1751	241	5.74	24.6
WHD 1	30/11/2017	8.0	1659	1078	187	9.95	25.1
WHD 2	30/11/2017	7.9	1289	838	200	4.32	26.8

[1] = TDS estimated from EC field measurements through following equation:

EC (µS/cm) X 0.65 = TDS (mg/L).

Annex E

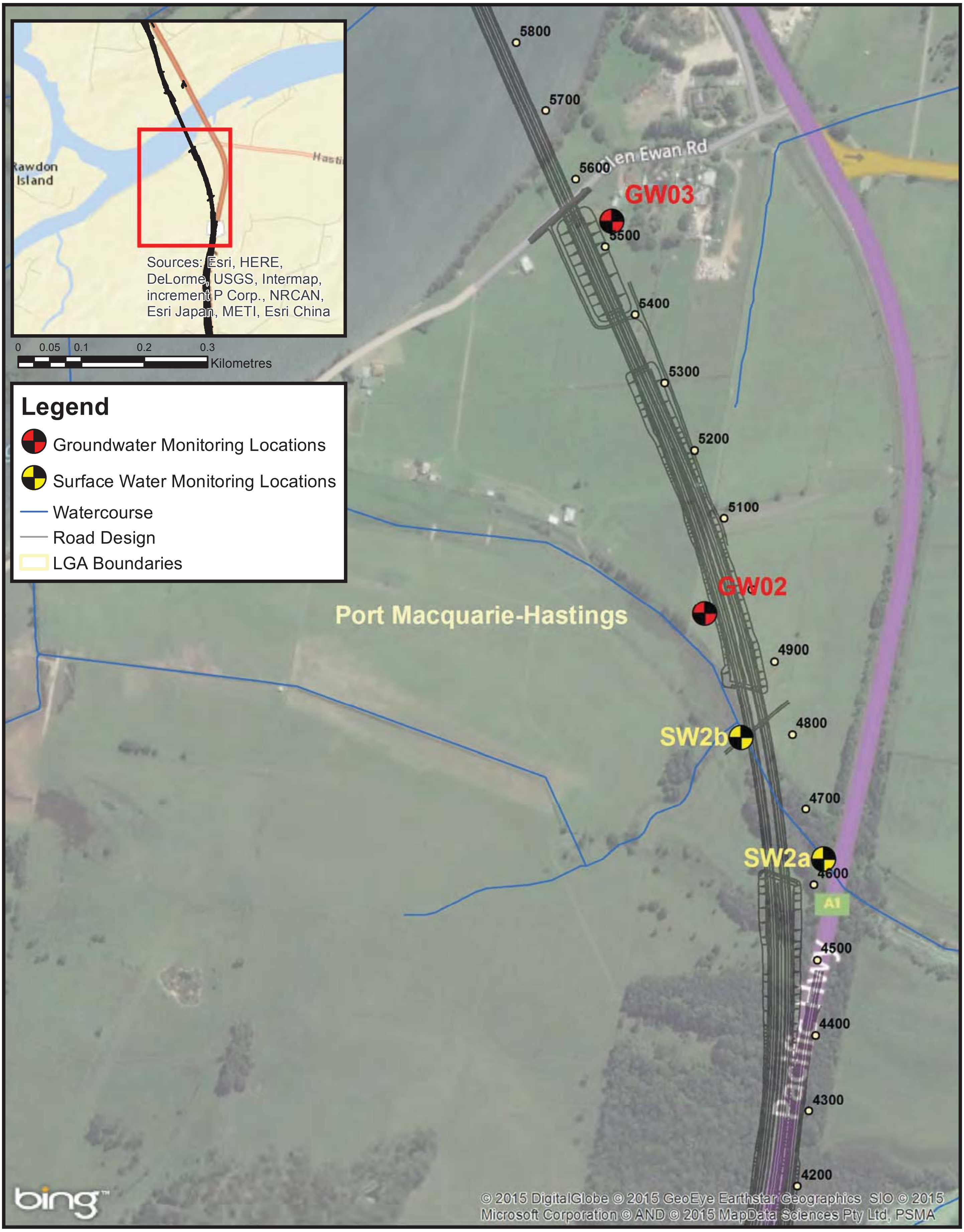
Background Surface Water Monitoring Results (RMS, 2014-2017)



Pacific Highway Upgrade
Oxley Highway to Kempsey

NSW GOVERNMENT | Transport Roads & Maritime Services

N	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

N	**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	Unit	LOR / probe limit	ANZECC default trigger value	Results									
				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	^0C	-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	°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	Results												
	Unit	LOR / probe limit	ANZECC default trigger value	February 2015					March 2015				
				SW1a derived trigger values*			SW1b	SW1c	SW1a derived trigger values*			SW1b	SW1c
				Std dev	80^{th} %	20^{th} %	Median	Median	Std dev	80^{th} %	20^{th} %	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 80^{th} percentile or below the 20^{th} 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	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	^0C	-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	Unit	LOR / probe limit	ANZECC default trigger value	Results									
				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	0C	-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				Results									
	Unit	LOR / probe limit	ANZECC default trigger value	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				Results									
	Unit	LOR / probe limit	ANZECC default trigger value	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				Results											
	Unit	LOR / probe limit	ANZECC default trigger value	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	0C	-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	80^{th} %	20^{th} %	Median	Std dev	80^{th} %	20^{th} %	Median	Std dev	80^{th} %	20^{th} %	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 80^{th} percentile or below the 20^{th} 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									
				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	°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	Unit	LOR / probe limit	ANZECC default trigger value	Results									
				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	Unit	LOR / probe limit	ANZECC default trigger value	Results									
				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				Results									
	Unit	LOR / probe limit	ANZECC default trigger value	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	Unit	LOR / probe limit	ANZECC default trigger value	May 2017 SW2b* Std dev	May 2017 SW2b* 80th %	May 2017 SW2b* 20th %	May 2017 SW2a Median	June 2017 SW2b* Std dev	June 2017 SW2b* 80th %	June 2017 SW2b* 20th %	June 2017 SW2a Median	July 2017 SW2b* Std dev	July 2017 SW2b* 80th %	July 2017 SW2b* 20th %	July 2017 SW2a 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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