Water Quality Monitoring Program

Project:	New M5 – Design and Construct
Contract Number:	15.7020.2597
Document Number:	M5N-ES-PLN-PWD-0049
Revision Date:	28 May 2020

Document Approval

Rev	Date	Prepared by	Reviewed by	Approved by	Remarks
A	21/06/19	CDS JV	M5AT / RMS		
B	04/03/2020	CDS JV	M5AT / RMS		
C	31/03/2020	CDS JV	DPIE		
00	28/05/2020	CDS JV			

WestConnex
We're building Tomorrow's Sydney

Table of Contents

TABLES

FIGURES

ANNEXURES

Glossary of terms

Term / acronym	Definition
ANZECC	Australian and New Zealand Environment and Conservation Council
Client	Project Trustee
CLM Act	*Contaminated Lands Management Act 1997*
CoA	Minister's Condition of Approval
Deed	As appropriate to the defined scope of the WestConnex New M5 O&M Deed
DPIE	NSW Department of Planning, Industry and Environment
EC	Electrical conductivity
EIS	Environmental Impact Statement
EMS	Environmental Management System
Environmental aspect	Element of an organisation's activities, products or services that can interact with the environment
Environmental impact	Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	NSW Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection License
FMS	Flood Management System
GDE	Groundwater dependent ecosystems
Infrastructure Approval	Approval under the *Environmental Planning & Assessment Act 1979* for SSI 6678 signed by the Minister for Planning on 20 April 2016.
LOR	Limit of reporting
MM	Maintenance Manager
NSW	New South Wales
NWQMS	National Water Quality Management Strategy
O&M	Operations and Maintenance
O&M Contractor	The contractor engaged to deliver the operations and maintenance contract for the WestConnex New M5 project. Fulton Hogan Egis O&M Pty Ltd
O&MM	Operations and Maintenance Manager
OEH	Office of Environment and Heritage
OEMP	Operation Environmental Management Plan
OWMP	Operation Water Management Plan
POEO Act	*Protection of the Environment Operations Act 1997*
Project	WestConnex New M5, SSI 6788
Project Company	WCXM5 PT Pty Ltd in its capacity as trustee of the WCXM5 Project Trust or its successor in title or assigns
PSM	Pells Sullivan Meynik
QSEM	Quality, Safety and Environmental Manager

Term / acronym	Definition
REMM	Revised Environmental Management Measure (from the SPIR)
RMS, Roads and Maritime	Roads and Maritime Services
RMS, Roads and Maritime Specification C&C G36	Roads and Maritime Specification Design and Construction G36 – Environmental Protection
SAP	Sensitive Area Plan – consolidation of environmental and socially sensitive areas, sites or places shown on a series of map-based sheets that extend the length of the site, used to assist with the planning and management of Work Under the deed.
SPIR	Submission and Preferred Infrastructure Report
SSI	State Significant Infrastructure
SWTC	As appropriate to the defined Scope of Works & Technical Criteria defined as Schedule 56 under the WestConnex New M5 D&C Deed
TN	Total Nitrogen
TP	Total Phosphorous
TPH	Total petroleum hydrocarbons
TRH	Total recoverable hydrocarbons
TSC Act	*Threatened Species Conservation Act 1995*
TSS	Total Suspended Solids
WCX	WestConnex
Work Procedure	A document that provides a detailed step-by-step description for how work activities will be carried out. May document Risks and Controls associated with each step
WQMP	Water Quality Monitoring Program (this program)
WQI	Water Quality Objectives
WTP	Water Treatment Plant

1 Introduction

1.1 Purpose and application

The purpose of this Water Quality Monitoring Program (WQMP, the program) is to describe how the Operation and Maintenance (O&M) Contractor will monitor the extent and nature of potential impacts to surface and ground water quality during operation of the WestConnex New M5 project (Figure 1).

The WQMP will be implemented to monitor the effectiveness of mitigation measures implemented as part of the project. This WQMP has been developed in accordance with the Conditions of Approval (SSI 6788), applicable legislation and the revised environmental management measures (REMMs) from the New M5 Submissions Report.

This program should be read in conjunction with the Operation Environmental Management Plan (OEMP) and in particular the Operation Water Management Plan (OWMP).

This WQMP has been prepared for the operational (post – construction) phase water quality monitoring; a separate WQMP for the construction phase of the project was developed and approved by the Department of Planning, Industry and Environment on 3 August 2016.

Monitoring of groundwater and surface water will continue during the operational phase to identify potential impacts and ensure a comprehensive management regime can be implemented to address those impacts and manage local water quality.

1.2 Objectives and targets

The objective of this WQMP is to maintain the existing quality of local surface water and groundwater aquifers through early identification of potential impacts through implementation of the WQMP, during and after construction to allow for appropriate response.

Table 1: Project targets for the Water Quality Monitoring Program

Metric / measure	Target	Timeframe	Accountability	Documentation / reporting
To avoid or minimise potential adverse impacts to surface water and groundwater as a result of operation of the project through early identification of potential impacts.	Implementation of all monitoring requirements as prescribed in this document. No impacts to surface water or groundwater as a direct result of operation and maintenance activities	At all times	O&M Manager	OEMP OWMP

1.3 Interface with other plans

During operation, this WQMP is a standalone document within the O&M Contractor's Environmental Management System. It is closely linked to and should be read in conjunction with the OEMP and the OWMP (refer to Figure 2).

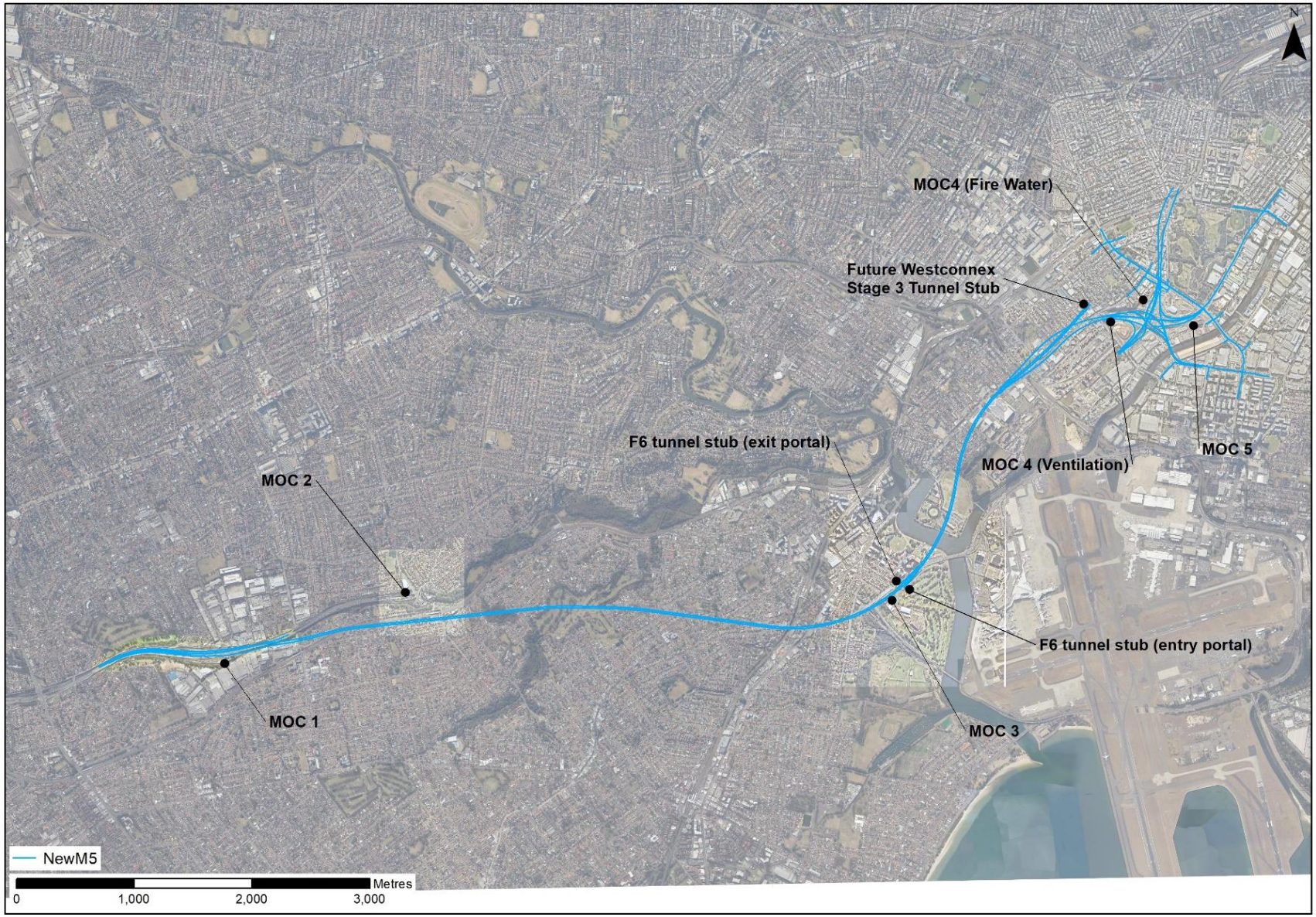


Figure 1: New M5 project location

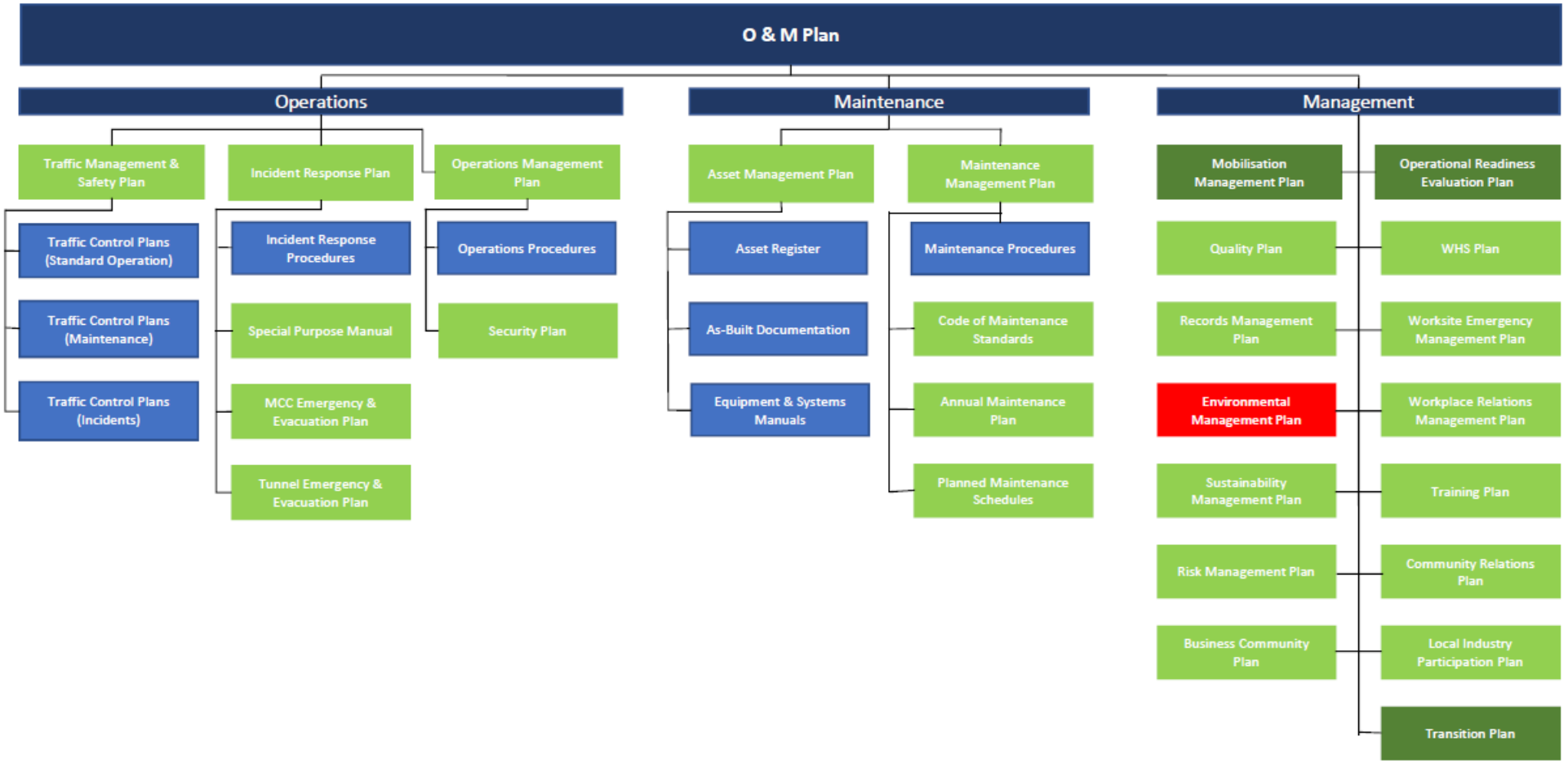


Figure 2: Relationship with other Project Plans

2 Legal and other requirements

2.1 Conditions of Approval

The Conditions of Approval (CoA) and other project requirements that relate to the WQMP are provided in Table 2. A cross reference is included to indicate where the condition/requirement is addressed in this WQMP or other project management documents. Details regarding implementation of the CoA during the construction phase of the project are provided in the WQMP (Construction), the Quarterly Construction Compliance Reports and the Pre-Operation Compliance Report.

Table 2: Conditions of Approval relevant to water quality monitoring

Reference	Condition / requirement	Reference	Responsibility	Timing
B28	A Water Quality Plan and Monitoring Program must be prepared and implemented to monitor and avoid or mitigate impacts on surface and groundwater quality and resources, during construction and operation. The Water Quality Plan and Monitoring Program must be developed in consultation with the EPA, DPI (Water), Sydney Water and relevant councils, and must include, but not be limited to:	This plan Section 2.6	QSEM	Prior to operation
	a identification of works and activities during construction and operation of the SSI, including tunnel discharge, runoff, emergencies and spill events, that have the potential to impact on groundwater quality, levels or potentiometric pressure (in confined aquifers) and surface water quality of potentially affected watercourses and riparian land.	Section 5	QSEM	Prior to operation
	b a risk management framework for evaluation of the risks to groundwater and surface water resources and dependent ecosystems as a result of groundwater inflows to the tunnels, including definition of impacts that trigger contingency and ameliorative measures.	Section 6 Section 8.3	QSEM	Prior to operation
	c the identification of environmental management measures relating to surface waters and groundwater during construction and operation, including water treatment, erosion and sediment control and stormwater management measures consistent with Water Sensitive Urban Design measures, where relevant, and consistent with the measures detailed in the documents listed in condition A2(b) and A2(d) inclusive;	Sections 5.1 and 8 Also refer to the OWMP, section 4	QSEM	Prior to and during operation
	d details of construction water treatment plants and the operational water treatment plant, including treatment processes, discharge water quality criteria (taking into consideration any water uses and proposed rehabilitation measures downstream of the discharge locations), discharge locations and rates (and justification for their location), treatment capacity, and any proposed on-site storage of flows;	Section 5.2	QSEM	Prior to and during operation
	e commitment to designing discharge points into watercourses affected by the SSI to emulate a natural stream system, where feasible and reasonable or where emulation cannot be achieved, adequate scour protection measures are to be implemented;	Refer to the SWMP, Section 6.1 Table 13 item M5	QSEM	During operation
	f consideration of any naturalisation or rehabilitation programs occurring upstream or downstream of waterways or drainage lines intersected by the SSI including the Wolli Creek Riparian Corridor Management Plan;	Section 4.2.1	QSEM	Operation

Reference	Condition / requirement	Reference	Responsibility	Timing
	g the presentation of water quality objectives, standards and parameters against which any changes to water quality will be assessed, having regard to the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Agriculture and Resource Management Council of Australia and New Zealand and the Australian and New Zealand Environment Conservation Council 2000). Where alternate guidelines are used to establish water quality objectives (including the level of protection of aquatic ecosystems in receiving waters), justification for this shall be provided; In particular, justification must be provide for the classification of waterways as 'highly disturbed' versus 'slightly to moderately disturbed' receiving environments	Section 3	QSEM	Prior to and during operation
	h details on the current water quality, including at least 12 months of representative background monitoring data (including but not limited to representative data collected by the relevant councils, agencies and organizations' where readily available) for surface and groundwater quality, levels and potentiometric pressures (in confined aquifers), to establish baseline water conditions prior to the commencement of construction;	Sections 4.2 and 4.3	N/A	Prior to operation
	i monitoring of the quality of discharges from construction and operational water treatment plants.	Section 7.3	QSEM	Prior to and during operation
	j identification of construction and operational phase surface water and groundwater monitoring locations including watercourses and waterbodies which are representative of the potential extent of impacts from the SSI, including the relevant analytes and frequency of monitoring	Section 7	QSEM	Prior to and during operation
	k groundwater monitoring must be able to demonstrate that groundwater discharge quality is consistent with supporting the water quality objectives defined in accordance with B28(g) and include, but not be limited to			
	i) sites in the vicinity of Bardwell Park (to confirm groundwater quality),	Section 7.4	QSEM	Prior to and during operation
	ii) inside and outside the cut-off wall at the Alexandria Landfill,	Table 12 For more information, refer to the Landfill Closure Management Plan (M5N-GOL-MNP-900-300-WT-9400)	QSEM	Prior to and during operation
	iii) monitoring of groundwater levels at Stotts Reserve, southern bank of Wolli Creek behind the Wolli Creek station and forested areas along Bardwell Creek to ascertain potential impacts on groundwater dependent ecosystems, and	Section 4.4 and 8.3, Table 12	QSEM	Prior to and during operation
	iv) monitoring of drawdown along the alignment of the tunnels;	Section 7.4	QSEM	Prior to and during operation

Reference	Condition / requirement	Reference	Responsibility	Timing
	l details on the condition and status of licensed bores likely to be impacted by the SSI;	Section 5.4	QSEM	Prior to operation
	m commitment to a minimum monitoring period of three years following the completion of construction or until the affected waterways and/ or groundwater resources are certified by a suitably qualified and experienced independent expert as being rehabilitated to an acceptable condition, unless otherwise approved or directed by the Secretary. The monitoring must also confirm the establishment of operational water control measures (such as sedimentation basins and vegetation swales);	Section 7.2.1 and 7.3	QSEM	Operation
	n details of how the potential impact of discharges on receiving waters would be avoided or minimised, including design and operational measures incorporated into the SSI to protect water quality and, where feasible and reasonable, enhance water quality over time';	Section 8	QSEM	Operation
	o contingency and ameliorative measures in the event that adverse impacts to water quality or groundwater flows, levels or potentiometric pressures (in confined aquifers) are identified, with reference to the impact triggers defined in accordance with B28(b);	Section 8	QSEM	Operation
	p identification of and commitment to 'make good' provisions for groundwater users to be implemented in the event of a decline in water supply levels from existing bores associated with groundwater changes from either construction and/or ongoing operational dewatering caused by the SSI;	Section 5.4	QSEM	Operation
	q procedures for monitoring of streambed fracturing;	Section 7.2.3	QSEM	Operation
	r procedures for monitoring and annual reporting of extracted groundwater volumes to DPI (Water) for a minimum monitoring period of three years following completion of construction, unless otherwise approved or directed by the Secretary; and	Section 9	QSEM	Operation
	s procedures for annual reporting of the monitoring results to the Secretary, EPA, and the relevant councils.	Section 9	QSEM	Operation

2.2 Revised environmental management measures

The REMMs that relate to the water monitoring program are presented in Table 3. Details regarding implementation of the REMMs during the construction phase of the project are provided in the WQMP (Construction), the Quarterly Construction Compliance Reports and the Pre-Operation Compliance Report.

Table 3: Revised environmental management measures relevant to water quality monitoring

Reference	Condition / requirement	Reference	Responsibility	Timing
OpSW03	Operational water quality monitoring would be conducted for 12 months post-construction or as otherwise required by the conditions of approval. This would include upstream (control) and downstream monitoring locations. The details of this monitoring program would be contained in the Soil and Water Management Plan, and would include the following: • Sampling locations to include upstream (control) and downstream measurement locations • Samples taken twice a month, once in dry conditions and once in wet conditions where possible • In-situ monitoring of: – pH – Reduction Oxidation Potential – Dissolved Oxygen – Temperature – Conductivity – Turbidity – Colour – Odour • Analytical sampling of the following potential constituents of concern: – Total Recoverable Hydrocarbons – Benzene, Toluene, Ethylbenzene, Xylene and Naphthalene – Nutrients including: Total Nitrogen, Total Kjeldahl Nitrogen, Nitrogen Oxide, Nitrite, Nitrate, – Total Phosphorous and Reactive Phosphorous – Heavy metals (Arsenic, Cadmium, Copper, Chromium, Lead, Mercury, Nickel, Zinc) – Manganese – Ferrous Iron and Total Iron.	Section 7.2	QSEM	Operation
OpSW07	The operational water treatment plant would be designed to meet the Water Quality Reference Criteria outlined in Annexure A of the Technical working paper: Surface water (Annexure N). Monitoring of the Cooks River would be undertaken during initial operation of the project to ensure discharge meets these criteria.	Section 7.3	QSEM	Operation

Reference	Condition / requirement	Reference	Responsibility	Timing
OpCM1	The ongoing management of the Alexandria Landfill will be undertaken in line with the Landfill Closure Management Plan (LCMP) (see Section 17.3.4 and Section 5.9.1 of the EIS)	Refer to the Landfill Closure Management Plan (M5N-GOL-MNP-900-300-WT-9400)	QSEM	Operation
OpCM2	Procedures to address spills, leaks and tunnel washing would be developed and implemented during operation of the project	Section 8.4	QSEM	Operation
OpGW01	An OEMP would be prepared and implemented to outline management measures for groundwater inflows, treatment and discharge and protocols for spillages or incidents. Monitoring parameters may include groundwater levels, groundwater quality including field parameters, laboratory analytes and sample frequency.	Refer to the OEMP (M5N-ES-PLN-PWD-0047)	QSEM	Operation
OpGW02	The drainage system would be regularly maintained in accordance with the Operational Environmental Management Plan.	Refer to the OEMP (M5N-ES-PLN-PWD-0047)	QSEM	Operation

2.3 Environment protection licence

The New M5 operational activities will be regulated by an Environment Protection Licence (EPL) issued by the NSW Environment Protection Authority (EPA). The operational water treatment plant will discharge water and be monitored in accordance with the requirements of the EPL. The EPL (21351) is included in Annexure B.

2.4 Roads and Maritime Services

The requirements of NSW Roads and Maritime Services (RMS) QA Specification G38 – Soil and Water Management are presented in Table 4. A cross reference is included to indicate where the condition/requirement is addressed in this WQMP or other project management documents. Details regarding implementation of specification during the construction phase of the project are provided in the WQMP (construction).

Table 4: Roads and Maritime Specification D&C G38 (G38) conditions relevant to water quality monitoring

Reference	Condition / requirement	Reference	Responsibility	Timing
RMS G38 2.3	List the objectives of the monitoring (including EPA licence requirements)	Section 1.2 and 2.3 of this WQMP.	QSEM	Prior to operation
	Give map showing the water sampling locations	Figure 4 and Figure 7 of this WQMP	QSEM	Prior to operation
	Describe the sampling protocol, including sample collection, chain of custody information and sample preservation	Section 7.4.3 of this WQMP	QSEM	Prior to operation
	List the parameters to be monitored	Section 7, Table 10 and Table 12 of this WQMP	QSEM	Prior to operation
	Describe the method for interpretation of field results and identifying exceedance of water quality criteria	Figure 10 and Figure 11	QSEM	Prior to operation
	Describe the accountabilities, responsibilities and training required the meet the monitoring objectives	Table 3 and Section 7 of this WQMP Tables 5-2, 5-3 and 9-1 of the OEMP	QSEM	Prior to operation
	Describe the method of comparison of results between sampling locations (e.g. upstream and downstream) and any water quality criteria and/or targets	Figure 10 and Figure 11 of this WQMP	QSEM	Prior to operation
	Describe the reporting and recording of the monitoring results	Section 9 of this WQMP	QSEM	Prior to operation
	Describe the responsibility for planning, implementing, checking and reviewing each element of the monitoring	Section 10 of this WQMP	QSEM	Prior to operation
	Describe the methodology for using monitoring results to assess and manage identified problems	Figure 10, Figure 11 and Figure 12 of this WQMP	QSEM	Prior to operation
	Describe the reporting requirements in the case the monitoring results exceed the set criteria	Figure 10, Figure 11 and Figure 12 of this WQMP	QSEM	Prior to and during operation

2.5 NSW Aquifer Interference Policy

The NSW Aquifer Interference Policy requires that potential impacts on groundwater sources, including their users and groundwater dependent ecosystems (GDEs), be assessed against minimal impact considerations. If the predicted impacts are less than the Level 1 minimal impact considerations, then these impacts would be considered as acceptable. If there are any exceedances of the criteria, then they would be considered potentially adverse and mitigation and monitoring measures would be implemented. Table 5 gives a summary of the expected impacts and the measures that would be adopted where necessary.

An evaluation of the risks to groundwater and surface water resources as a result of drawdown associated with ground water inflow into the tunnel is provided in Table 5.

Table 5: Summary of impacts relative to Aquifer Interference Policy minimal impact criteria

Type of Impact	Minimal impact considerations	Summary of impacts
Water table impacts	Less than or equal to 10% cumulative variation in the water table allowing for typical “post-water sharing plan” variations, 40m from any high priority GDE or high priority culturally significant site listed in the schedule of the relevant water sharing plan. A maximum of a 2 m decline cumulatively at any water supply well.	There are no high priority groundwater dependent ecosystems listed under Appendix 4 of the Greater Metropolitan Regional Groundwater Sources Water Sharing Plan that are within the Hawkesbury Sandstone or Ashfield Shale. No culturally significant sites within the Greater Metropolitan Regional Groundwater Water Sharing Plan were reported in the EIS (AECOM, 2015). Locations of water supply bores with drawdown estimated to be more than 2 metres due to tunnel drainage are identified in the Hydrogeological Design Report.
Water pressure impacts	A cumulative pressure head decline of no more than 2m decline at any water supply well.	The groundwater modelling has included the cumulative impacts of the existing M5 East Motorway tunnel. Shallow drained foundations and other shallow drained structures are not expected to have wide ranging impacts on regional groundwater levels and therefore, were excluded from the model. In the event that groundwater users are impacted by the project by a permanent decline in groundwater levels in operational water supply bores in excess of 2 m, provisions will be made to ‘make good’ the supply by restoring the water supply to pre-development levels. The measures taken would be made in consultation with the affected licence holder
Water quality impacts	Any change in groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.	The inherent groundwater quality characteristics and urban environment suggest that the groundwater has limited beneficial use potential, particularly within the surficial and Ashfield Shale aquifers. It is noted however, that groundwater in the Hawkesbury Sandstone is used for domestic purposes. The beneficial use category of groundwater is not expected to be changed beyond 40m of the tunnel.

2.6 Consultation with relevant agencies

The Conditions of Approval (CoA) B28 require that the EPA, DPI (Water) (now the National Resource Access Regulator (NRAR)), Sydney Water and relevant councils are consulted during preparation of the WQMP. The project consulted with all required stakeholders during the development of the initial Water Quality Monitoring Program in 2016. Further consultation is being undertaken with the EPA and NRAR during the development of this operational phase Water Quality Monitoring Program. A document titled 'Consultation for the New M5 OEMP and subplans' has been prepared separately to this plan to provide detail relating to the consultation received and where feedback has been covered or addressed in this document.

3 Guidelines and objectives

3.1 Australian and New Zealand Guidelines for Fresh and Marine Water Quality

The Australian and New Zealand Environment and Conservation Council and the Agriculture and Resource Management Council of Australia and New Zealand developed the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC/ARMCANZ 2000) as part of the Australian National Water Quality Management Strategy (NWQMS). The NWQMS aims to achieve the sustainable use of Australia's and New Zealand's water resources by protecting and enhancing their quality while maintaining economic and social development. The 2018 revision of the Water Quality Guidelines is presented as an online platform, to improve usability and facilitate updates as new information becomes available.

3.2 Water Quality Objectives

For each catchment in NSW, the State Government has endorsed the community's environmental values for water, known as Water Quality Objectives' (WQOs). The NSW WQOs are the environmental values and long-term goals for consideration when assessing and managing the likely impact of activities on waterways (Water Quality Australia, 2018).

Environmental values are particular values or uses of the environment important to maintain a healthy eco-system, to provide a public benefit, and improve or maintain safety or health from the effects of pollution, waste discharges and deposits. The environmental values expressed as WQOs provide goals that help in the selection of the most appropriate management options. The guiding principles are:

- *Where the environmental values are being achieved in a waterway they should be protected; and*
- *Where the environmental values are not being achieved in a waterway, all activities should work towards their achievement over time.*

Both local waterways and the upper estuary waters could be affected by the project. The water quality objectives for both of these are:

Protection of:

- Aquatic ecosystems;
- Visual amenity;
- Secondary contact recreation (e.g. boating);
- Primary contact recreation (e.g. swimming) in the longer term (10-year); and
- For the upper tributary waters only, protection of aquatic foods (cooked).

A range of water quality indicators are used to help assess whether the current condition of a waterway supports these values. Each indicator has an associated "trigger" value which, if exceeded, could mean one or more of the water quality objectives might not be met. These key indicators are derived from Water Quality Australia (2018). Note that some of the indicators associated with contact recreation are biological indicators such as faecal coliforms and viruses and, given the project would not result in an increase in these, they have not been included.

Much of the project's catchment is urbanised, therefore waterways are affected by poor water quality and a changed flow regime. The waterways have been greatly modified, with creek systems being extensively channelised or hard-edged with concrete. Wetlands have been destroyed or degraded and, where natural

remnants of vegetation exist, they are often affected by weeds and rubbish[1]. A summary of the waterways which the Project interacts with can be found in Table 7.

Baseline water quality results show that the ambient water quality of the receiving waters is poor, with concentrations of most indicators exceeding the default values given in ANZECC/ARMCANZ (2000) (AECOM, 2015) for *slightly to moderately disturbed* ecosystems.

3.3 Site-Specific Trigger Values – Surface Water

The Australian and New Zealand Environment and Conservation Council and the Agriculture and Resource Management Council of Australia and New Zealand (ANZECC/ARMCANZ) developed the ANZECC (2000) guidelines. The ANZECC (2000) guidelines provide specific assessment criteria and water quality guideline values that aim to protect and manage the environment supported by a water resource whilst maintaining economic and social development. The 2018 revision of the Water Quality Guidelines is presented as an online platform, with no or very minor revisions to some default guideline values.

The ANZECC (2000) guidelines for marine water quality and fresh water quality specific to south-east Australian lowland rivers and NSW coastal rivers have been used throughout this document in accordance with the Conditions of Approval so as to inform ongoing assessments of potential impacts on water quality. The ANZECC (2000) guidelines provide guidance on the development of management trigger values. The ANZECC (2000) guidelines (Section 7.4.4) recommend a minimum of 24 months of consecutive data to be collected before valid management trigger values for water quality can be established.

A programme of surface water quality sampling was carried out during the pre-construction and construction phase in accordance with the previously approved WQMP. As part of the sampling programme, monthly surface water sampling occurred at twelve (12) surface water monitoring sites, including locations within Wolli Creek, Sheas Creek / Alexandra Canal, Cooks River, Muddy Creek, and the Eastern Stormwater Drain at Sydenham. The locations of these monitoring sites are presented in Figure 4.

Surface water samples were tested for the following analytes:

- General parameters (physical parameters, nutrients, ammonia);
- Total Recoverable Hydrocarbons (TRH);
- BTEX (benzene, toluene, ethylbenzene, xylene); and
- Heavy metals (As, Cd, Cr, Cu, Pb, Mn, Ni, Zn, Fe, Hg).

Water quality data collected during the construction phase of the Project reflected observations made within Appendix A of Appendix N (Technical Working Paper: Surface Water) of the EIS. The receiving waters surrounding the Project are highly variable and contain concentrations of toxins which exceed the Default Guideline Values (DGVs). This is particularly evident in the Alexandra Canal and the Cooks River.

The management trigger values for freshwater have been adopted from the previously approved WQMP, which have been developed using pre-construction baseline data and the water quality reference criteria within Appendix A of Appendix N (Technical Working Paper: Surface Water) of the EIS. The methodology on how these were developed is referenced within the Surface Water Quality Baseline Monitoring Report (included within Annexure A).

Surface water quality data have been divided into two categories when calculating the management trigger value based on the receiving watercourses:

- Freshwater: comprising Wolli Creek, Sheas Creek and Eastern Stormwater drain; and
- Estuarine: comprising Cooks River, Alexandra Canal, and tributary to Muddy Creek.

Table 6 shows the adopted management trigger values for the freshwater and the estuarine environments.

[1] Refer to http://www.environment.nsw.gov.au/ieo/SydneyHarbour/report-02.htm

Table 6: Management Trigger Values

Parameter	Unit	Freshwater	Estuary
Suspended Solids	mg/l	50	21
Arsenic	mg/l	0.360	0.0024
Cadmium	mg/l	0.0008	0.0005
Chromium	mg/l	0.040	0.0004
Copper	mg/l	0.012	0.0003
Lead	mg/l	0.0094	0.0004
Manganese	mg/l	3.600	0.19
Nickel	mg/l	0.017	0.007
Zinc	mg/l	0.059	0.0056
Mercury	mg/l	0.0054	0.0004
Ferrous Iron	mg/l	0.3	0.3
Ammonia	mg/l	2.3	0.091
Nitrate as N	mg/l	17	0.07
Total Nitrogen as N	mg/l	2.89	1.2
Total Phosphorus as P	mg/l	0.12	0.17
pH	-	6.5 – 8.5	7.0-8.5
Dissolved Oxygen	% Sat	60	60-110
Conductivity	µS/cm	310-1660	50200
Turbidity	NTU	29	10

Historical and baseline water quality data shows the ambient water quality of the receiving waters is poor. The Cooks River estuary is in an extensively modified condition as a result of urbanisation of the Cooks River Catchment. In summary:

- pH conditions are near neutral to alkaline;
- Salinity is fresh to saline, typical of an estuarine environment, where salinity is influenced by tides;
- TSS and turbidity concentrations can be elevated (likely coinciding with rainfall events);
- Dissolved metals are detected, with high concentrations of chromium, copper, lead and zinc;
- Nutrient concentrations are generally high; and
- Concentrations of total petroleum hydrocarbons (TPH) and total recoverable hydrocarbons (TRH) are detected.

3.4 Other objectives

Bayside Council

Bayside Council has specified operational water quality objectives for developments in their Botany Bay and Catchment Water Quality Improvement Plan (SMCMA, 2011). These are not relevant to the construction phase of the project but may be applied to the operational phase of the Project. These include:

- 90 per cent reduction in the post development mean annual load of total gross pollutant (greater than five millimetres);
- 85 per cent reduction in the post development mean annual load of Total Suspended Solids (TSS);
- 60 per cent reduction in the post development mean annual load of Total Phosphorus (TP); and
- 45 per cent reduction in the post development mean annual load of Total Nitrogen (TN).

The water quality assessment for the Botany Bay area of the project shows that stormwater treatment in this section of the project would lead to pollution reduction for total phosphorus, total nitrogen and total suspended solids which is greater than the Bayside Council objectives.

The objective of the Bayside Council pollutant reduction targets is to improve the quality of stormwater entering receiving waters, therefore the targets specify percent reduction objectives levels for total gross pollutants, TSS and phosphorus and nitrogen, which are common pollutants from roadways and developments in stormwater. These targets are not applicable to discharge from the operational water treatment plant, as it will not receive or treat stormwater from the New M5 roadway, only groundwater. The application of ANZECC targets to the water treatment plant discharge is more appropriate and will provide more stringent discharge criteria for the water treatment plant than the application of the Bayside Council pollutant reduction targets.

The above targets were considered during the development of trigger values and management responses as detailed in Section 8 of this WQMP.

4 Project environment

4.1 Topography

The Project alignment is within the Cooks River catchment which gradually falls towards Botany Bay. The topography of the Project corridor is undulating and is comprised of a series of elevated ridges, between 30 meters Australian Height Datum (AHD) to 50 meters AHD, and relatively low lying broad valleys with gently inclined slopes. The drainage features along the Project corridor are detailed in Figure 3. Near the confluence of Cooks River, the topography is relatively flat and low lying, around 5 meters ADH to 10 meters ADH, which gradually falls towards Botany Bay.

Land within and joining the Project corridor has been substantially modified over lime and includes land reclamation activities and urban land-uses. Major land uses surrounding the Project's footprint include: major utilities infrastructure (Sydney Airport, Sydney Ports - Port of Botany, Botany Industrial Park); industrial; commercial; roads; railways; residential and open space.

4.2 Surface water

Several feeder streams (or their tributaries) cross the alignment or are in close proximity (Figure 3). These include:

- Cooks River;
- Wolli Creek (and tributary Bardwell Creek);
- Eastern Channel;
- Alexandra Canal (formally Sheas Creek); and
- Shea's Creek.

Riparian connectivity along creek lines that cross the project footprint is minimal due to surrounding residential and industrial areas with often very little, if any, vegetation present along the edges of most waterways. Table 7 details the condition of each of the waterways and the potential project interaction with each.

Table 7: Watercourses associated with the project

Watercourse	Condition	Project interaction
Cooks River	The Cooks River catchment is highly urbanised, with extensive subsurface pit and pipe networks. The Cooks River is largely lined with steel sheets pilings, concrete walls or shone/block revetments, though with some rehabilitated, naturalised sections. The Cooks River flows for roughly 23 kilometres from Graf Park in Bankstown into Botany Nay at Kyeemagh.	The Motorway Operational Complex (MoC) at Arncliffe is approximately 500 m from the Cooks River. This facility includes the operational water treatment plant which collects and treats the groundwater from the tunnels and discharges it into the stormwater system on Marsh Street which drains directly into the Cooks River.

Watercourse	Condition	Project interaction
Wolli Creek	Wolli Creek begins in Beverly Hills and runs through Wolli Creek Valley in a north-easterly direction from Kingsgrove in the west, flowing towards the east until joining the Cooks River near Tempe. The upper section of Wolli Creek is anthropogenically modified with hard engineered lining consisting of a mix of open concrete-lined trapezoidal channels, reconstructed semi-natural watercourse channel, underground concrete channels, piped channels and rock-lined channels. The middle section is considered semi-natural channel is constructed of grout rock rip-rap and vegetation. Downstream of this the channel returns to a constructed concrete lined trapezoidal channel. At Bexley Road the creek passes through a box culvert before flowing into a modified, natural channel. The in-stream, lower bank and riparian zone of the lower section of Wolli Creek is dominated by weeds that have historically and continue to cause sedimentation and minor bank erosion where the banks are exposed.	MOC1 – Kingsgrove is within the Wolli Creek catchment and it is approximately 50 m from Wolli Creek. Pavement resulting from the western surface works and western portals would increase the imperviousness within the catchment area and within proximity to Wolli Creek. The New M5 will have upgraded one of five water quality basins and removed another in order to have a series of four water quality basins which will store and treat surface water for release directly into Wolli Creek.
Alexandria Canal	Alexandra Canal is a constructed canal, originally a natural watercourse named Sheas Creek. It flows into the Cooks River near the north-western corner of Sydney Airport. The canal is owned and operated by Sydney Water as are the major trunk drainage lines discharging into it. Numerous minor drains in the Alexandra Canal sub-catchment are managed by Sydney, Inner West and Botany Bay Councils. Three channels discharge into Alexandra Canal: Munni Street Stormwater Channel, Sheas Creek Channel and the Botany Road to Doody Street Channel.	The St Peters interchange site is within the Alexandria Canal catchment and is within 200 m of Alexandria Canal. New stormwater discharge outlets from south west and south east of Campbell Road Bridge will discharge stormwater to Alexandria Canal approximately 3 km from the Cooks River junction.
Sheas Creek	Sheas Creek is now a shortened concrete-lined channel upstream of Alexandra Canal. Sections of the Local Roads Upgrades drain into this creek. The creek services the piped drainage system of the upper Alexandra Canal catchment.	Sheas Creek is approximately 1 km from MOC5 – St Peters. No direct impacts are expected from the operation of this facility. Upgrades to Euston Road and the intersection with Sydney Park Road / Huntley Street is approximately 200 m from Sheas Creek. Stormwater from the operation of the roads will drain to this waterway.
Eastern Channel	The Eastern Channel (SWC 66) runs along the Sydenham to Tempe railway line, discharging into the Cooks River. The channel conveys stormwater as a trapezoidal-shaped concrete-lined open channel with 1 to 4 slopes. The main open section is roughly 2.3 km from Murray Street, Marrickville to its confluence with the Cooks River adjacent to Tempe Station. Part of the channel is tidal due to its connectivity with the Cooks River.	The project includes an upgraded discharge outlet into the Eastern Channel. The stormwater is captured by the pavement drainage system and is stored and treated in Camdenville Park. The water then drains into the concrete lined Eastern Channel.

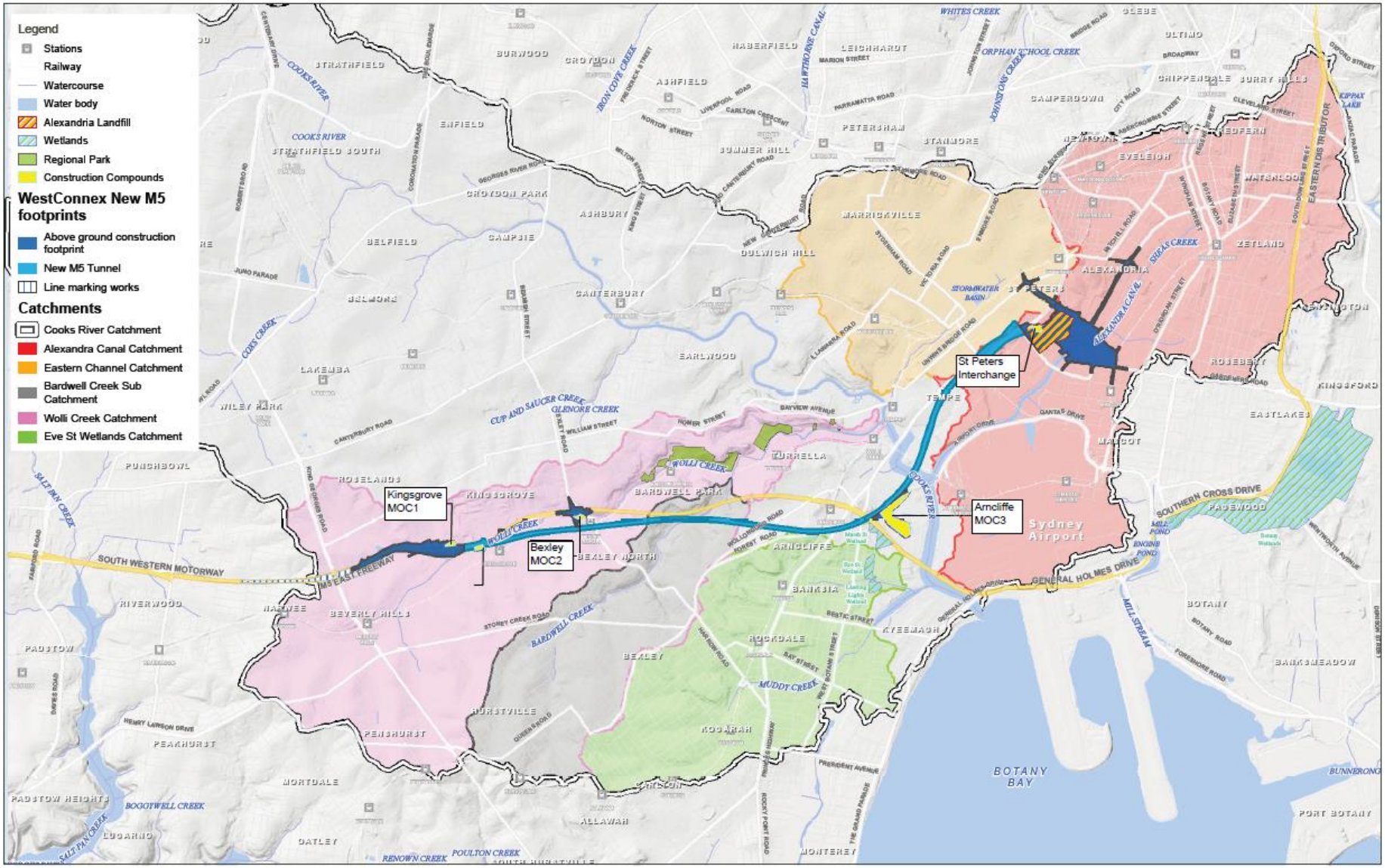


Figure 3: Waterways and Catchments (AECOM 2015)

4.2.1 Sensitive receiving environments

The following information has been taken from the New M5 EIS (AECOM 2015).

A 'sensitive receiving environment' is defined as one that has a high conservation or community value and/or supports ecosystems or human uses of water that are particularly sensitive to pollution or degradation of water quality.

Sensitive receiving environments include:

- Nationally Important Wetlands and State Environmental Planning Policy No 14 (SEPP 14) wetlands (actual or potential groundwater dependent ecosystems);
- National parks, marine parks, nature reserves and State conservation areas;
- Threatened ecological communities associated with aquatic ecosystems;
- Known and potential habitats for threatened fish;
- Key fish habitats as identified by the NSW Department of Primary Industries (DPI);
- Recreational swimming areas;
- Areas that contribute to drinking water catchments;
- Areas that are available or used for aquaculture and commercial fishing; and
- Green and Golden Bell Frog RTA Ponds at Arncliffe.

The project has the potential to interact with a number of sensitive receiving environments:

- The Cooks River;
- Botany Bay;
- Saltmarsh and other wetlands around Sydney Airport;
- The Green and Golden Bell Frog ponds at Arncliffe; and
- Wolli Creek and Wolli Creek Regional Park.

4.2.2 Surface Water Quality

The New M5 project falls within the catchment of the Cooks River and Botany Bay. Water and sediment quality within the Cooks River estuary is generally poor, largely due to polluted stormwater runoff. There are a large number of sources of pollutants from urban areas in the estuary catchment, such as:

- Nutrients, e.g. from fertilisers and cleaning products;
- Heavy metals, e.g. from some industrial sites and roads;
- Organochlorine and organophosphate pesticides;
- Polycyclic aromatic hydrocarbons associated with heavy industry/combustion;
- Phenols used in industrial chemical synthesis; and
- Sewage from sewer overflows.

The surface water quality in waterways relevant to the project is largely influenced by stormwater, aquatic weeds and erosion, which are attributable to the catchment in which these creeks reside. Sewer overflows, particularly during high rainfall events, also influence water quality in these catchments, providing additional sources of nitrogen, phosphorus, suspended solids and faecal coliforms.

As per Section 3.3 and in accordance with the Water Quality Monitoring Program (construction), monthly surface water quality was undertaken during pre-construction (April 2015 – April 2016) and construction (August 2016 – present) to determine baseline water quality in waterways that would be impacted by the

project. Where practicable, the Water Quality Monitoring Program accounted for an upstream reference site above the works and one downstream site on each waterway that is crossed by infrastructure associated with the project.

Wet weather monitoring was conducted quarterly (once every 3 months during construction) when more than ten millimetres of rain was received in the local catchment during a 24 hour period. For safety reasons sampling was not undertaken during peak storm-flows. Sampling was completed when flows were reasonably constant and safe.

A summary of water quality results collected to date from each monitoring location is included in the Surface Water Quality and Monitoring Program – Annual Report/s, which can be found online - https://www.westconnex.com.au/NewM5Environment).

Twelve sites (Figure 4 and Table 8) were monitored for surface water quality during the baseline periods. Water was collected and analysed for baseline parameters on a monthly basis. Baseline water quality monitoring consisted of the parameters listed in Table 11.

Table 8: Surface water quality monitoring sites

Site ID	Easting	Northing	Watercourse	Location	Monitoring period
LDS-SW-01	332938	6246524	Sheas' Creek	Upstream	June 2015 – present
LDS-SW-02	331540	6244935	Alexandra Canal	Downstream	June 2015 – present
LDS-SW-03	330581	6245909	Eastern Channel	Downstream	June 2015 – present
LDS-SW-04	329292	6242429	Eve St Wetlands	Upstream	June 2015 – July 2017
LDS-SW-05	329491	6244746	Cooks River	Upstream	June 2015 – present
LDS-SW-06	329895	6243716	Cooks River	Downstream	June 2015 – present
LDS-SW-07	330120	6243607	Cooks River	Downstream	June 2015 – July 2017
LDS-SW-08*	322993	6242760	Wolli Creek	Upstream	June 2015 – present
LDS-SW-09*	324663	6243087	Wolli Creek	Upstream	June 2015 – present
LDS-SW-10	325577	6243239	Wolli Creek	Upstream	June 2015 – present
LDS-SW-11	327910	6244087	Wolli Creek	Downstream	June 2015 – present
LDS-SW-12	329991	6243607	Cooks River	Adjacent	July 2017 – present

**Wet weather monitoring only, as there is an inadequate volume of water in the channel during dry weather to enable sampling to occur.*

Minor amendments to monitoring locations occurred during the construction period. Details are contained within the annual reports and have been summarised in Table 9.

Table 9: Modified monitoring locations during construction

Site ID	Easting	Northing	Watercourse	Location	Monitoring period
Removal of monitoring point					
LDS-SW-04	329292	6242429	Eve St Wetlands	Upstream	June 2015 – July 2017
Additional monitoring point					
LDS-SW-12	329991	6243607	Cooks River	Adjacent	July 2017 - present
Movement of monitoring point					
LDS-SW-07	330120	6242327	Cooks River	Downstream	July 2017 – present

Table 10: Surface water quality monitoring parameters

Frequency	Chemical Group	Analyte
Monthly	General Parameters	ph (field)
		Electrical Conductivity (EC) (field)
		Temperature (field)
		Disolved Oxygen (DO) (field)
		Redox (field)
		Total Dissolved Solids (TDS) (field)
		Total Suspended Solids (TSS)
		Turbidity
	Dissolved metals	Arsenic (As)
		Cadmium (Cd)
		Chromium (Cr)
		Copper (Cu)
		Iron (Fe)
		Lead (Pb)
		Nickel (Ni)
		Mercury (Hg)
		Zinc (Zn)
	Nutrients	Ammonium as N
		Ammonia as N
		Nitrite as N
		Nitrate as N
		Nitrite and Nitrate as N
		Total Nitrogen as N
		Total Kjeldah Nitrogen as N
		Total Phosphorus as P
	Total Petroleum Hydrocarbons (TPH)	C6-C40
	Total Recoverable Hydrocarbons (TRH)	
	Benzene, Toluene, Ethylbenzene, Xylene, Naphthalene (BTEXN)	

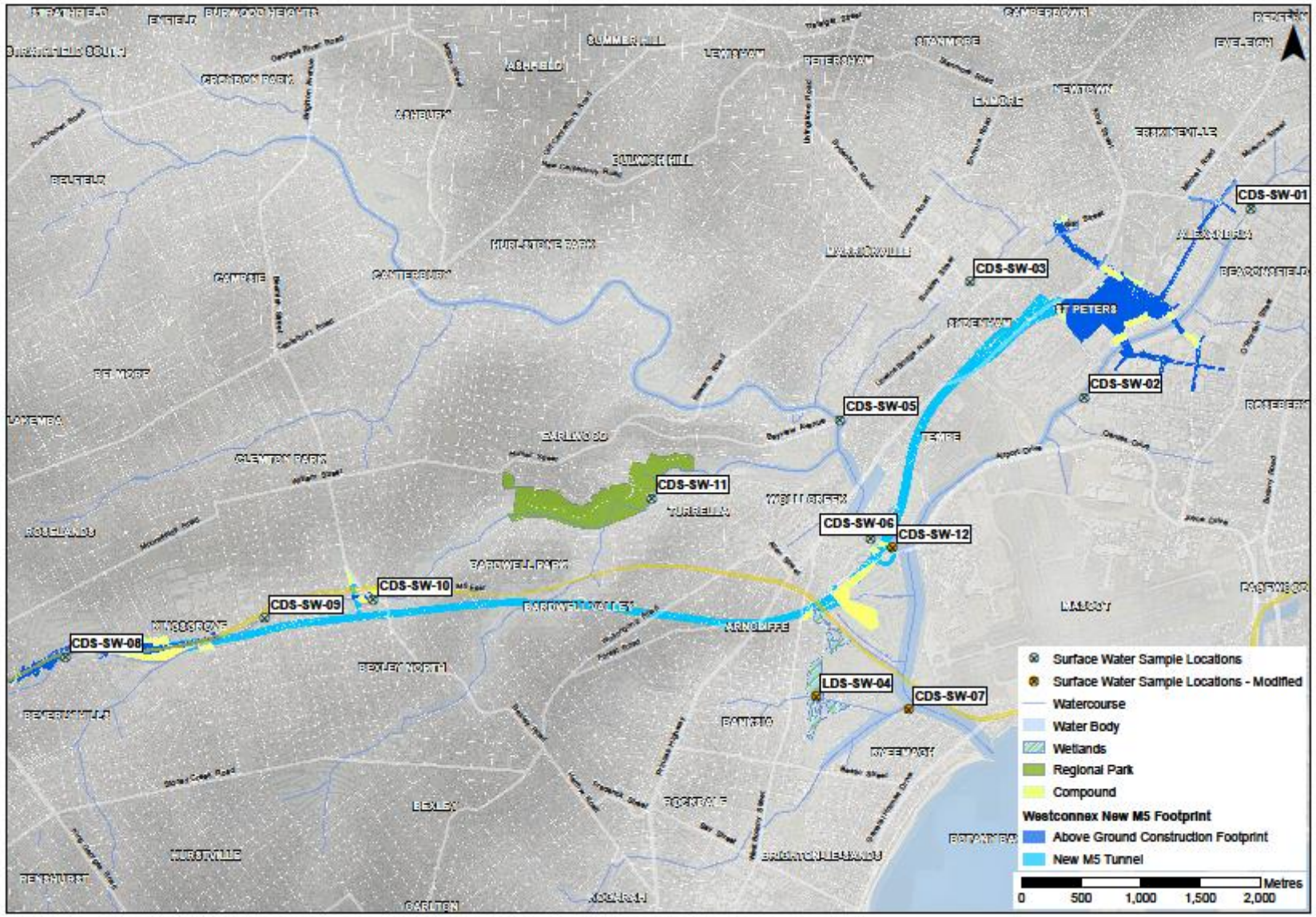


Figure 4: Surface water monitoring locations

4.3 Groundwater

4.3.1 Pre-construction groundwater environment

Groundwater is present within the alluvium around Cooks River, Botany Sands, Ashfield Shale and Hawkesbury Sandstone. The water table is generally a subdued expression of the topography, depth varies from near-surface within fill material, residual fill and alluvium in low-lying areas to more than 7 m in the Ashfield Shale to over 40 m in the Hawkesbury Sandstone. Regionally groundwater flow is eastward discharging into Botany Bay and Alexandria Canal.

Existing groundwater levels are influenced by infrastructure such as pumping or along the alignment of the M5 East Motorway tunnel which is a drained tunnel. Conversely in some areas the local water table may be elevated above natural conditions due to irrigation such as at the Kogarah Golf Course or subsurface structures such as infrastructure or building foundations that inhibit groundwater flow causing localised groundwater mounding. Groundwater recharge has typically decreased as the degree of urbanisation has increased due to enhanced runoff from hardstand areas directing stormwater to Botany Bay.

AECOM (2015) found that groundwater conditions in this area are influenced by the following:

- Leachate associated within former brick works quarries in Sydney Park, Camdenville Park and Alexandria Landfill at St Peters Interchange;
- Groundwater contamination in an area known as the St Peter Local Roads area (located between Campbell Street, Euston Road and Bourke Road in the suburbs of Alexandria, Mascot and St Peters) where manufacturing and workshops were identified as potential sources of contamination;
- Groundwater contamination consisting of elevated dissolved hydrocarbons and metals at 5/5A Canal Road, St Peters due to historical uses on site including a metal smelter and battery storage and migration from the adjacent Alexandria Landfill;
- Elevated dissolved hydrocarbon contamination at 6A Huntley Street, Alexandria due to leaks from above ground and underground storage tanks (PAHs, total petroleum hydrocarbons (TPHs));
- Groundwater beneath the Kogarah Golf Course has the potential to be contaminated by fertilizers, pesticides and herbicides due to its former use as market gardens and current use as a golf course; and
- Groundwater used for water supply and irrigation within one kilometre radius of the tunnel alignment.

Groundwater quality within the Ashfield Shale is highly variable but is typically brackish or saline, due to the marine salts contained within the shale. The shale aquifer is characterised by low yields, limited storage, and poor groundwater quality and is artificially depressed within the eastern part of the alignment due to local pumping of leachate from the Alexandria Landfill. Groundwater within the Hawkesbury Sandstone is generally acidic but of low salinity, however the salinity of the upper part of the aquifer can be elevated due to leakage from the Ashfield Shale.

The Project tunnels have been constructed as drained tunnels, with ongoing groundwater inflow, capture and discharge. Groundwater modelling (CDM Smith, 2015) predicted groundwater dependent ecosystems would not experience significant drawdown howeverthe long-term drawdown created by the project was identified to present some risk to groundwater dependent ecosystems in the area.

4.3.2 Groundwater monitoring

A pre-construction groundwater baseline monitoring program was undertaken prior to construction and included monitoring groundwater quality at 53 monitoring locations; 18 existing monitoring wells previously installed by AECOM (AECOM 2015), 33 newly installed monitoring wells and two newly installed vibrating wire piezometers (VWPs).

The groundwater monitoring program included the collection of groundwater samples from up to 26 locations and the collection of water level measurement data from up to 53 locations. Groundwater monitoring was undertaken 6-monthly, in accordance with the construction WQP&MP.

Monitoring bores are presented in Table 11 and Figure 5, monitoring parameters are shown in Table 12. There is substantial site coverage both along the Project tunnels and adjacent to the alignment to monitor shallow and deep groundwater trends during the construction phase.

Five monitoring bore holes are used to monitor potential impacts to Groundwater Dependent Ecosystems with further details provided in section 4.4. Further detail on the bores and the results are available within the Groundwater Monitoring Progress Reports that were submitted as part of the Construction WQP&MP annual report. These can be found: https://www.westconnex.com.au/NewM5Environment

Table 11: Groundwater quality and level monitoring locations

Monitoring Well	Hydrostratigraphic Unit Screened	Eastings	Northings	Water Quality	Water Level	Data Logger
LDS-BH-1026	Hawkesbury Sandstone	324448	6242973	✓	✓	✓
LDS-BH-1027	Hawkesbury Sandstone	324475	6242852	✓	✓	
LDS-BH-1031	Hawkesbury Sandstone	325760	6243091	✓	✓	✓
LDS-BH-1033B	Hawkesbury Sandstone	326949	6243223	✓	✓	
LDS-BH-1038	Hawkesbury Sandstone	329099	6243198	✓	✓	✓
LDS-BH-1041	Alluvium / Hawkesbury Sandstone	329465	6243437		✓	✓
LDS-BH-1066	Hawkesbury Sandstone	326531	6242873		✓	✓
LDS-BH-2001	Alluvium	329361	6243035	✓	✓	✓
LDS-BH-2003	Alluvium	329720	6242895		✓	✓
LDS-BH-2005A	Hawkesbury Sandstone	329618	6243371	✓	✓	✓
LDS-BH-2011A	Hawkesbury Sandstone	330097	6244325	✓	✓	✓
LDS-BH-2011B	Alluvium	330097	6244323	✓	✓	
LDS-BH-2015	Hawkesbury Sandstone	330176	6244776	✓	✓	✓
LDS-BH-2018	Hawkesbury Sandstone	330615	6245117	✓	✓	✓
WCX-BH018	Hawkesbury Sandstone	326717	6243422		✓	✓
WCX-BH024	Hawkesbury Sandstone	327222	6243306	✓	✓	✓
WCX-BH025	Hawkesbury Sandstone	328637	6243271		✓	✓
WCX-BH039	Hawkesbury Sandstone	329553	6244158		✓	✓
WCX-BH084	Hawkesbury Sandstone	325613	6243435	✓	✓	✓
WCX-BH088	Hawkesbury Sandstone	326182	6243434		✓	✓
WCX-BH093	Hawkesbury Sandstone	327657	6243183	✓	✓	✓
WCX-BH094	Hawkesbury Sandstone	327867	6243174		✓	✓
WCX-BH103	Hawkesbury Sandstone	330431	6245201	✓	✓	✓
WCX-BH137	Hawkesbury Sandstone	324858	6243065	✓	✓	✓
WCX-BH153	Hawkesbury Sandstone	330468	6244766		✓	✓
WCX-BH168	Hawkesbury Sandstone	329702	6243775	✓	✓	✓

Notes: Groundwater monitoring (levels and quality) is additionally required in accordance with the St Peters Interchange Landfill Environmental Management Plan (LEMP). To avoid duplicating requirements, the LEMP wells are not included as part of this table or the WQPMP.

Table 12: Field Parameters and laboratory suite for groundwater monitoring

Parameter	Testing Method	Frequency of testing
Turbidity	Field test – probe/meter	6-monthly
Electrical Conductivity (salinity)	Field test – probe/meter	6-monthly
Temperature	Field test – probe/meter	6-monthly
pH	Field test – probe/meter	6-monthly
Dissolved oxygen	Field test – probe/meter	6-monthly
Oxygen Reduction Potential	Field test – probe/meter	6-monthly
Ammonium	Sampled and laboratory test	6-monthly
Dissolved metals (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	Sampled and laboratory test	6-monthly
Additional metal (Fe and Mn)	Sampled and laboratory test	6-monthly
Organics, Total Recoverable Hydrocarbons (C6-C40)	Sampled and laboratory test	6-monthly
Iron - Ferrous (dissolved)	Sampled and laboratory test	6-monthly
Benzene, Toluene, Ethylbenzene, Xylene	Sampled and laboratory test	6-monthly
Polycyclic Aromatic Hydrocarbons (PAHs),	Sampled and laboratory test	6-monthly
Phenols	Sampled and laboratory test	6-monthly
Organochlorine Pesticides	Sampled and laboratory test	6-monthly
Organophosphorus Pesticides	Sampled and laboratory test	6-monthly
Polychlorinated Biphenyls	Sampled and laboratory test	6-monthly

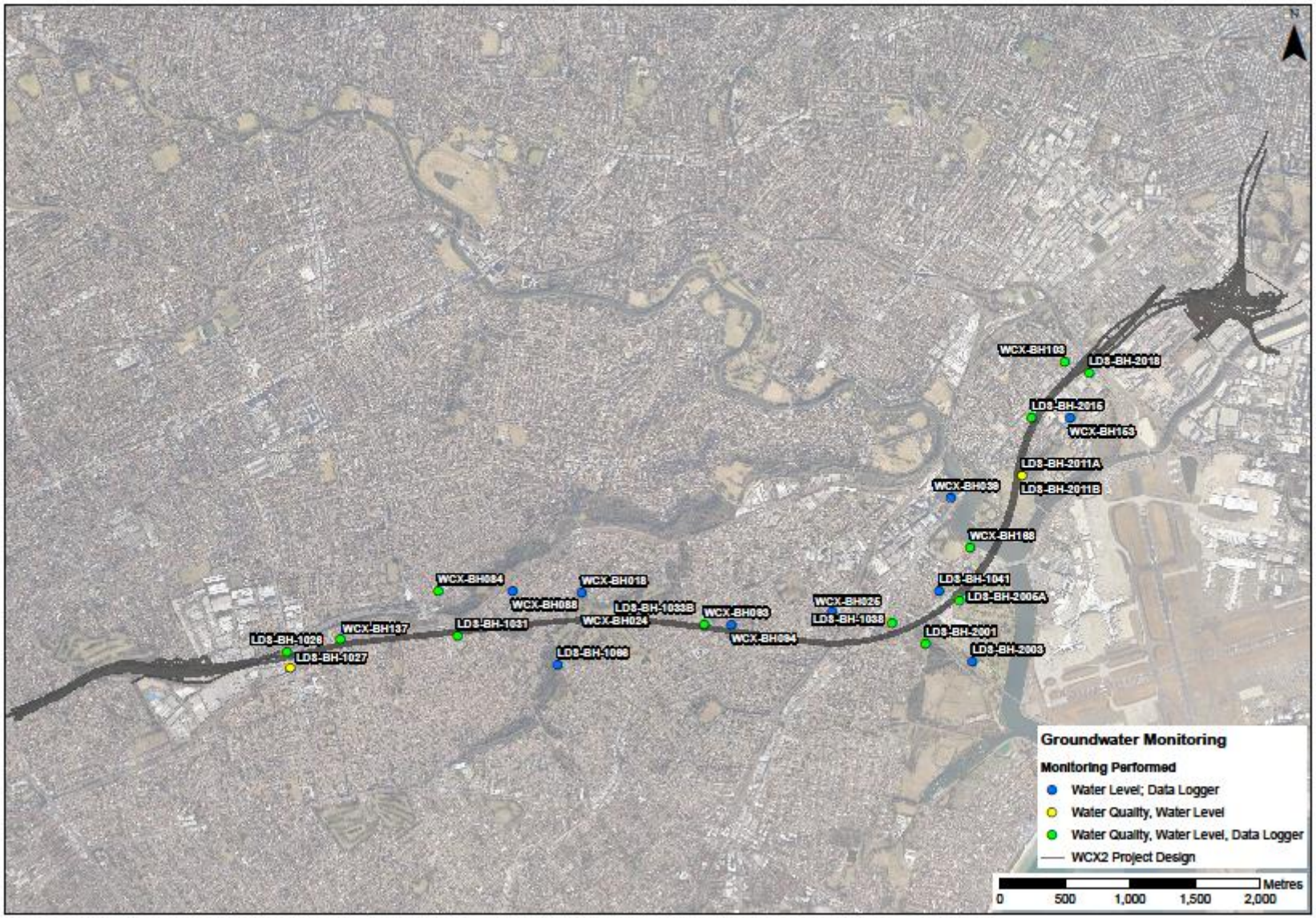


Figure 5: Groundwater Monitoring Locations

4.4 Groundwater dependent ecosystems

Groundwater Dependent Ecosystems (GDEs) are defined as ecosystems whose current species composition, structure and function are reliant on a supply of groundwater as opposed to surface water supplies from overland flow paths. The frequency of groundwater influence may range from daily to inter-annually, however it becomes clearly apparent when either the supply of groundwater or its quality (or both) is altered for a sufficient length of time to cause changes in plant function.

Table 13: Potential GDEs identified

Location	GDE	Type of GDE	Nature of dependence
Western interchange – Beverly Grove Park	Cooks River Castlereagh Ironbark Forest (1.80 ha) along northern edge of highway and south of golf course (listed as Critically Endangered under the EPBC Act and Endangered under the TSC Act).	Ecosystem dependant on subsurface presence of groundwater (i.e. riparian vegetation)	Not applicable – majority of vegetation has been cleared during construction.
MOC3 - Arncliffe	Reach of Cooks River adjacent to operational footprint.	Ecosystem is groundwater inflow dependant	Drawdown at this site may reduce the flow of water from aquifer to the Cooks River. The current flow rate at this location is unknown but is unlikely to be significant.
Bardwell Valley Parkland and Broadford Street Reserve	Hinterland sandstone gully forest (17 ha)	Ecosystem dependent on subsurface groundwater	This GDE is on the edge of the drawdown area. The forest also has access to surface water in Bardwell Creek. Only half of the forest is inside the drawdown boundary.
Stotts Reserve, Bexley North	Coastal sandstone ridgetop woodland (3.5 ha)	Ecosystem dependent on subsurface groundwater	Stotts Reserve is directly above the mainline tunnel. Drawdown could be up to 10 metres, and if trees are dependent on groundwater, a large part of the reserve could show signs of stress in prolonged dry periods. Community would recover with sufficient rainfall.
Forest between the southern bank of Wolli Creek and the rail line behind Wolli Creek Station	Estuarine fringe forest and mangrove forest (3.4 ha)	Ecosystem dependent on subsurface groundwater	This tract of vegetation is on the bank of Wolli Creek, near the edge of the drawdown boundary. It is unlikely that drawdown would be significant here.

The monitoring bore (LDS-BH-1032) used to monitor groundwater levels at Stotts Reserve was destroyed during the construction phase. Ecological monitoring by a suitably quality ecologist was undertaken at Stott's Reserve during construction every three months from August 2018 following preliminary assessments in December 2017 and February 2018. Seasonal canopy growth was recorded with no significant changes in shrub condition. As of February 2020, ecological monitoring indicated that construction activities related to the New M5 tunnel have not impacted the Stott's Reserve GDE.

No monitoring requirements for GDE are proposed for the operational phase. In the event that monitoring is triggered, ecological monitoring by a suitably qualified ecologist is to be undertaken at Stott's reserved on a six-monthly basis.

5 Identification of potential water impacts

5.1 Surface water quality impacts

Post-construction, the small increase in impermeable surfaces would have minimal impact on the local hydrological regime, however there might be an impact on water quality associated with the mobilisation of pollutants in stormwater runoff from these surfaces.

Pollutants in stormwater runoff may include sediments, nutrients, hydrocarbons and metals. These deposits build up on road surfaces and pavement areas and are transported to downstream waterways following rainfall. Other pollutants in the atmosphere, derived from local and regional sources, would also continue to be deposited and build up on road pavements and could impact water quality.

In addition to runoff, spills of fuels, wastes and/or chemicals associated with traffic accidents or transport of hazardous materials could be transported into the receiving environment.

An assessment was undertaken by the construction contractor to consider naturalisation and rehabilitation programs occurring within the waterways along the tunnel alignment; Wolli Creek, Bardwell Creek, lower catchment of Cooks River, Alexandra Canal and the adjoining Shea's Creek. It is understood Sydney Water have been undertaking rehabilitation programs in the upper catchment of the Cooks River and in Alexandra Canal. Operation and maintenance activities will not occur in these rehabilitation areas and are not anticipated to impact these programs. The Wolli Creek Riparian Corridor Management Plan, implemented by the former Sydney Metropolitan Catchment Management Authority (now Local Land Services, Greater Sydney), and the Cooks River Urban Water Initiative implemented by Local Land Services, Greater Sydney, no longer have activities directly adjacent to any operational areas. The O&M contractor will consult with Sydney Water and the relevant councils to ensure any new rehabilitation / naturalisation programs are considered during operations.

The Urban Design and Landscape Plan has been prepared in consultation with the relevant stakeholders to ensure an appropriate landscaping treatment is provided during rehabilitation works in this area. The landscaping design also incorporates water saving urban design principles including:

- Landscaping has been designed to capture runoff from stormwater,
- Plants have been selected that are drought tolerant,
- Watering of vegetation will only take place during establishment, and
- Provision of a rainwater tank at the Motorway Operations Complex (MOC) at Kingsgrove and St Peters.

5.1.1 Stormwater treatment devices

The New M5 drainage design involves a combination of surface drainage structures and underground drainage systems to divert storm water into existing drainage systems which ultimately discharge to the receiving environment.

The Project EIS (New M5 EIS Volume 2E Appendix N – Surface Water) states that water quality treatment will be implemented for the New M5 main carriageways. Water quality controls are located along the length of the main carriageway as identified in Table 14 and shown in Figure 6 and Figure 7.

5.1.1.1 Water Quality Control Basins

A Water Quality Control Basin (WQCB) is a basin with a permanent water storage component. This category of device has an average depth greater than 1.5 m to minimise the growth of emergent plant species and are primarily incorporated into a development configuration for aesthetics.

All WQCB are sized using the first flush and 1-year Average Recurrence Interval (ARI) design criteria, where practical. WestConnex New M5 WQCBs are identified in Table 14 and shown in Figure 6 and Figure 7.

5.1.1.2 Biofiltration systems

Biofiltration systems include biofiltration swales and biofiltration basins. These systems contain bio-filter materials and are vegetated with effective nutrient removal plants. These basins and swales are normally dry with a vegetated surface. Biofiltration systems are identified in Table 14 and shown in Figure 6 and Figure 7.

5.1.1.3 Alternative propriety type water quality controls

The existing M5 East, Gardeners Road, Campbell Road, Campbell Street, Princes Highway and Euston Road are located within a highly urbanised and disturbed catchment. Within existing arterial roads, there is limited space to construct water quality treatment measures, such as water quality basins. Therefore, spill containment basins, Gross Pollutant Traps (GPTs) and hydrodynamic separators have been installed in various locations to reduce the pollutant loads discharged to the receiving environment.

GPTs have typically been provided for this project before the portal pump to reduce litter and in particular, organic matter, from entering and possibly creating anoxic conditions in the wet well and rising mains. The GPTs also reduce the potential anoxic conditions in the rising main from the portal pump.

A hydrodynamic separator is a water quality control device to remove hydrocarbons and suspended solids from stormwater runoff, preventing oil spills and minimising non-point source pollution entering downstream system. Hydrodynamic separators are typically provided for the local roads and Western Interchange.

Table 14: Water Quality Controls for the Asset

Area	Name	Location	Discharge location	Treatment	Sedimentation / spill containment area / volume (relevant storm event for nominated area/volume)
Western Interchange and Portal	Biofiltration swale 2.WQCS.01	Adjacent to New M5 Eastbound portal and shared user path	Wolli Creek	0.7m filter media (sandy loam) 0.1m transition layer (course sand) 0.2m drainage layer (gravel)	Base width 3m 130m in length Incorporated with drainage and the adjacent shared user path design
	Biofiltration basin 2.WQCB.01	Adjacent to New M5 Eastbound portal, Garema Circuit		Emergent vegetation for nutrient polishing	1600m^2 Flow rate: 2.10m^3/sec at 1 year ARI
St Peters Interchange	Biofiltration swale 9.SWB.01	Adjacent to Euston Road to Stage 3 Ramp (Burrows Road)	Alexandra Canal	0.7m filter media (sandy loam) 0.1m transition layer (course sand) 0.15 fine drainage layer 0.2m drainage layer (gravel)	4100m^2 (at surface level)/sec 1.25m^3/sec 1-year ARI
	Water quality basin 9.SWB.02	Adjacent to Stage 3 to Euston Road Ramp (Campbell Road)		Retention time based on 1-year ARI	2650m^3 1.67m^3/sec 1-year ARI
St Peters Local Roads, Campbell Street	Camdenville Basin Strategy Storage Tanks 1 - 5	Campbell Street (west of Princes Hwy to Bedwin Road)	Camdenville Basin, Eastern Chanel	HumeCeptor, treatment on TSS, TP, TN and hydrocarbon spill containment	Total tank capacity 4000m^3 5-year ARI

Area	Name	Location	Discharge location	Treatment	Sedimentation / spill containment area / volume (relevant storm event for nominated area/volume)
St Peters Local Roads, Burrows Road	Biofiltration swale 7B.SW6	Adjacent to Euston Road and Campbell Street (next to MOC5)	Alexandra Canal (formally Shae's Creek)	0.54m filter media (sandy loam) 0.1m transition layer (course sand) 0.2m drainage layer (gravel)	0.054m^3/sec at 1-year ARI

Figure 6: Water quality basins (western portion of the asset)

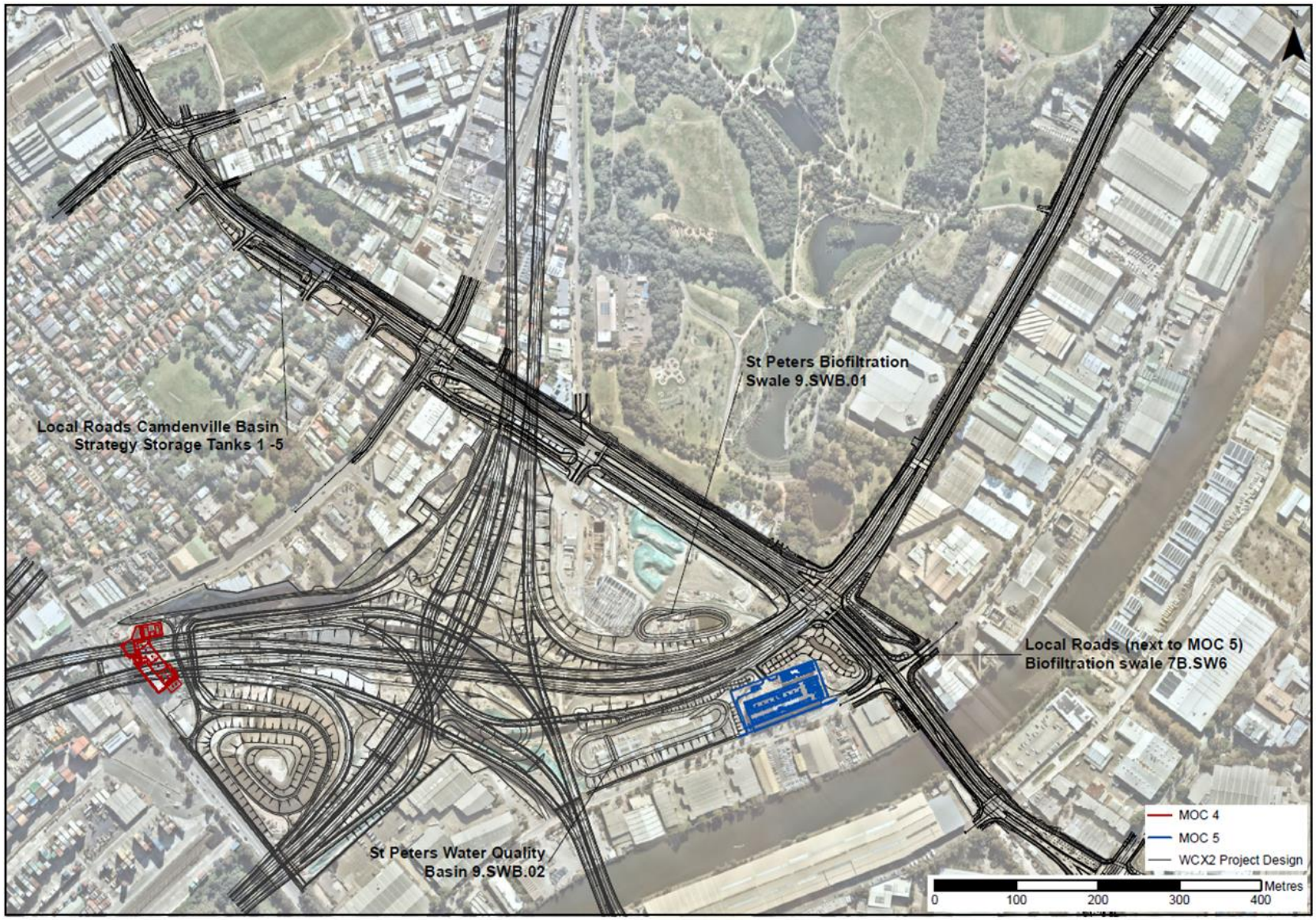


Figure 7: Water quality basins (eastern portion of the asset)

5.1.2 Naturalisation works

Sydney Water are undertaking drainage upgrade activities between Joynton Avenue, Zetland and Maddox Street Alexandria. Alexandra Canal (formerly Sheas Creek) has been widened and a sandstone finish, with rehabilitation and landscaping works is currently being completed in areas along Sheas Creek. The Project's O&M activities will not impact the program of these works.

Sydney Water's rehabilitation programs in the upper catchment of the Cooks River will continue throughout the Project O&M program.

5.2 Operations water treatment plant

During the operational phase of the project, there will be an ongoing inflow of groundwater into the tunnels. The tunnel drainage system has been designed to accommodate the capture, removal, treatment and discharge of groundwater. The permanent operational water treatment facility would be provided at MOC3 - Arncliffe, to treat groundwater to a level suitable for discharge via solids removal, pH correction and metal oxidisation in accordance with the EPL conditions (Annexure B).

Raw water for treatment will be groundwater and washdown water collected in the road tunnels and is expected to contain elevated levels of some metals and nutrients and suspended solids. The water will be pumped to the surface and will be treated through the operation water treatment plant. During normal operation, the water treatment plant will treat and discharge approximately 2ML of water per day.

The water treatment plant has been designed to discharge water which does not deleteriously impact the water quality objectives and values of the receiving environment, as per the ANZECC (2000) Guidelines

A summary of the treatment process is summarised in Figure 8, and will consist of the following components:

- Water from the tunnel is pumped to the surface and through a strainer basket, before being collected in the water treatment plant balance tank,
- At the balance tank, water is aerated and continuously monitored for pH, oxidation reduction potential and dissolved oxygen. The purpose of the tank is to:
  - Balance flow,
  - Provide detention to allow for the complete oxidation reaction,
  - Aeration of the water to mix the contents of the tank, oxidise iron and manganese and strip carbon dioxide, and
  - Correction of the pH with sodium hydroxide (the feed of sodium hydroxide is controlled by the pH monitor),
- Upon leaving the balance tank, water is dosed with a polymer and coagulant to assist in the removal of solids before reaching the Dissolved Air Floatation (DAF) unit.
- The DAF unit will remove solids from the waste water through floatation. The flocculated solids rise to the surface and the sludge produced from this process is collected in a sludge holding tank.
- Sludge from the holding tank is dosed with polyelectrolyte before being dewatered through a rotary screw press. The solids will be discharged directly from the outlet of the screw press into a skip bin which can then be removed offsite to waste facility. The water from this process is then directed back into the balance tank.
- Treated water from the DAF is then dosed and treated through multi-media-filters, where dissolved metals and traces of polymer and fine sediments are captured. The filters are back flushed periodically with water which has been treated through the media filters. The backflush water is directed back into the balance tank for treatment.
- pH, temperature and turbidity is monitored before water is transferred to a tidal storage basin.

The water treatment plant is controlled and monitored via an external control room with full control functionality. At the control room the operator is able to monitor the quality of water at various stages in the treatment process, along with the status of all water treatment plant system alarms and plant.

5.2.1 Operations water treatment plant discharge point

The operation water treatment plant (WTP) discharges treated effluent to a tidal storage basin located to the north of the WTP. Water from the tidal storage basin will be discharged into the concrete-lined Marsh Street Canal at the location shown in Figure 9.

Effluent within the tidal storage basin will be discharged during the outgoing tide via a “wet well” which receives water from the tidal storage basin via PVC pipe at the base of the basin headwall. Effluent will be pumped from the wet well via a submersible pump to a box culvert, which is part of the Arncliffe stormwater drainage network (installed during the Marsh Street Widening Works).

The box culvert passes below Marsh Street and drains to the southern bank of the Cooks River via three 900 mm diameter pipes. The pipes are submerged to a depth of -0.115m AHD, with the outfall to the Cooks River located approximately 100 m north-west of the Marsh Street Bridge (refer to Figure 9).

The New M5 operational activities will be regulated by an Environment Protection Licence (EPL) issued by the NSW Environment Protection Authority (EPA). The operational water treatment plant will discharge water and be monitored in accordance with the requirements of the EPL. The EPL is included in Annexure B.

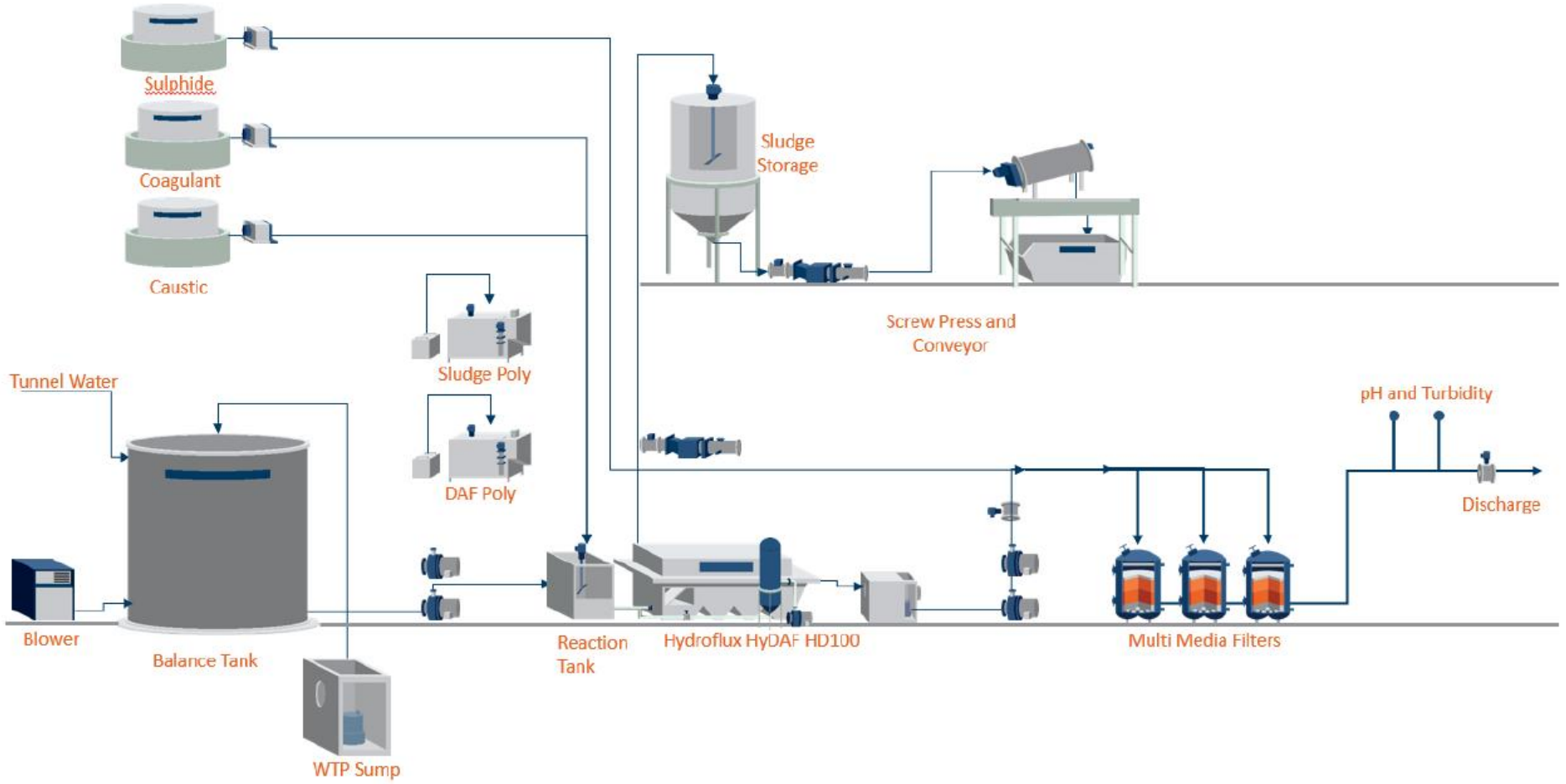


Figure 8: Treatment process for operational water treatment plant

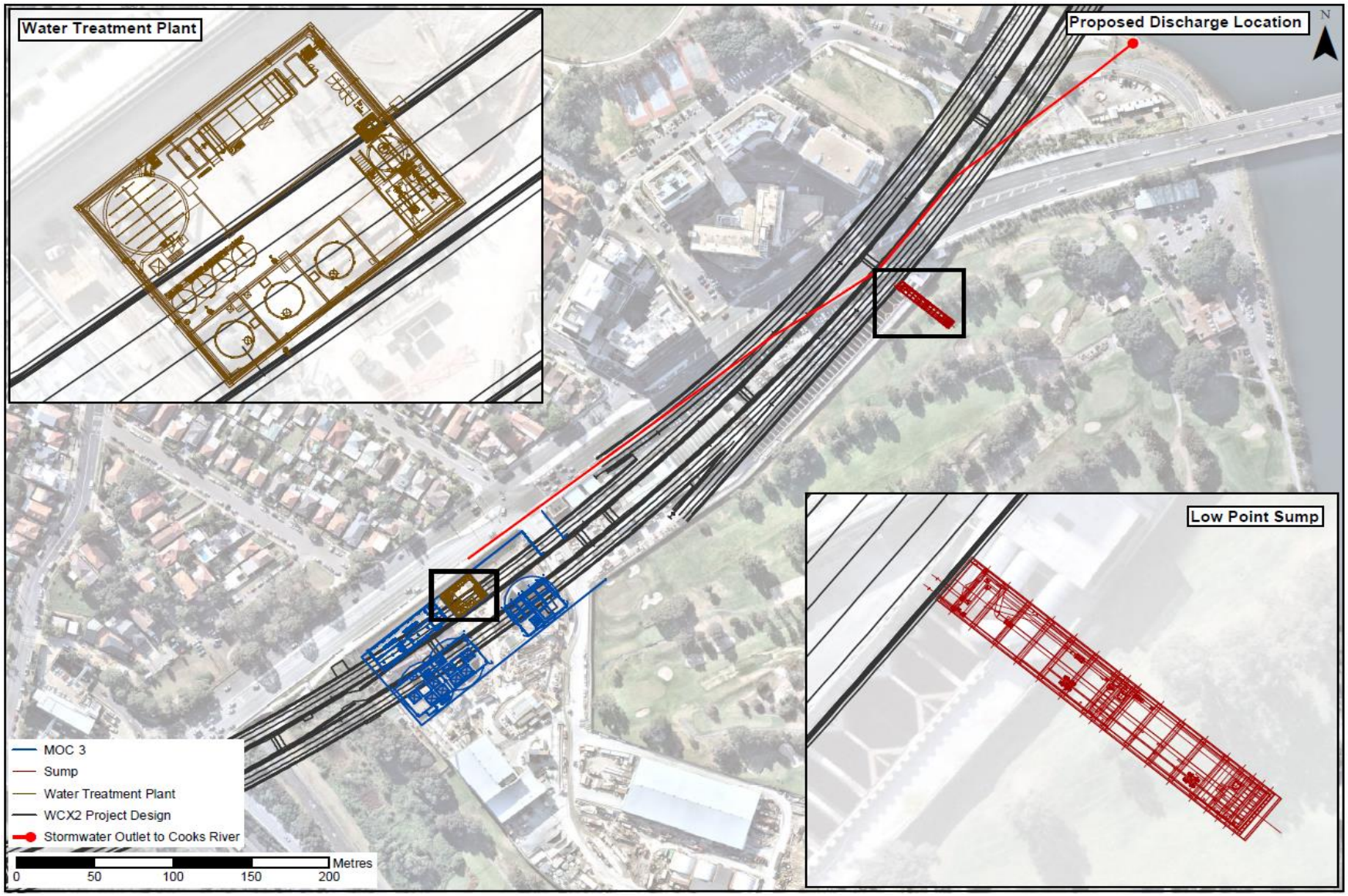


Figure 9: Operation water treatment plant, water tidal basin and discharge point

5.3 Tunnel water quality impacts

Background quality of groundwater in an urban environment like those found within the project corridor is impacted by diffuse contamination sources such as: sewer and stormwater leakage; fertiliser and pesticides applied within residential areas; copper and nickel from vehicle brake pads and lead, nitrogen oxides and hydrocarbons from vehicle exhaust fumes. These diffuse sources are likely to cause groundwater to have background concentration of ammonia, nitrate, lead, copper and nickel, above zero (Golder 2017).

As described in section 4.3, groundwater quality monitoring has been collected from the monitoring network for the period since April 2015. An assessment of groundwater quality monitoring data and predicted inflow rates to determine the concentrations of key contaminants in combined tunnel influent for the tunnel was undertaken during the construction phase and used to model the potential water quality during operations, and the treatment processes required.

5.4 Groundwater Drawdown

Groundwater drawdown resulting from tunnel dewatering may impact local groundwater users and cause changes in water quality. Operational term inflows are anticipated to be less than one litre per second per kilometre of tunnel.

Long term dewatering may impact existing groundwater users registered with NSW DPI (Water). A review of the NSW DPI (Water) groundwater database indicates that of the registered bores within one kilometre of the project alignment approximately half are registered as being used for water supply or irrigation. The majority of these registered bores are shallow (no greater than 10 metres in depth) located within the Botany Sands, Wolli Creek and Cooks River alluvium. Groundwater drawdown at these locations due to drainage into the project tunnels is expected to be minimal due to the hydraulic connection of the alluvium with the surface water in Wolli Creek and Cooks River.

An overview of the licensed bores within one kilometre of the project is included in Appendix A (registered groundwater bores) of Annexure A.

In the event that the drawdown in a water supply bore or irrigation bore exceeds the predicted drawdown, measures would be taken to ‘make good’ the impact by restoring the water supply to pre-development levels. The measures taken will be dependent upon the location of the impacted bore but could include, deepening the bore, drilling a new bore or providing an alternative water supply.

Groundwater drawdown is not predicted to impact nearby GDEs as previously discussed in Section 4.4.

6 Risk management framework

6.1 Risk assessment

A risk management framework for the evaluation of risks to groundwater and surface water resources and dependant ecosystems as a result of the project is provided to identify the level of risk based on the following:

- The likelihood of a potential impact occurring; and
- The consequence of that potential impact.

The definition of likelihood and the consequences are detailed in Table 15 and Table 16 respectively. Table 17 provides the risk assessment matrix.

Table 15: Classification of likelihood for operational activities

Level	Consequence	Description
A	Almost certain	is expected to occur during the project, >90% probability
B	Likely	will probably occur during the project, ~50% probability
C	Moderate	might occur at some time during the project, ~25% probability
D	Unlikely	could occur at some time during the project, ~10% probability
E	Rare	only occur in exceptional circumstances, <1% probability

Table 16: Classification of consequence

Level	Consequence	Description
1	Insignificant	no significant change in flow volumes, water levels or water quality
2	Minor	minor short term and reversible change in flow volumes, water levels or water quality
3	Moderate	moderate, minor breaches of environmental statutes or changes to flow volumes, water levels o r water quality
4	Major	major, ongoing breaches of environmental statutes with major changes to flow volumes, water levels or water quality
5	Severe	shutdown of the Project due to environmental breach causing severe changes to flow volumes, water levels or water quality that may be irreversible

Table 17: Risk assessment matrix

Likelihood	Consequences				
	1 insignificant	2 minor	3 moderate	4 major	5 severe
A almost certain	medium	significant	high	high	extreme
B likely	medium	medium	significant	high	extreme
C moderate	low	medium	significant	high	high
D unlikely	low	low	medium	significant	high
E rare	low	low	low	medium	significant

6.2 Risk evaluation

The risks of potential impacts caused by project (assuming no controls are in place) are summarised in Table 18. Potential impacts identified as having a medium or above risk classification can be downgraded if appropriate controls and management measures are implemented and maintained.

Table 18: Assessment of potential water quality impacts due to the project

Activity	Potential Impact(s)	Receptor	Risk Analysis (likelihood and consequence)				
			Low	Medium	Significant	High	Extreme
Following rainfall event	Increased runoff leading to hydrological and ecological changes to local waterways.	Surface Water		B2			
	Excess rainfall causes deposits build up on road surfaces and pavement areas during dry weather to be washed off and transported to local waterways.	Surface Water			D4		
	Excess rainfall causes erosion.	Surface Water			C3		
	High rainfall causes erosion.	Surface Water			E4		
	Changes in water quality leading to impacts on downstream ecology and downstream community users.	Surface Water			C3		
	Culverts and drainage including sedimentation basins causes reduced water quality in local waterways due to increased turbidity and sediment loading through sediment-laden runoff.	Surface Water	E3				

Activity	Potential Impact(s)	Receptor	Risk Analysis (likelihood and consequence)				
			Low	Medium	Significant	High	Extreme
Vegetation disturbance	Mulching of vegetation trimmings causes: • Contamination of surface water by tannins • Negative impact on local waterways • Reduced water quality in local waterways due to increased turbidity and sediment loading from unstabilised mulch stockpiles.	Surface water	E3				
Emergency scenarios	Spills of hydrocarbons that occur during maintenance activities or vehicle incidents on Motorway	Surface Water and Groundwater		E4			
	Fuel spills during repair of pavements causes contamination of surface water by hydrocarbons.	Surface and ground water		D3			
	Foam release in tunnel (accidentally or in response to an incident).	Surface water			C3		
	Fire in tunnel in combination with hydrocarbon release (i.e. truck in tunnel involved in incident) and heavy rain fills deluge tank.	Surface water				D4	
Litter from Motorway users	Material deposited by motorists, such as non-biodegradable litter and food wastes impacts water quality, amenity and aquatic ecosystems if transported into receiving waterways.	Surface water			D3		
	Litter deposited by motorists, such as non-biodegradable litter and food wastes impacts water quality, amenity and aquatic ecosystems if transported into receiving waterways.	Surface water			D3		
Maintenance Activities	Sediment-laden water from cleaning of drainage and sedimentation basins discharged into waterways.	Surface water			D3		
Groundwater ingress	Contaminated groundwater seepage.	Groundwater and groundwater seepage		D3			
	Ingress of saline groundwater.	Groundwater			D4		
	Lowering of groundwater tables leading to oxidation of potential acid sulfate soils.	Surface and groundwater		D3			
	Changes in groundwater levels leading to impacts on groundwater dependent ecosystems.	Groundwater		E4			
	Altered groundwater chemistry, with releases to surface water.	Surface and groundwater			C3		
	Permanently altered groundwater levels.	Groundwater				A3	
	Drawdown of aquifers and impacts on other groundwater users.	Groundwater			C3		
	Water treatment plant discharges untreated water.	Surface water		D3			

Activity	Potential Impact(s)	Receptor	Risk Analysis (likelihood and consequence)				
			Low	Medium	Significant	High	Extreme
	Water treatment plant discharges untreated water (post 3 year monitoring period).	Surface water		D3			

7 Operation phase Water Quality Monitoring Program

7.1 Introduction

Monitoring will be undertaken in accordance with Australian Standards, ANZECC/ARMCANZ (2000), applicable EPL conditions and the OEMP.

7.2 Surface water monitoring

7.2.1 Water quality monitoring

The Water Quality Monitoring Program will continue for a period of at least three years post-construction (during operation of the project) or until the affected waterways and / groundwater resources are certified by a suitably qualified and experienced independent expert as being rehabilitated to an acceptable condition, unless otherwise approved or directed by the Secretary.

During operation, surface water monitoring will occur at the locations shown in Table 19. The monitoring locations for surface water quality incorporate upstream (control) sites and downstream (impact) sites and are generally a continuation of the pre-construction (baseline) monitoring program and are the same locations monitoring during construction. Surface water monitoring will be undertaken on a monthly basis for the first 12 months of operation, then quarterly for the following two years or unless approved or directed by the Secretary. This will include at least one wet weather monitoring event. This type of monitoring allows for measurements in trends in water quality at each site and also any natural variations in water quality between the upstream and downstream locations.

Given the highly urbanised catchments and potential for tidal influence on downstream reaches, it is expected that there will be natural variations between the upstream and downstream sites and these variations have informed the development of management trigger values (refer to Table 6).

Table 10 contains the parameters to be tested as part of the operation surface Water Quality Monitoring Program. Management trigger values will be used to assess potential impacts on the receiving environment (Section 3.3). In addition:

- Physical parameters (i.e. pH and EC) and dissolved metals will be used to assess basic water characteristics;
- Turbidity changes between upstream and downstream locations will provide an indication of potential impact;
- Nutrients such as ammonia, nitrates and phosphates provide an indication of the organic load present in the water; and
- Total petroleum hydrocarbons (TPH) and BTEXN provide an indication of pollution from hydrocarbons e.g. from fuels, oils, solvents and grease.

Section 5 outlines the operational activities which have the potential to impact surface water quality, including stormwater runoff and discharge from the operational water treatment plant. Stormwater runoff from the operational project has the potential to affect levels of sediments, nutrients, hydrocarbons and metals, as they may be deposited on road surfaces and pavement areas or result from spills associated with traffic accidents. Groundwater treated in the operational water treatment plant is anticipated to contain nutrients, iron and suspended solids, therefore treatment processes focus on solids removal, pH correction and metal oxidation. Based on the potential impacts and parameters of interest associated with operational activities, the project does not propose to include biological indicators in the monitoring program.

O&M Maintenance personnel, duly qualified, will undertake the sampling and monitoring in accordance with the appropriate Standard Operation Procedure (SOP) for Sampling and Monitoring Surface Water. The QSE Manager will review the monitoring and report on the results.

Table 19: Operation Surface Water Monitoring Locations

Site ID	Easting	Northing	Watercourse	Location	Receiving environment
LDS-SW-01	332938	6246524	Freshwater	Upstream	Sheas' Creek
LDS-SW-02	331540	6244935	Estuarine / marine	Downstream	Alexandra Canal
LDS-SW-03	330581	6245909	Freshwater	Downstream	Eastern Channel
LDS-SW-05	329491	6244746	Estuarine / marine	Upstream	Cooks River
LDS-SW-06	329895	6243716	Estuarine / marine	Downstream	Cooks River
LDS-SW-07	330120	6243607	Estuarine / marine	Downstream	Cooks River
LDS-SW-08*	322993	6242760	Freshwater	Upstream	Wolli Creek
LDS-SW-09*	324663	6243087	Freshwater	Upstream	Wolli Creek
LDS-SW-10	325577	6243239	Freshwater	Upstream	Wolli Creek
LDS-SW-11	327910	6244087	Freshwater	Downstream	Wolli Creek
LDS-SW-12	329991	6243607	Estuarine / marine	Adjacent	Cooks River

Note: *Wet weather monitoring only, as there is an inadequate volume of water in the channel during dry weather to enable sampling to occur.

7.2.2 Quality assurance

As part of the operation sampling, quality assurance and control samples will be undertaken to ensure the integrity of the dataset in accordance with Geoscience Australia's Groundwater sampling and Analysis – A Field Guide (Geoscience Australia 2009). This includes the following QA/QC procedures:

- Samples were collected in clearly labelled bottles with appropriate preservation solutions;
- Samples were delivered to the laboratories within the specified holding times;
- Unstable parameters were analysed in the field (physico-chemical parameters); and

- Field duplicate samples (QA samples) were collected at a rate of one in ten samples.

All containers are to be clearly labelled with the location, date/time, method, name and duplicate details, with the same documented on dedicated field sheets. Samples are to be placed immediately in chilled containers and transported to a NATA-accredited laboratory under documented chain-of-custody protocols.

7.2.3 Streambed fracturing

Streambed fracture relates to the flow of creek water over rock outcrops and the possibility of creek bed joints opening due to tunnel construction; the impact of which is potential diversion of surface water to underground. The presence of rock outcrops within the active channel of waterways is not known to occur along the project alignment. Wolli Creek, Bardwell Creeks and Cooks River flow over alluvium infilled valleys rather than rock outcrops. There were no known observable occurrences of rock outcrops along the active channels of Bardwell Creek and Wolli Creeks during the construction phase of the Project.

Streambed fracture is a potential risk where tunnelling traverses a waterway. Streambed fracturing during construction was monitored by:

- Assessing water inflows to the tunnel excavation; and
- Visual surveillance of waterways when tunnelling in proximity of waterways.

Due to no known streambed fracturing events during the construction period, no monitoring requirements are proposed for the operational phase.

7.3 Water Treatment Plant discharge monitoring

The water treatment plant has been designed to discharge water which does not deleteriously impact the water quality objectives and values of the receiving environment, as per the ANZECC (2000) Guidelines.

Water within the water treatment plant will be continuously monitored for pH, oxidation reduction potential and dissolved oxygen to inform the treatment process. Once treated, water will also be continuously monitored for pH, conductivity and turbidity before being discharged to the tidal storage basin (refer to section 5.2).Treated water from the water treatment plant and adjacent receiving waters will also be monitored in accordance with the Environmental Protection Licence (Annexure B).

7.4 Groundwater monitoring

Operational groundwater monitoring will continue for a minimum period of three years or until a suitably qualified and experienced independent expert certifies groundwater conditions are in an acceptable condition (whichever is sooner). Groundwater monitoring will be undertaken on a six monthly basis for three years or unless approved or directed by the Secretary. This frequency during the operational phase is deemed to be suitable to characterise any changes in groundwater quality conditions, as groundwater migration is slow and any quality changes would subsequently emerge slowly.

Further details on the monitoring program are provided below.

7.4.1 Groundwater Quality Monitoring

During the operation of the project groundwater quality monitoring would be completed at the locations in Table 20 and Figure 5. Groundwater monitoring will be undertaken on a six-monthly basis for three years or unless approved or directed by the Secretary. Trend analysis will be undertaken for selected analytes as outlined in Table 21 to identify changes in groundwater quality. The QSE Manager will monitor and report on the results.

Table 20: Groundwater Monitoring Bores during Operation

Monitoring Bore	Coordinates		Elevation (m AHD)	Screen Interval (m AHD)		Groundwater level (range)	Type of installation	Screened unit
	Easting	Northing		Top	Bottom			
LDS-BH-1026	324448	6242973	16.45	-17.4	-23.4	15.65 to 16.07	Standpipe piezometer	Hawkesbury Sandstone
LDS-BH-1027	324475	6242852	20.17	13.2	10.2	15.30 to 15.57	Standpipe piezometer	Hawkesbury Sandstone
LDS-BH-1031	325760	6243091	13.89	-24.1	-30.1	4.87 to 5.31	Standpipe piezometer	Hawkesbury Sandstone
LDS-BH-1033B	326949	6243221	12.57	-12.43		6.36 to 7.06	Standpipe piezometer	Hawkesbury Sandstone
				-1.4	-7.4	6.34 to 6.50	Standpipe piezometer	Hawkesbury Sandstone
LDS-BH-1038	329099	6243198	15.15	-49.8	-58.8	-0.47 to -0.07	Standpipe piezometer	Hawkesbury Sandstone
LDS-BH-1041	329465	6243437	1.93	-12.17		-1.04 to -0.21	VWP inclined at 70	Alluvium
				-20.72		-1.51 to -0.34	VWP inclined at 70	Alluvium
				-25.32		-1.83 to -0.45	VWP inclined at 70	Alluvium
				-59.53		-1.25 to -0.46	VWP inclined at 70	Hawkesbury Sandstone
LDS-BH-1066	326526	6242873	12.59	-17.8	-23.8	12.59	Standpipe piezometer	Hawkesbury Sandstone
LDS-BH-2001	329361	6243035	2.21	0.2	-2.8	1.70 to 2.11	Standpipe piezometer	Alluvium
LDS-BH-2003	329720	6242895	2.41	-3.6	-6.6	0.69 to 0.99	Standpipe piezometer	Alluvium
LDS-BH-2005a	329618	6243371	1.10	-11.4		-0.93 to -0.60	VWP	Alluvium
				-15.9		-1.05 to -0.86	VWP	Alluvium
				-21.9		-0.92 to -0.75	VWP	Alluvium
				-25.9	-26.9	-0.52 to -0.13	Standpipe piezometer	Hawkesbury Sandstone
LDS-BH-2011A	330075	6244315	2.22	-27.8	-39.8	0.99 to 1.16	Standpipe piezometer	Hawkesbury Sandstone
LDS-BH-2011B	330075	6244316	2.19	-0.8	-2.8	1.16 to 1.27	Standpipe piezometer	Alluvium
LDS-BH-2015	330178	6244781	15.80	-21.2	-30.2	7.36 to 7.50	Standpipe piezometer	Hawkesbury Sandstone
LDS-BH-2018	330616	6245122	12.67	0.2	-5.8	4.68 to 5.02	Standpipe piezometer	Hawkesbury Sandstone
WCX-BH018	326717	6243422	34.84	-16.2	-19.2	-3.83 to 14.54	Standpipe piezometer	Hawkesbury Sandstone
WCX-BH024	327222	6243306	8.17	-17.9	-20.9	-1.14 to -0.53	Standpipe piezometer	Hawkesbury Sandstone
WCX-BH025	328637	6243271	23.85	-31.2	-34.2	-5.55 to -5.55	Standpipe piezometer	Hawkesbury Sandstone
WCX-BH039	329553	6244158	3.32	-45.7	-48.7	-1.18 to -0.78	Standpipe piezometer	Hawkesbury Sandstone
WCX-BH088	326182	6243434	16.78	-24.2	-27.2	0.65 to 1.44	Standpipe piezometer	Hawkesbury Sandstone
WCX-BH093	327657	6243183	36.39	-10.6	-13.6	23.09 to 27.57	Standpipe piezometer	Hawkesbury Sandstone
WCX-BH094	327867	6243174	31.17	-22.8	-25.8	24.11 to 29.34	Standpipe piezometer	Hawkesbury Sandstone
WCX-BH103	330431	6245201	11.10	-36.9	-39.9	4.35 to 5.00	Standpipe piezometer	Hawkesbury Sandstone
WCX-BH137	324858	6243065	15.15	-38.9	-41.9	14.97 to 15.12	Standpipe piezometer	Hawkesbury Sandstone
WCX-BH153	330468	6244766	11.24	-34.8	-37.8	3.03 to 3.28	Standpipe piezometer	Hawkesbury Sandstone

Monitoring Bore	Coordinates		Elevation (m AHD)	Screen Interval (m AHD)		Groundwater level (range)	Type of installation	Screened unit
	Easting	Northing		Top	Bottom			
WCX-BH168	329702	6243775	1.36	-46.6	-49.6	-0.37 to 0.16	Standpipe piezometer	Hawkesbury Sandstone

Table 21: Analytes selected for trend analysis in groundwater

Analyte(s)	Rationale for selection
pH	Monitor for any potential influence from acid sulphate soil possibly present in some of the project area
EC	Monitor for saltwater intrusion from Cooks River
Arsenic **Chromium** **Copper** **Lead** **Iron** **Ammonia**	Monitor for potential mobilisation of these analytes from the surrounding environment based on the potential ecotoxicology of these metals and based on baseline observations.
TRH **BTEX**	Monitor for potential mobilisation of these analytes from the surrounding environment (i.e. petrol stations).

7.4.1.1 Leachate Treatment Plant

The St Peters Interchange surface site is located at the former Alexandria Landfill. Landfill leachate will continue to be directed to the landfill leachate treatment plant, in accordance with the landfill's Environment Protect Licence (EPL4627), where applicable and discharged to sewer in accordance with the trade waste agreement with Sydney Water. This Operation Water Quality Plan and Monitoring Program does not address the Alexandria Landfill leachate collection and treatment systems. Detail on these systems is provided in the St Peters Interchange - Landfill Closure Management Plan.

7.4.2 Groundwater Level Monitoring

Groundwater level monitoring will be undertaken at all monitoring locations noted in Table 20 and Figure 5. To provide a more detailed understanding of the groundwater water monitoring, automatic data loggers were installed in the majority of wells measuring groundwater fluctuations automatically at a two-hour interval. Monitoring wells have been positioned to allow for monitoring of shallow and deep groundwater levels during both the construction and post-construction phases of the project and in key areas, such as near potential groundwater dependent ecosystems.

Measured groundwater levels across the tunnel alignment range from 31.3 mAHD to -17.39 mAHD and are influenced by the topography and presence of geological structural features. Groundwater levels in and around the Alexandria Landfill fluctuate in response to a number of influences. The groundwater levels decline after extended periods of low rainfall and the influences of the leachate pumping from the western part of the landfill. Conversely groundwater levels rise in response to rainfall recharge and the leachate pump being switched off.

Groundwater levels measured within the Ashfield Shale in the eastern part of the alignment are considered to be artificially depressed due to local pumping of leachate from the Alexandria Landfill. Groundwater level fluctuations within the basalt have been measured in BH040, located adjacent to Cooks River. The groundwater levels appear to be hydraulically linked to the river as there are daily oscillations of approximately 0.2 m which are attributed to tidal influences.

Groundwater level measured in the alluvium adjacent to Cooks River at Tempe Railway Station fluctuates with a daily cyclic oscillation of between 0.2 m and 0.4 m attributed to tidal influences, and in response to rainfall. Groundwater level fluctuations have been monitored in the Botany Sands aquifer in Banksia Field, Arncliffe and appear to be influenced by rapid recharge measured in mid-February 2015 and rapid drawdown presumably due to pumping.

The majority of the alignment intersects groundwater within the Hawkesbury Sandstone. East and West of the Cooks River groundwater levels fluctuate in response to rainfall over an amplitude between 0.5 m and 1 m. Superimposed over these changes in groundwater levels in monitoring wells close to Cooks River are cyclic variations of a few millimetres which are interpreted as tidal influences; this suggesting there is a hydraulic connection with the Cooks River.

Identification of a groundwater decline (including a decline in quality and/or quantity) in a water supply bore (beyond seasonal fluctuations in nearby monitoring bores) will be monitored to determine whether the decline is attributable to dewatering from the project. The assessment will include a review of groundwater levels and groundwater quality in the relevant bore and surrounding monitoring bores. Where such an impact is confirmed, 'make good' provisions for the relevant groundwater users will apply. 'Make good' will only apply to registered bore users.

Modelling predicts a maximum of two metres of groundwater drawdown in areas of retained Groundwater Dependent Ecosystems. This is unlikely to stress the community as the natural seasonal variation drawdown is within this parameter (CDM Smith, 2015).

7.4.3 Monitoring Methodology

7.4.3.1 Elevation assessment and purging

The following procedure will be implemented for groundwater elevation testing:

- Groundwater monitoring is to be overseen by personnel with appropriate qualifications and experience, with field sampling undertaken by trained personnel using appropriate personal protective equipment (PPE) (note that gloves are to be changed for each sampling site to prevent cross-contamination).
- The static groundwater elevation within each groundwater monitoring well will be measured prior to purging (if required) or sampling. The water level will be measured using a groundwater level dip metre from the Top of Casing (TOC) to the nearest millimetre.
- Bottom of Casing (BOC) will be measured to the nearest millimetre as well by lowering the meter to the base of the well until it touches the bottom. These levels will be recorded;
- Following measurements of water level, the monitoring well will be purged using a low flow pump prior to sampling to remove stagnant water within the well casing and ensure a representative sample can be collected. If use of Hydrosleeve sampling method is adopted purging will not be required.
- Field water quality parameters will be measured using calibrated equipment including temperature, dissolved oxygen, pH, oxidation and reduction potential and electrical conductivity) during purging (if applicable).
- The groundwater monitoring well will be considered to be purged when one of the following criteria is achieved (whichever occurs first):
  - Three well volumes of water have been purged; or
  - The well is purged until no more water can be removed (considered dry); or
  - The water quality parameters are stabilised within 10% over three consecutive recorded measurements.

In the event that any water level logger is removed from the bore, it will be checked and maintained as necessary before being re-calibrated and then returned to the monitoring bore and at the known distance from the measuring point, but so as to not sit on the bottom of the bore.

7.4.3.2 Sample collection

At the completion of purging (if relevant), groundwater samples will be collected into dedicated laboratory-supplied sampling bottles with sufficient volume to satisfy the requirements for all analytes.

The samples will be placed into a chilled ice-chest for transport to the nominated laboratory(s). Where required for some laboratory containers (metal analysis), the water sample will also be field filtered using a dedicated 0.45µm water filter to remove fine suspended particles.

Cross-contamination of samples will be prevented through either dedicated tubing at the pump, dedicated Hydrosleeve sampling devices or by decontamination with phosphate-free detergent and clean water between sampling locations.

7.4.3.3 Quality Assurance and documentation

As part of sampling, quality assurance and control samples during sampling will be undertaken to ensure the integrity of the dataset. These are to include:

- Rinsate blanks (one per sampling event only);
- Blind duplicates (at a rate not less than 20% of total samples); and
- Split duplicates (at a rate not less than 20% of total samples).

All containers are to be clearly labelled with the location, date/time, method, name and duplicate details, with the same documented on dedicated field sheets.

Samples are to be transported to a NATA-accredited laboratory under documented chain-of-custody protocols.

8 Management and Mitigation

The control measures to achieve best management water quality practices are included in the OEMP (refer to the Operational Water Management Plan, section 4) and are not repeated here. The following sections detail incident management and trigger response actions.

8.1 Surface Water Quality

The ongoing water monitoring program will be used to identify potential project impacts on the receiving waters during operation, and to inform appropriate management and mitigation responses. For surface water quality, a management response will be triggered if exceedances of any of the management trigger values listed in Section 3.3 occurs. The management response process flow is presented in Figure 10.

It is important to note that the method used to calculate management trigger values for the project recognises the inherent variability of natural systems by acknowledging natural and sampling induced variation. The data's occasional excursion beyond a management trigger value may be a chance occurrence, may be due to other land use factors or may indicate a potential problem. The method used to calculate management trigger values for the project recognises the inherent variability of natural systems by acknowledging natural and sampling induced variation.

Water quality management trigger values will be reviewed for appropriateness in each annual monitoring report.

8.2 Groundwater Quality

The ongoing water monitoring program will be used to identify potential project impacts on groundwater during operation and to inform appropriate management and mitigation responses.

For groundwater quality, a management response will be triggered as described in the response action process flow presented in Figure 11.

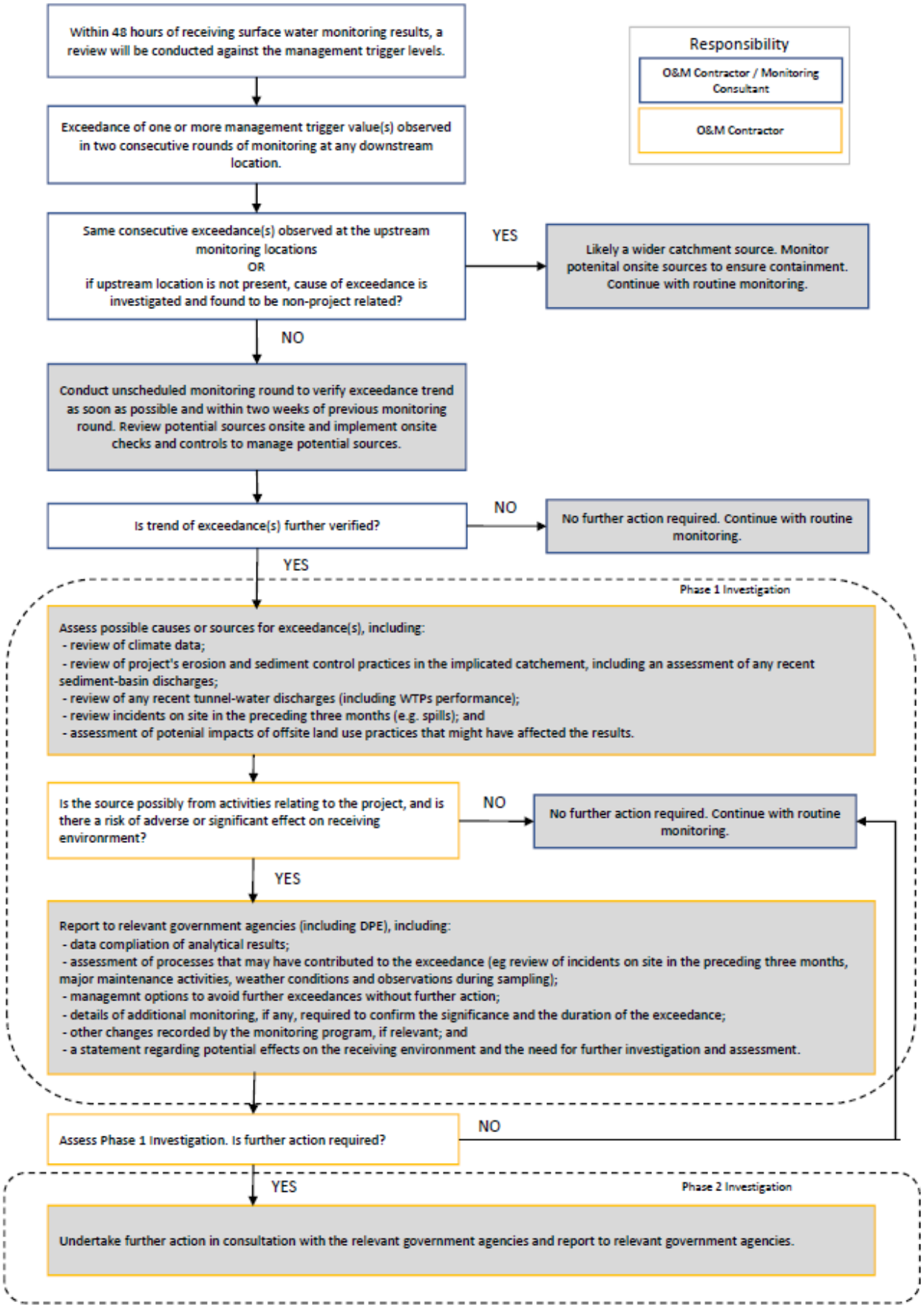


Figure 10: Response action process for exceedances of surface water quality threshold

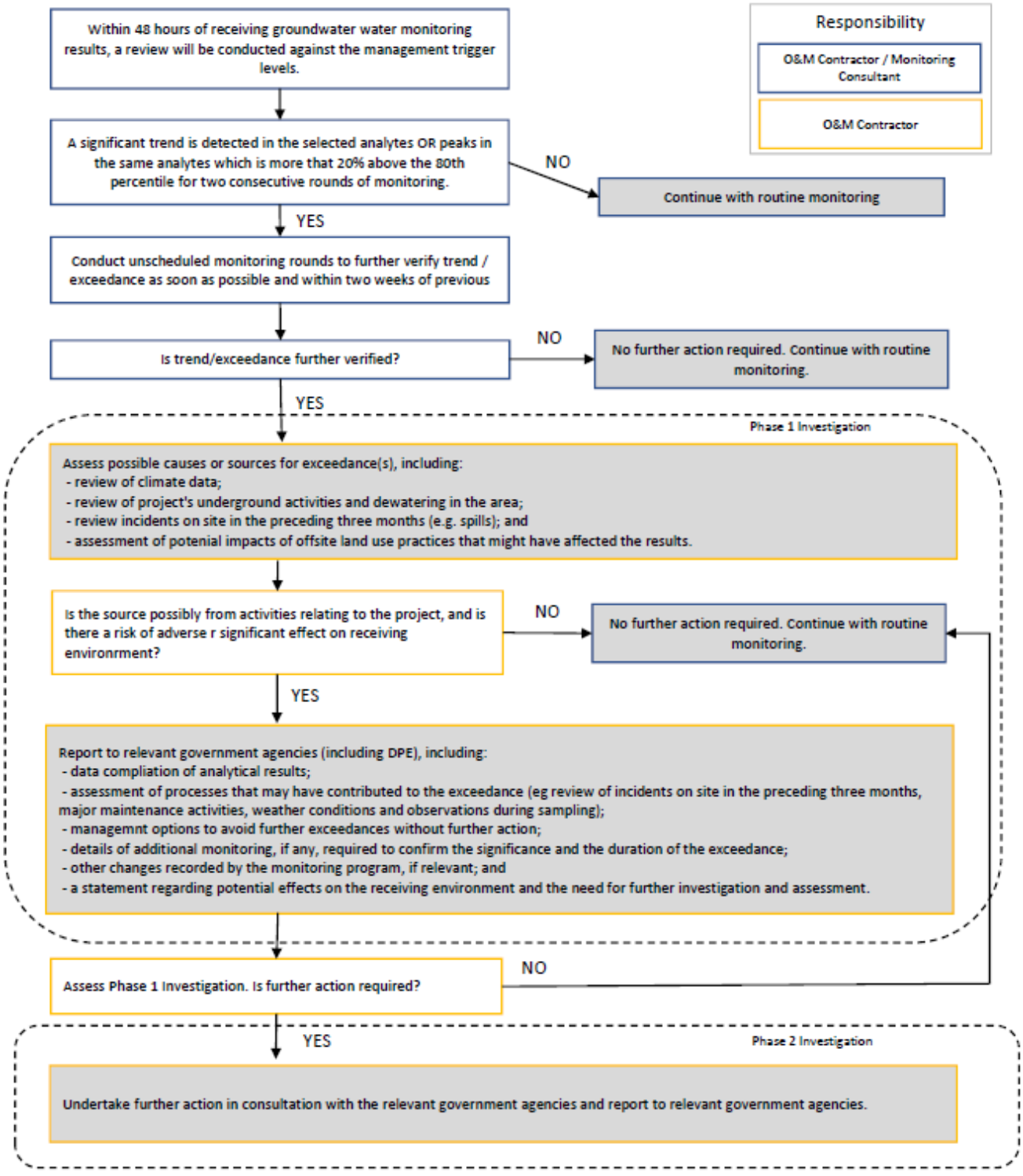


Figure 11: Response action process for exceedance of groundwater quality threshold

8.3 Groundwater Levels

A management response will be triggered if groundwater level drawdown in monitoring bores LDS-BH-1033B, LDS-BH-1066, and WCX-BH039 exceeds the nominated threshold by more than 2 m. The response action process is described in Figure 12.

The groundwater level threshold will be reviewed for appropriateness in the annual monitoring report.

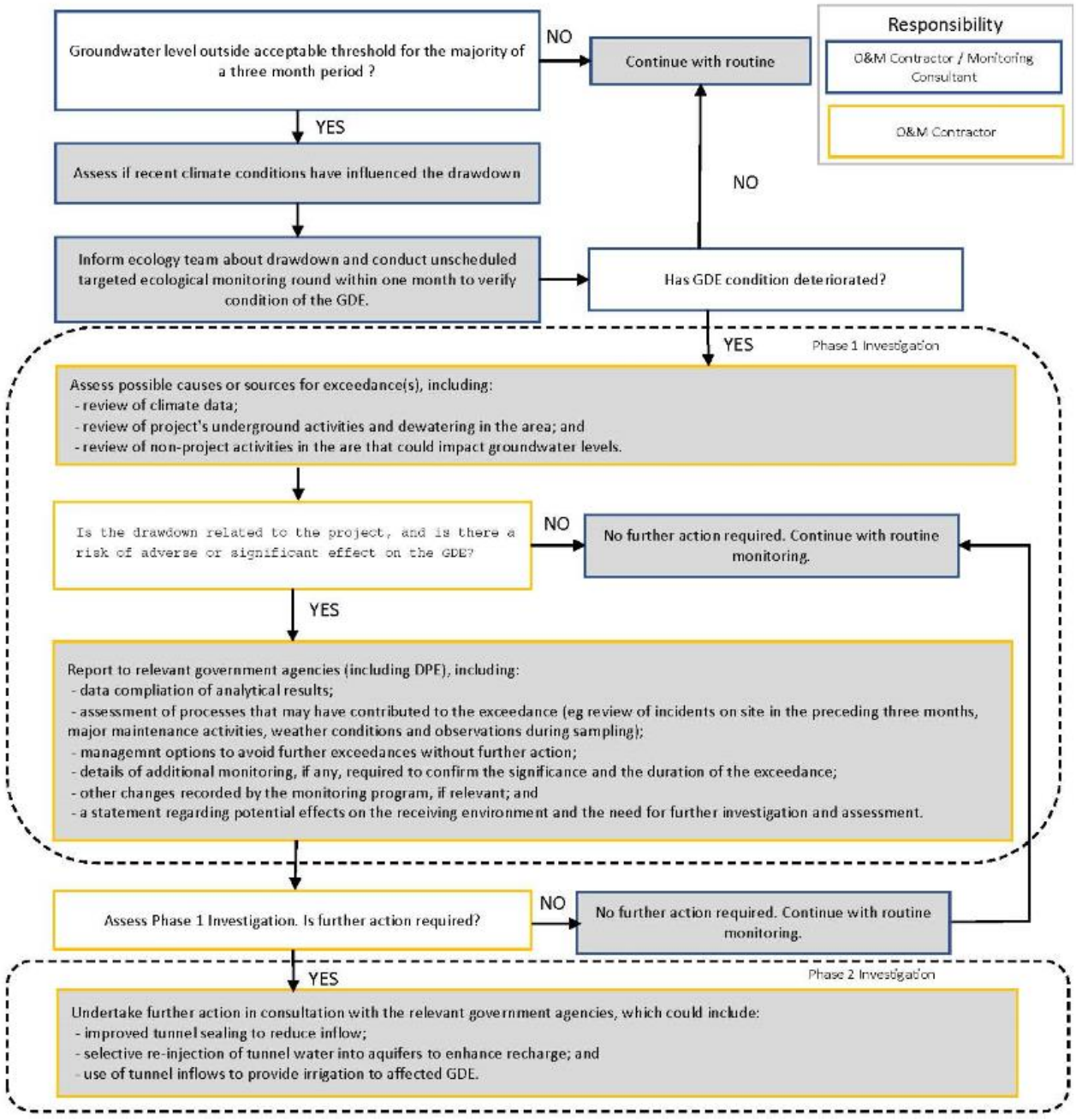


Figure 12: Response action process for exceedance of groundwater level threshold

8.4 Incidents

Table 22 describes potential incidents and potential responses that could be undertaken for their mitigation. Note that other responses might be deemed appropriate at the discretion of the O&M Project Manager. The table applies equally to surface and tunnel works.

Table 22: Incident triggers and potential responses

Incident	Potential Responses (note that others are possible)	Responsibility
Spillage of hazardous materials	• Stop work • Activate spill containment procedures (Refer to OEMP) immediately • Report the incident	O&MM, MM, QSEM
Unanticipated discovery of contaminated soil/water	• Stop work • Activate contamination contingency plan (Refer to OEMP) immediately • Report the incident	O&MM, MM, QSEM
Fish kill in receiving waters	• Stop work • Report the incident to OEH, Fisheries • Commence investigation into potential causes • Follow Project Emergency Response procedure if required.	O&MM, MM, QSEM
Exceptional rainfall event	• Use erosion controls (i.e. source controls) wherever possible • Maintain/manage erosion and sediment control devices, including sediment basins • Conduct ongoing monitoring and maintenance of controls.	O&MM, MM, QSEM
Treatment plant/basin failure	• Stop work in relevant catchment • If rain is forecast cover all exposed soil surfaces with soil binder or geotextile • Repair the basin or treatment plant • Refer to the water quality monitoring data and seek professional help in the case of a treatment plant failure.	O&MM, MM, QSEM

O&MM – Operation and Maintenance Manager, MM – Maintenance Manager, QSEM – Quality Safety and Environmental Manager

9 Reporting

Reporting is required as part of this WQMP to ensure project management is responsive and appropriate. Table 23 details the proposed reporting schedule.

Table 23: Operational reporting schedule

Project phase	Report timing	Report requirements
Operation	Six-monthly (for a minimum of three years)	Raw surface and groundwater data to be collected and tabulated. Trigger exceedances to be highlighted.
		Report to confirm implementation and compliance of required operational water control measures, including sedimentation basins, swales and operational water treatment plant. Monitoring data collected will be utilised to review and, if required, revise the management trigger values so they are consistent with ANZECC guidelines
	Annual	Extracted groundwater volumes to be reported to DPI (Water) for a minimum of three years (in accordance with CoA B28(r)).
	Annual	Summary report of water monitoring data required under this WQMP, including any relevant findings, to be provided to DP&E, EPA and the relevant councils (in accordance with CoA B28(s)).
	Monthly	Summary reporting of monitoring data required by the Environmental Protection Licence for the operation of the Operations Water Treatment Plant.
	As required	Report on justification for continuation or cessation of the Water Quality Monitoring Program as required (generally in line with CoA B28(m)).

10 Review and improvement

Continual improvement is achieved through constant measurement and evaluation, audit and review of the effectiveness of the plan, and adjustment and improvement of the OEMP, project environmental outcomes and O&M Environmental Management System.

This program will be updated as required:

- To take into account changes to the environment or generally accepted environmental management practices, new risks to the environment, any hazardous substances, contamination or changes in law;
- Where requested or required by the NSW Department of Planning, Industry and Environment or any other Authority; or
- In response to internal or external audits or quarterly management reviews.

During operation the update program would be reviewed and approved in accordance with the process in Section 9 of the Operation Environment Management Plan.

11 References

AECOM (2015), WestConnex The New M5 – Environmental Impact Statement. Prepared for Roads and Maritime Services, 20 November 2015.

AECOM (2015). WestConnex The New M5 – Appendix N Technical Working Paper Surface Water. Prepared for Roads and Maritime Services, 20 November 2015.

AECOM (2015). WestConnex The New M5 – Appendix Q Technical Working Paper Groundwater. Prepared for Roads and Maritime Services, 20 November 2015.

ANZECC/ARMCANZ (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (collectively known as the 'ANZECC Guidelines').

ANZECC/ARMCANZ (2000). *Australian and New Zealand Guidelines for Water Quality Monitoring and Reporting* (collectively known as the 'ANZECC Guidelines').

Bureau of Meteorology (BOM) 2015. Atlas of Groundwater Dependent Ecosystems. Available: http://www.bom.gov.au/water/groundwater/gde/map.shtml [Accessed 02 December 2015]

CDM Smith (2015). West Connex Stage 2 New M5 Groundwater Modelling Report. Prepared for AECOM, 28 September 2015.

DECC (2008). *Managing Urban Stormwater: Soils and Construction.* Volume 2D: Main Road Construction. Department of Environment and Climate Change. NSW Government, Sydney.

Department of Primary Industries (2015). http://allwaterdata.water.nsw.gov.au/water.stm Accessed October 2015.

Golders (2017) WestConnex New M5 Hydrogeological Design Report. prepared for CDS-JV, 13 April 2017

Landcom (2004). *Managing Urban Stormwater: Soils and Construction.* Volume 1, 4th Edition. NSW Government, Sydney.

Annexure A Water Quality Plan & Monitoring Program (Construction Phase)

Water Quality Plan & Monitoring Program

Project Name: WestConnex New M5

Project number:	15.7020.2597
Document number:	M5N-ES-PLN-PWD-0027
Revision date:	8/12/2016
Revision:	05

Document Approval

Rev.	Date	Prepared by	Reviewed by	Recommended by	Approved by	Remarks
00	17/02/16	CDS-JV				
01	01/04/16	CDS-JV				
02	27/04/16	CDS-JV				
03	07/06/16	CDS-JV				
04	20/07/16	CDS-JV				
05	08/12/16	CDS-JV				
Signature:						

Details of Revision Amendments

Document Control

The Project Director is responsible for ensuring that this Plan is reviewed and approved. The Support Services Director is responsible for updating this Plan to reflect changes to the Project, legal and other requirements, as required.

Amendments

Any revisions or amendments must be approved by the Project Director before being distributed or implemented.

Revision Details

Revision	Details
00	Initial Draft for Information / Informal Review
01	Issued for consultation and review by DP&E
02	Issued for consultation and review by key stakeholders
03	Issued to DP&E approval
04	Revised to address DPI Water, Inner West Council, and DP&E comments. Issued for DP&E approval
05	Update to address additional DPI Water comments. Issued for information.

Contents

1. Introduction

1.1 Purpose and Application

The purpose of this Water Quality Plan and Monitoring Program (WQP&MP) is to describe how CPB Contractors Dragados Samsung Joint Venture (CDS-JV) will monitor the extent and nature of potential impacts to surface and groundwater quality during construction of the WestConnex New M5 Project.

This WQP&MP will be implemented to monitor the effectiveness of mitigation measures applied as part of the Project. This Plan and Program is prepared to consider Project requirements, applicable legislation and the New M5 environmental impact statement (EIS) (AECOM 2015). This WQP&MP is based on the comprehensive assessment and analysis performed as part of the New M5 EIS and SPIR, and therefore takes into consideration the environmental risks identified within it.

This WQP&MP does not apply to the Alexandria Landfill leachate collection and treatment systems. Permanent drainage, stormwater quality and flooding is considered in the Design Criteria Report – Drainage, Stormwater Quality and Flooding (M5N-AJV-TER-100-300-DR-1012).

This WQP&MP should be read in conjunction with the Construction Environment Management Plan (CEMP) and, in particular, the Construction Soil and Water Quality Sub-Plan (CSWQSP).

1.2 Context

The Project area is described in detail within the Construction Soil and Water Quality Sub Plan (CSWQSP). The CSWQSP includes specific sections on topography, soils, surface water, groundwater and groundwater dependent ecosystems. The CSWQSP should be referred to for the detailed information regarding the project environment and receiving environment.

In summary, the Project is wholly located within the Cooks River catchment. Several waterways cross the Project area or are in close proximity to the Project area. Riparian connectivity along creek lines that cross the Project footprint is minimal due to surrounding residential and industrial areas with little, if any, vegetation present along the edges of most waterways. Wolli Creek is an exception, with the Wolli Creek Regional Park located between Earlwood and Turrella. Figure 1 presents the waterways and catchments the Project lies within.

The Project's Environmental Impact Statement (EIS) (AECOM, 2015), and Submissions and Preferred Infrastructure Report (AECOM, 2016) identified that groundwater systems within the Project area are located in Quaternary age sediments; Triassic age Ashfield Shale; and Triassic age Hawkesbury Sandstone. Sixty-one bores registered by DPI Water were identified in the EIS (AECOM 2015) within a one kilometre radius of the Project area. The majority of the bores are located in the Tempe, St Peters and Alexandria area (43 bores), at or in the vicinity of Kogarah Golf Course (15 bores), with three bores located along the M5 East Motorway to the west of Arncliffe.

Groundwater dependent ecosystems (GDE) with the potential to be impacted by groundwater drawdown associated with the Project (construction and operation) have been identified in the CSWQSP and detailed in Section 6 of this plan.

Baseline water quality monitoring commenced with groundwater monitoring in March 2015 and surface water monitoring in June 2015. Appendix F contains the baseline surface water quality monitoring results. Baseline groundwater monitoring will continue until the commencement of construction, in accordance with the monitoring plan outlined in Appendix B of the Surface Water Technical Paper (Appendix N of the EIS)..

Legend

- Stations
- Railway
- Watercourse
- Water body
- Alexandria Landfill
- Wetlands
- Regional Park
- Construction Compounds

WestConnex New M5 footprints

- Above ground construction footprint
- New M5 Tunnel
- Line marking works

Catchments

- Cooks River Catchment
- Alexandra Canal Catchment
- Eastern Channel Catchment
- Bardwell Creek Sub Catchment
- Wolli Creek Catchment
- Eve St Wetlands Catchment

St Peters Interchange Site Compound

Kingsgrove North Site Compound

Kingsgrove South Site Compound

Bexley Rd South Site Compound

Kogarah Golf Course Site Compound

REV	DATE	DESCRIPTION	AUTH	REVI	APPR
0	18/11/2015	Draft for comment	JP	LB	PF

A3 scale: 1:45,000

0 0.275 0.55 km

MGA Zone 56

Sydney Motorway Corporation | WestConnex

LEIGHTON | DRAGADOS | SAMSUNG C&T

WestConnex

aurecon | JACOBS | HASSELL | Golder Associates

WestConnex Stage 2 New M5

Water Quality Plan and Monitoring Program

Issued for discussion purposes only

Waterways and catchments

Figure: 1

Rev **0**

This page has been left blank intentionally

1.3 Objectives and Targets

The objectives of the WQP&MP are to:

- Comply with environmental commitments in the EIS, SPIR and CoA,
- Provide a framework to help prevent pollution of surface and groundwater through appropriate management.
- Identify potential impacts to receiving waters during and after construction, identify appropriate monitoring and assessment of the impacts and provide detail of how to avoid or minimise these potential impacts.
- Detail how to appropriately treat and manage discharges from the Project.

Project targets are detailed in Table 1. A separate Water Quality Plan and Monitoring Program will be developed for the operational stages of the SSI and will be provide operational phase targets for water quality planning and monitoring for the project.

Table 1: Project targets associated with the management of water quality

Metric / measure	Target	Timeframe	Accountability	Documentation / reporting
To measure and monitor potential adverse impacts to surface water and groundwater as a result of construction of the Project	Collection and analysis of all scheduled samples in compliance with this plan.	At all times	Environment and Sustainability Manager	Water monitoring records; Annual water quality monitoring reports (refer Section 8) EPL reports.
Review, investigate and respond to identified potential adverse impacts on water quality	All exceedances of trigger values are investigated.	At all times	Environment and Sustainability Manager	Water monitoring records; Annual water quality monitoring reports (refer Section 8); EPL reports.
	Make good provisions for impacts from construction on registered bore users implemented within 3 months of an identified impact.	At all times	Environment and Sustainability Manager Project Manager	Water monitoring records; Annual water quality monitoring reports (refer Section 8); EPL reports; Consultation/ correspondence records.
Report monitoring results annually to the Secretary of DP&E, DPI Water, and the relevant councils	Annual reports submitted within one month of receiving previous 12 months monitoring data	Annually	Environment and Sustainability Manager	Annual water quality monitoring reports (refer Section 8)

2. Legal and Other Requirements

The sections below provide the Project requirements and relevant legislation that apply to water quality aspects of construction.

2.1 Legislation

Legislation relevant to water quality management for the Project includes:

- *Environmental Planning and Assessment Act 1979* (EP&A Act)
- *Protection of the Environment Operations Act, 1997* (POEO Act)
- *Water Act 1912*
- *Water Management Act 2000*
- *Water Management (General) Regulation 2011*

Relevant provisions of the above legislation are explained in the register of legal and other requirements included in the CEMP Appendix D – Environmental Obligations Register

2.2 Planning Approval Conditions

Project approval has been granted and issued with Conditions of Approval (CoA).

Conditions of Approval that specifically address the management of water quality are identified in Table 2.

Table 2: Conditions of Approval that address management of water quality

Reference	Requirement	Where addressed
B28	A Water Quality Plan and Monitoring Program must be prepared and implemented to monitor and avoid or mitigate impacts on surface and groundwater quality and resources, during construction and operation. The Water Quality Plan and Monitoring Program must be developed in consultation with the DPI (Water), Sydney Water and relevant councils, and must include, but not be limited to:	This plan and program focus on the construction phase of the project
	(a) identification of works and activities during construction and operation of the SSI, including tunnel discharge, runoff, emergencies and spill events, that have the potential to impact on groundwater quality, levels or potentiometric pressure (in confined aquifers), and surface water quality of potentially affected watercourses and riparian land;	Section 4 Also refer to Section 6 of the Construction Soil and Water Quality Sub-plan (M5N-ES-PLN-PWD-0005)
	(b) a risk management framework for evaluation of the risks to groundwater and surface water resources and dependent ecosystems as a result of groundwater inflows to the tunnels or discharges to surface water receiving environments, including definition of trigger values for contingency and ameliorative measures;	Section 4, 5, 6, 7 and 8 Appendix B
	(c) the identification of environmental management measures that would be implemented to manage impacts to surface waters and groundwater during construction and operation, including water treatment, erosion and sediment control and stormwater management measures consistent with Water Sensitive Urban Design measures, where relevant, and consistent with the measures detailed in the documents listed in conditions A2(b) and A2(c);	Construction Soil and Water Quality Sub-Plan (M5N-ES-PLN-PWD-0005) – Sections 5.7, 7 and 8 Section 6.2
	(d) details of construction water treatment plants and the operational water treatment plants, including treatment processes, discharge water quality criteria (taking into consideration any water uses and proposed rehabilitation measures downstream of the discharge locations), discharge locations and rates (and justification for their	Section 5 Appendix E Alexandria Landfill - Leachate Treatment Plant Design Report

Reference	Requirement	Where addressed
	location), treatment capacity, and any proposed on-site storage of flows;	
	(e) commitment to designing discharge points into watercourses affected by the SSI to emulate a natural stream system, where feasible and reasonable, or where emulation cannot be achieved, adequate scour protection measures are to be implemented;	Section 7
	(f) consideration of any naturalisation or rehabilitation programs occurring upstream or downstream of waterways or drainage lines intersected by the SSI, including the Wolli Creek Riparian Corridor Management Plan;	Section 4
	(g) the presentation of water quality objectives, standards, environmental values and parameters against which any changes to water quality will be assessed, based on the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Agriculture and Resource Management Council of Australia and New Zealand and the Australian and New Zealand Environment and Conservation Council, 2000), Where alternate guidelines are used to establish water quality objectives (including the levels for protection of aquatic ecosystems in receiving waters), justification for this must be provided. In particular, justification must be provided for the classification of waterways as 'highly disturbed' versus 'slightly to moderately disturbed' receiving environments;	Section 5, 6 and 7
	(h) details on the current water quality, including at least 12 months of representative background monitoring data (including but not limited to representative data collected by the relevant councils, agencies and organisations where readily available) for surface and groundwater quality, levels and potentiometric pressures (in confined aquifers), to establish baseline water conditions prior to the commencement of construction;	Section 6 Appendix F
	(i) monitoring of the quality of discharges from construction and operational water treatment plants;	Section 5 As per Environment Protection Licence (EPL 20772 and EPL 4627) issued to Project
	(j) identification of construction and operational phase surface water and groundwater monitoring locations including watercourses and waterbodies which are representative of the potential extent of impacts from the SSI, including the relevant analytes and frequency of monitoring;	Section 6
	(k) groundwater monitoring must be able to demonstrate that groundwater discharge quality is consistent with supporting the water quality objectives defined in accordance with B28(g) and include, but not be limited to - (¡) sites in the vicinity of Bardwell Park (to confirm groundwater quality), (ii) inside and outside the cut-off wall at the Alexandria Landfill, (iii) monitoring of groundwater levels at Stotts Reserve, southern bank of Wolli Creek behind the Wolli Creek station and forested areas along Bardwell Creek to ascertain potential impacts on groundwater dependent ecosystems, and (iv) monitoring of drawdown along the alignment of the tunnels;	Section 6
	(l) details on the condition and status of licensed bores likely to be impacted by the SSI;	Appendix A

Reference	Requirement	Where addressed
	(m) commitment to a minimum monitoring period of three years following the completion of construction or until the affected waterways and/ or groundwater resources are certified by a suitably qualified and experienced independent expert as being rehabilitated to an acceptable condition, unless otherwise approved or directed by the Secretary. The monitoring must also confirm the establishment of operational water control measures (such as sedimentation basins and vegetation swales);	Section 8 This condition will be addressed in the Operational WQP&MP
	(n) details of how the potential impact of discharges on receiving waters would be avoided or minimised, including design and operational measures incorporated into the SSI to protect water quality and, where feasible and reasonable, enhance water quality over time;	Section 5, 6, 7 and 8 Construction Soil and Water Quality Sub-Plan (M5N-ES-PLN-PWD-0005) – Sections 7 and 8
	(o) contingency and ameliorative measures in the event that adverse impacts to water quality or groundwater flows, levels or potentiometric pressures (in confined aquifers) are identified, with reference to the impact triggers defined in accordance with B28(b);	Section 7
	(p) identification of and commitment to 'make good' provisions for groundwater users to be implemented in the event of a decline in water supply levels, quality and quantity from existing bores associated with groundwater changes from either construction and/or ongoing operational dewatering caused by the SSI;	Section 7
	(q) procedures for monitoring of streambed fracturing;	Sections 4.4, 6.2.5 and 7
	(r) procedures for monitoring and annual reporting of extracted groundwater volumes to DPI (Water) for a minimum monitoring period of three years following completion of construction, unless otherwise approved or directed by the Secretary; and	Section 8 This condition will be addressed in the Operational WQP&MP
	(s) procedures for annual reporting of the monitoring results to the Secretary, DPI (Water), and the relevant councils;	Section 8
	The Water Quality Plan and Monitoring Program must be submitted to the Secretary for approval prior to the commencement of construction of the SSI, unless otherwise agreed by the Secretary. A copy of the Water Quality Plan and Monitoring Program must be submitted to the DPI (Water), Sydney Water and relevant councils prior to its implementation. Nothing in this condition prevents the Proponent from preparing separate Water Quality and Monitoring Programs for the construction and operational stages of the SSI. Where a separate Water Quality and Monitoring Program is prepared for the operation of the SSI, this must be submitted to the Secretary for approval at least six months prior to the commencement of operation of the SSI.	This WQP&MP relates to the construction phase of the project. A subsequent operational WQP&MP will be submitted prior to commencement of operation.

2.3 EIS Requirements

The revised environmental mitigation measures (REMMs) included in the EIS and SPIR relating to the management of water quality are included in Table 3.

Table 3: Revised environmental mitigation measures from New M5 EIS and SPIR relevant to the management of water quality

Reference	Requirement	Where addressed
Water quality		
REMM SW04.	The Soil and Water Management Plan would include: • All water generated during construction would be captured, tested (and treated if required) prior to reuse or discharge under a site specific arrangement, depending on the quality of water generated. This would target compliance with the Water Quality Reference Criteria. At the St Peters interchange site this would include transfer of some water to the leachate treatment Plant as outlined below. Varying levels of groundwater quality would also require a variation to treatment approaches;	Section 5
REMM SW05.	The water quality and outflow velocities of the water treatment Plants at the following compounds would be in accordance with the Project's Water Quality Reference Criteria and the Project's Environment Protection Licence: Kingsgrove North construction compound (C1), Commercial Road construction compound (C3), Bexley Road South construction compound (C5), Arncliffe construction compound (C7), Canal Road construction compound (C8).	Section 5 Appendix E Construction Soil and Water Quality Sub-Plan (M5N-ES-PLN-PWD-0005), Sections 7.1, 7.3 and 8
REMM SW06.	The Project specific water quality monitoring program would continue to collect to at least 12 months of data or to the commencement of construction (whichever is sooner) to represent pre-construction conditions for the Project. Monitoring would continue during construction of the Project as identified in Appendix A of the Technical working paper: Surface water (Appendix N). The details of this monitoring program would be contained in the Soil and Water Management Plan, and would include the following: • Sampling locations to include upstream (control) and downstream measurement locations; and • Samples taken twice a month, once in dry conditions and once in wet conditions where possible. In-situ monitoring of: • pH; • Reduction Oxidation Potential; • Dissolved Oxygen; • Temperature; • Conductivity; • Turbidity; • Colour; and • Odour. Analytical sampling of the following potential constituents of concern: • Total Recoverable Hydrocarbons; • Benzene, Toluene, Ethylbenzene, Xylene and Naphthalene; • Nutrients including: Total Nitrogen, Total Kjeldahl Nitrogen, Nitrogen Oxide, Nitrite, Nitrate;	Section 6 Appendix F

Reference	Requirement	Where addressed
	• Total Phosphorous and Reactive Phosphorous; • Heavy metals (Arsenic, Cadmium, Copper, Chromium, Lead, Mercury, Nickel, Zinc); • Manganese; and • Ferrous Iron and Total Iron.	
REMM SW07.	Water quality monitoring of the breeding ponds for Green and Golden Bell Frog near Marsh Street, Arncliffe would occur during construction by a suitably qualified scientist as part of the Green and Golden Bell Frog Plan of Management.	Green and Golden Bell Frog Plan of Management.
Water reuse		
REMM SW08.	Opportunities for reuse of treated water generated at the Arncliffe motorway operations complex would be considered during detailed design.	Sustainability Plan (M5N-ES-PLN-PWD-0020) Water Reuse Strategy (under development) Sustainability Initiatives Register and appraisal procedure
Contamination		
REMM SW11.	During landfill closure activities, surface water management measures would be implemented in accordance with The Blue Book to isolate and capture potentially contaminated water. Any such water would be transferred to the leachate treatment Plant for treatment prior to discharge to sewer under a trade waste agreement with Sydney Water.	Section 7 Landfill Closure Management Plan (M5N-GOL-TER-900-116-0012), Annexure G (Landfill EMP)
Groundwater		
REMM GW05.	Intersected shallow contaminated groundwater would be directed to the construction water treatment Plant prior to discharge. Elsewhere, collection and treatment options would be considered and releases made under relevant discharge criteria.	Section 5.2 and 6 Construction Soil and Water Quality Sub-Plan (M5N-ES-PLN-PWD-0005), Section 7.3
REMM GW07.	Treated waste water would be stored and re-used for Project purposes wherever possible. Groundwater reuse would be in accordance with the policies of sustainable water use of the NSW Office of Water [now DPI Water], such as dust suppression and earthworks.	Construction Soil and Water Quality Sub-Plan (M5N-ES-PLN-PWD-0005), Section 7.3

Reference	Requirement	Where addressed
		Water Reuse Strategy (under development) Manage Soil and Water Procedure (M5N-ES-PRC-PWD-0035), including Water Discharge Flowchart
REMM GW13.	A groundwater monitoring program would be prepared and implemented to monitor groundwater impacts during construction. This would include the monitoring of groundwater inflow into the tunnels. The program would be developed in consultation with the EPA, DPI (Fisheries), NSW DPI Water and relevant councils.	Section 6.3
REMM GW15.	In the event that the drawdown in a licensed water supply bore or irrigation bore exceeds two metres (in accordance with the Aquifer Interference Policy) or that impacts to groundwater quality alter the beneficial use of the water, measures would be taken to 'make good' the impact by restoring the water supply to pre-development levels. The measures taken would be dependent upon the location of the impacted bore and would be determined in consultation with the affected licence holder but could include, deepening the bore, providing a new bore or providing an alternative water supply.	Section 7

2.4 Project Legislative Exemptions

Section 115ZG of the EP&A Act details the approvals under NSW legislation that are not required for a Critical SSI project approved under Part 5.1 of the EP&A Act. The approvals not required under NSW legislation were identified in Section 2.3 of the EIS (AECOM 2015).

Water Management Act 2000 and Regulation

The water related approvals that are not required for the project under the *Water Management Act 2000*, are:

- Water use approvals under section 89;
- Water management work approvals under section 90; and
- Activity approvals (other than aquifer interference approvals) under section 91.

Roads authorities currently have an exemption for the short term take of groundwater required for construction and maintenance activities under Schedule 5, Part 1, clause 2 of the Water Management (General) Regulation 2011, but this exemption is limited to construction and maintenance.

Aquifer Interference Policy

The EIS notes that an aquifer interference (AI) approval may be required under the Water Management Act 2000 if construction requires the intersection of a groundwater source. Aquifer interference approvals have not yet commenced under the Act but may be required in the future.

2.4.1 EPL Conditions

The Project's construction activities are regulated by Environment Protection Licences (EPL No. 20772 and EPL No. 4627) issued by the NSW Environment Protection Authority (EPA). Refer to the Construction Soil and Water Quality Sub-Plan (M5N-PM-PLN-PWD-0005) for the conditions relevant to this water quality plan and monitoring program.

2.5 Guidelines and Relevant Documents

The main guidelines, specification and policy documents relevant to this WQP&MP include:

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (October 2000).
- Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 4th Edition March 2004) and Volume 2D Main Roads Construction (DECC 2008) - the “Blue Book”;
- Department of Primary Industries (DPI) Water NSW Aquifer Interference Policy (September 2012).
- DPI Water Groundwater monitoring and modelling plans – Information for Prospective Mining and Petroleum Exploration Activities (NSW Office of Water 2014).
- DPI Water Guidelines for Controlled Activities on Waterfront Land (July 2012).
- Roads and Maritime Services Specification D&C G36 – Environmental Protection (06 August 2014).
- Roads and Maritime Services Specification D&C G38 - Soil and Water Management (04 June 2014).
- RMS Water Policy.
- RMS Code of Practice of Water Management: Road Development and Management (April 1999).
- RMS Technical Guideline: Environmental Management of Construction Site Dewatering (April 2011).

3. Consultation

This plan and program was provided to Department of Primary Industries - Water (DPI Water), Sydney Water and all relevant councils for review and comment. Comments have been received from the City of Sydney Council, Marrickville City Council (now Inner West Council) and DPI Water. Responses to comments are provided in the Consultation Comment and Response Register.

A copy of the plan and program will be submitted to DPI Water, Sydney Water and relevant councils prior to its implementation.

The final operational elements of the plan and program will be developed in consultation with DPI Water, Sydney Water, and relevant councils and a copy of the operational plan and program will be submitted to these parties prior to its implementation. The final operational elements of the plan and program shall be submitted to the Secretary for approval, at least six months prior to the commencement of operation of the Project.

4. Environmental Aspects and Impacts

4.1 Environmental Aspects

4.1.1 Surface Water

The State Government has endorsed the community's environmental values for water, known as 'Water Quality Objectives' (WQOs), for each catchment in NSW. The NSW WQOs are the environmental values and long term goals for consideration when assessing and managing the likely impact of activities on waterways (ANZECC/ARMCANZ, 2000).

Environmental values are particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health and which require protection from the effects of pollution, waste discharges and deposits. Environmental values expressed as WQOs provide goals that help in the selection of the most appropriate management options (Department of Environment and Conservation, 2006). The guiding principles are:

- Where the environmental values are being achieved in a waterway they should be protected; and
- Where the environmental values are not being achieved in a waterway, all activities should work towards their achievement over time.

The Cooks River Health Report Card 2013-2014 (2015), published by the Cooks River Alliance, remarked that while parts of the system have improved from poor to fair, it is noted that this health report does not assess the data in accordance with the ANZECC/ARMCANZ guidelines. Using the definitions of the accepted criteria (ANZECC/ARMCANZ, 2000), the Cooks River and surrounding tributaries are classified as 'highly disturbed systems' (AECOM 2015). Prior studies of water quality in the Cooks River catchment have provided the following remarks about various contaminants:

- Nutrients, phosphorus and nitrogen were found in high levels in the Cooks River. Sources include pets and birds, fertilisers, detergents, sewage discharges and golf courses.
- Faecal Coliforms – High levels found in the Cooks River, exceeding those of recreational guidelines
- Dissolved oxygen – Depleted levels found in the lower reaches of Cooks River.
- Toxicants – Elevated levels of toxicants such as organics and heavy metals have been found in high concentrations in the Cooks River. Fish kills have also been attributed to pesticide use.
- Suspended solids and turbidity – Results for all Cooks River catchments in the past have indicated results well above the ANZECC/ARMCANZ Water Quality Guidelines (ANZECC/ARMCANZ, 2000).
- pH – Results within the Cooks River have tended to indicate compliance guidelines.

Rockdale, Canterbury and Marrickville councils along with The University of New South Wales completed sediment sampling between 2008 and 2011 that showed highly contaminated river sediments. It was noted that surface sediments were less contaminated than sediments at depth, which implied that improvements in waste or discharge management in recent years had reduced the transport of contaminated materials to the river. They cited that a risk of heavy metal mobilisation would be associated with remediation activities (RCC, 2011).

Surface water monitoring has been conducted along Wolli Creek, the Cooks River and in the upper portion of Alexandra Canal. Preliminary results show that nutrients and heavy metals generally exceed the default trigger values. A baseline monitoring report (Appendix F) was completed following 12 months of surface water monitoring in May 2016.

Section 4.2 of the Technical working paper: Surface water (Appendix N of the EIS) provides a description of the waterways and catchments that have the potential to be impacted by the project. The watercourses within the project area are generalised as highly disturbed, with concrete channelisation and reconstructed rock banks dominating the waterway channels in areas directly adjacent to the project surface worksites. The technical working paper: Biodiversity assessment report (Appendix S of the EIS) described the aquatic and riparian values. The report concluded that there was no significant riparian vegetation that would be directly impacted by the project.

4.1.2 Tidal limits

The tidal limit of the Cooks River is approximately adjacent to Sando Reserve, Croydon Park (Manly Hydraulics Laboratory (MHL), 2005), shown in Figure 2. This is roughly 7.5 kilometres upstream of the Bayview Avenue Bridge and the upstream extent of any impacts related to the Project. Tidal variations will affect the surface water characteristics such as flow rates, pollutant mixing zones and water quality parameters.

Table 4 Tidal limits within the Project area

Creek	Eastings	Northings	Distance from the ocean (kms)	Comments
Alexandra Canal /Shea's Creek	332829	6246365	15.8	Tidal to a point ~100m downstream from Huntley Road bridge
Cooks River	323389	6247165	21.9	Tidal to within ~200m of Punchbowl Road bridge
Wolli Creek	327499	6243865	15.5	Tidal to vicinity of Bardwell Creek, 600m upstream from weir
Muddy Creek	328314	6240975	12.9	Tidal to vicinity of a small bridge, ~380m down from Princes Highway

4.1.3 Naturalisation and Rehabilitation Programs

An assessment has been undertaken to consider naturalisation and rehabilitation programs occurring within the waterways along the Project; Wolli Creek, Bardwell Creek, lower catchment of Cooks River, Alexandra Canal and the adjoining Shea's Creek (refer Figure 1). CDS-JV are aware of current rehabilitation programs which Sydney Water are undertaking in the upper catchment of the Cooks River and in Alexandra Canal. Project activities will not occur in these rehabilitation areas and are not anticipated to impact these programs. The Wolli Creek Riparian Corridor Management Plan, implemented by the former Sydney Metropolitan Catchment Management Authority (now Local Land Services, Greater Sydney), and the Cooks River Urban Water Initiative implemented by Local Land Services, Greater Sydney, no longer have activities directly adjacent to any project areas. CDS-JV will continue to consult with Sydney Water and the relevant councils to ensure any new rehabilitation / naturalisation programs are considered during construction.

4.1.4 Groundwater

The water table in the Project environment is heavily modified. It is locally impacted by the existing M5 East Motorway tunnels, however it is unlikely that the Airport Link tunnel impacts groundwater movement near the Project alignment. The local water table may be elevated above natural conditions by irrigation in areas such as the Kogarah Golf Course, leaky stormwater, sewer and main water infrastructures and building foundations that inhibit groundwater flow causing localised groundwater mounding (AECOM, 2015).

Assessments of the impacts on vegetation in the upper reaches of Wolli and Bardwell Creeks due to groundwater drawdown were undertaken as part of the Technical working paper: Biodiversity assessment report and assessed the significance of the impacts as low. In the lower reaches of the Cooks River, groundwater is in hydraulic connection with the Cooks River via the alluvium and changes in groundwater levels are predicted to be minimal.

Detail on groundwater levels & quality, including data from the EIS monitoring program and historic data are located in Appendix Q Groundwater Technical Report of the EIS. A baseline study of groundwater levels and quality commenced in March 2015 and will conclude prior to undertaking activities which have the potential to impact groundwater. A baseline groundwater monitoring report will be prepared within this timeframe.

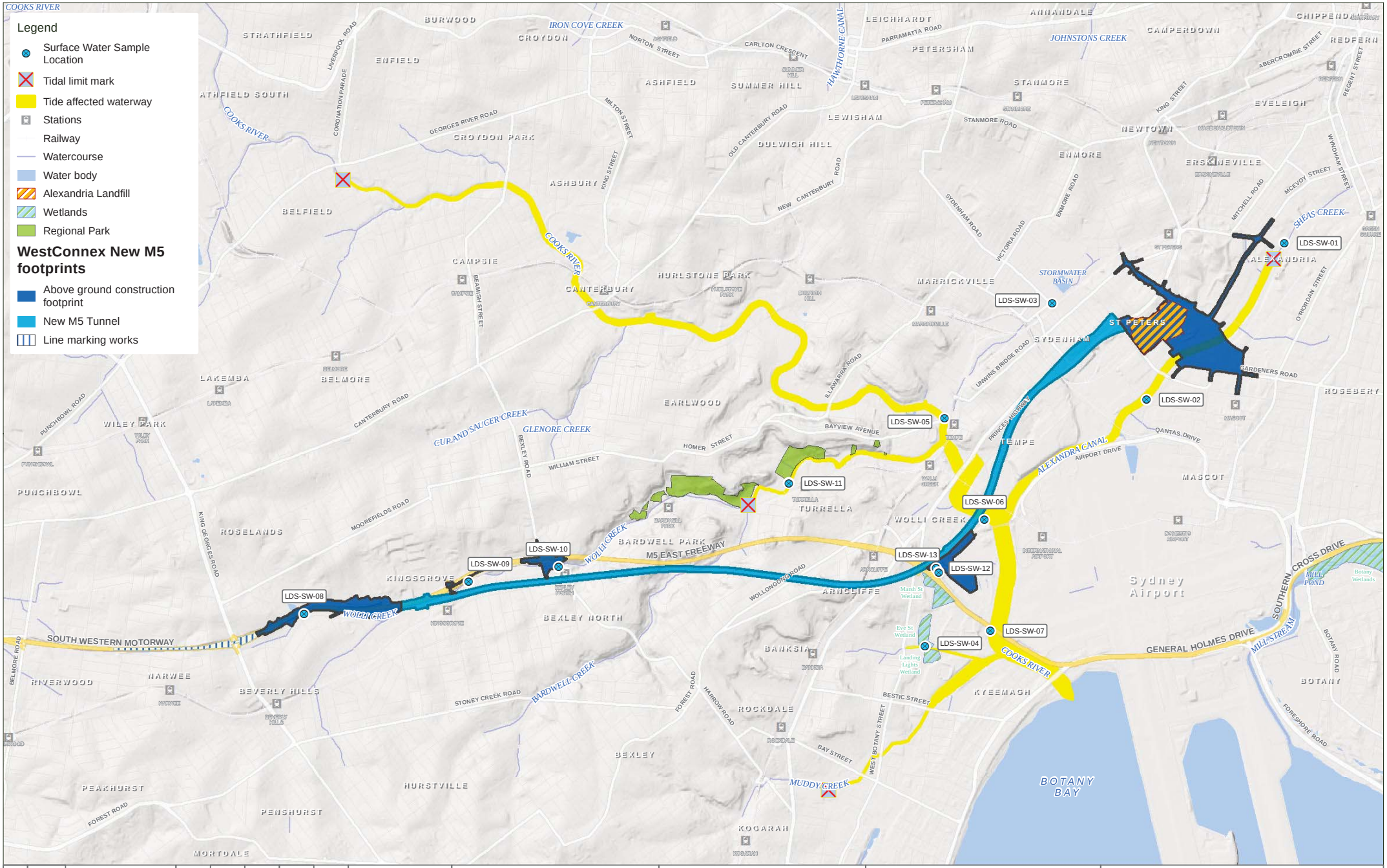
A network of groundwater monitoring wells was installed along the alignment during 2014 and 2015 (EIS (AECOM 2015)). The range of groundwater levels observed was highly variable and dependent upon the topography and locally impacted by groundwater users and infrastructure such as the M5 East Motorway. Hydrographs of the Hawkesbury Sandstone show less than one metre of fluctuation; suggesting that the formation is in equilibrium (recharge and discharge are equal). There is a clear

correlation between rainfall and an increase in water level at numerous monitoring locations, which may take up to 48 hours to respond, when rainfall exceeds 10 millimetres (EIS (AECOM 2015)).

At the Tempe Railway Station, adjacent to the Cooks River, the nested monitoring well completed in the alluvium and within the Hawkesbury Sandstone indicates that the standing water level in the alluvium is lower than in the Hawkesbury Sandstone. This suggests that there is an upward groundwater pressure gradient to the alluvium and is consistent with observations from nested monitoring wells in the Botany Sands and Hawkesbury Sandstone at Arncliffe (AECOM, 2015).

The Project tunnels will be constructed as drained tunnels, with ongoing groundwater inflow, capture and discharge. Groundwater modelling (CDM Smith, 2015) predicted model inflows of 1,115 cubic metres per day into the Project tunnels. Over a modelled length of 20 kilometres an inflow rate of 0.63 litres per second along every kilometre of east bound (shallower) tunnel and 0.67 litres per second along every kilometre of the westbound (deeper) tunnel was predicted. Groundwater modelling (CDM Smith, 2015) predicted GDE's would not experience significant drawdown over the course of the construction phase.

Groundwater will be collected treated and discharged in accordance with the surface water requirements. The Project discharge requirements have been developed in accordance with ANZECC/ARMCANZ (2000). The Alexandria Landfill actively extracts leachate, inducing groundwater to flow toward the centre of the landfill to prevent contamination from dispersing into the surrounding aquifers. This lowers the groundwater levels within the Botany Sands and Ashfield Shale and the leachate is discharged to sewer in accordance with a Trade Waste Agreement with Sydney Water.



								A3 scale: 1:35,000	
								0 0.225 0.45 km	
0	18/11/2015	Draft for comment	JP	LB	PF				
REV	DATE	DESCRIPTION	AUTH	REVI	APPR			MGA Zone 56	

Sydney Motorway Corporation | WestConnex

DRAGADOS | SAMSUNG C&T | WestConnex | aurecon | JACOBS | HASSELL | Golder Associates

WestConnex Stage 2 New M5

Water Quality Plan and Monitoring Program

Issued for discussion purposes only

Tidal limits within the project area

Figure: 2 Rev 0

This page has been left blank intentionally.

4.2 Potential Impacts and the Risk Management Framework

4.2.1 Risk Assessment and Management Framework

Potential water quality impacts caused by construction activities are summarised in Table 5 with associated risk ratings identified through a risk analysis. Environmental risk analysis was undertaken in accordance with the principles of the Australian and New Zealand standard AS/NZS ISO 31000: 2009 Risk Management – Principles and Guidelines. The likelihood and consequence criteria relevant to environment and risk rating tables are provided in Appendix B.

Initial risk ratings can be reduced through the identification and implementation of appropriate controls and management measures. The residual risk ratings are those determined after the implementation of the identified control measures.

This page has been left blank intentionally.

Table 5: Assessment of potential construction water quality impacts

Activity	Potential Aspect	Potential Impact(s)	Initial Risk Rating			Control Measure	Residual Risk Rating		
			Likelihood	Consequence	Significant (Refer to Appendix D)		Likelihood	Consequence	Significant
Potential construction water quality impacts to surface water									
Vegetation clearance / grubbing / demolition	Silt and debris	Erosion and sedimentation impacts on downstream waterways due to exposed land, inadequate controls or failure of controls	Almost certain (5)	Minor (2)	M10	Construction Soil and Water Quality Sub-Plan (M5N-ES-PLN-PWD-0005) – section 7.1 A1 - A6	Likely (4)	Negligible (1)	L4
Earthworks and excavation	Silt and debris	Erosion and sedimentation impacts on downstream waterways due to exposed land, inadequate controls or failure of controls	Almost certain (5)	Minor (2)	M10	Construction Soil and Water Quality Sub-Plan (M5N-ES-PLN-PWD-0005) – section 7	Likely (4)	Negligible (1)	L4
	Disturbance of land	Distribution of or mis-management of unexpected contamination or acid sulphate soils	Almost certain (5)	Moderate (3)	VH18	Manage Contaminated Land Procedure (M5N-ES-PRC-PWD-0036) and Manage Acid Sulfate Soils Procedure (M5N-ES-PRC-PWD-0038)	Possible (3)	Minor (2)	M8
Establishment and operation of ancillary facilities	Uncontrolled release	Failure of construction water treatment plant leads to uncontrolled discharge or discharge that doesn't meet	Unlikely (2)	Major (4)	H15	WTP Contingency Plan, WTP Permit, Plant Inspection & Checklists and Plant Maintenance	Rare (1)	Moderate (3)	M11

Activity	Potential Aspect	Potential Impact(s)	Initial Risk Rating			Control Measure	Residual Risk Rating		
			Likelihood	Consequence	Significant (Refer to Appendix D)		Likelihood	Consequence	Significant
		Infrastructure Approval or EPL conditions							
	Release of water / contamination	Contamination of soil or water from spill or leak of dangerous or hazardous materials from plant / equipment	Almost certain (5)	Minor (2)	M10	Manage Hazardous Substances Procedure (M5N-ES-PRC-PWD-0041)	Likely (4)	Minor (2)	M9
	Silt and debris	Erosion and sedimentation impacts on downstream waterways due to exposed land, inadequate controls or failure of controls	Almost certain (5)	Minor (2)	M10	Construction Soil and Water Quality Sub-Plan (M5N-ES-PLN-PWD-0005) – Section 7.1, 7.2, 7.4	Likely (4)	Negligible (1)	L4
General construction activities	Uncontrolled release of water / contamination	Breach of CoA or EPL conditions, legal or client requirements leading to PINs, fines, prosecution, loss of reputation, strained relationships, contractual implications	Unlikely (2)	Major (4)	H15	CEMP (M5N-ES-PLN-PWD-0001) and sub plans	Rare (1)	Moderate (3)	M11
	Spills and leaks	Minor incidents, e.g. small leaks / spills, that do not cause or threaten material harm to the environment	Almost certain (5)	Minor (2)	M10	Manage Hazardous Substances Procedure (M5N-ES-PRC-PWD-0041)	Likely (4)	Negligible (1)	L4
	Silt and debris	Erosion and sedimentation impacts on downstream waterways due to	Almost certain (5)	Minor (2)	M10	Construction Soil and Water Quality Sub-Plan (M5N-ES-PLN-PWD-	Likely (4)	Negligible (1)	L4

Activity	Potential Aspect	Potential Impact(s)	Initial Risk Rating			Control Measure	Residual Risk Rating		
			Likelihood	Consequence	Significant (Refer to Appendix D)		Likelihood	Consequence	Significant
		exposed land, inadequate controls or failure of controls				0005) – Section 7.1, 7.2, 7.5			
	Uncontrolled release of water / contamination	Infiltration of surface water to groundwater sources or groundwater dependant ecosystems, including sediments and particles and soluble pollutants (such as acids, salts, nitrates and soluble hydrocarbons), for example through recharge activities	Possible (3)	Minor (2)	M8	CEMP (M5N-ES-PLN-PWD-0001), Construction Soil and Water Quality Sub-Plan (M5N-ES-PLN-PWD-0005) – Section 7.1, 7.2, 7.5 and Manage Soil and Water Procedure (M5N-ES-PRC-PWD-0035)	Possible (3)	Minor (2)	M8
	Uncontrolled release of water / contamination / Concrete and building / demo waste	Release of Inappropriately managed/disposed uncured concrete and other building/demolition wastes.	Almost certain (5)	Moderate (3)	VH18	Manage Hazardous Substances Procedure (M5N-ES-PRC-PWD-0041) and Demolition Plan	Possible (3)	Negligible (1)	L3
Tunnel excavations	Uncontrolled release of water / contamination	Changes to groundwater level and quality leading to contamination, changes in salinity, ASS etc	Possible (3)	Moderate (3)	H13	CEMP (M5N-ES-PLN-PWD-0001), Construction Soil and Water Quality Sub-Plan (M5N-ES-PLN-PWD-0005) – Section 7.1 B1 – B5, Section 7.3 and 7.6,	Rare (1)	Moderate (3)	M11

Activity	Potential Aspect	Potential Impact(s)	Initial Risk Rating			Control Measure	Residual Risk Rating		
			Likelihood	Consequence	Significant (Refer to Appendix D)		Likelihood	Consequence	Significant
						Groundwater Plan and Tunnel Plan.			
	Uncontrolled release of water / contamination	Inappropriate disposal of contaminated groundwater	Possible (3)	Moderate (3)	H13	CEMP (M5N-ES-PLN-PWD-0001), Construction Soil and Water Quality Sub-Plan (M5N-ES-PLN-PWD-0005) – Section 7.1 B1 – B5, Section 7.3 and 7.6, and Manage Soil and Water Procedure (M5N-ES-PRC-PWD-0035)	Possible (3)	Minor (2)	M8
Potential construction impacts to groundwater quality and volume									
Tunnel excavations	Uncontrolled release of water / contamination	Changes to groundwater level and quality leading to contamination, changes in salinity, ASS etc	Possible (3)	Moderate (3)	H13	CEMP (M5N-ES-PLN-PWD-0001), Construction Soil and Water Quality Sub-Plan (M5N-ES-PLN-PWD-0005) – Section 7.1 B1 – B5, Groundwater Plan and Tunnel Plan.	Rare (1)	Moderate (3)	M11
	Uncontrolled release of water / contamination	Inappropriate disposal of contaminated groundwater	Possible (3)	Moderate (3)	H13	CEMP (M5N-ES-PLN-PWD-0001), Construction Soil and Water Quality Sub-Plan (M5N-	Unlikely (2)	Minor (2)	L7

Activity	Potential Aspect	Potential Impact(s)	Initial Risk Rating			Control Measure	Residual Risk Rating		
			Likelihood	Consequence	Significant (Refer to Appendix D)		Likelihood	Consequence	Significant
						ES-PLN-PWD-0005) – section 7.1 B1 – B5, Section 7.3 and 7.6, and Manage Soil and Water Procedure (M5N-ES-PRC-PWD-0035)			
	Construction tunnel dewatering	Drawdown causing changes to groundwater levels.	Rare (1)	Substantial (5)	H16	CEMP (M5N-ES-PLN-PWD-0001), Construction Soil and Water Quality Sub-Plan (M5N-ES-PLN-PWD-0005) – Section 7.1 B1 – B5, Groundwater Plan and Tunnel Plan.	Rare (1)	Moderate (3)	M11
	Construction tunnel dewatering	Saline intrusion / changes to salinity levels resulting from drawdown of groundwater levels	Rare (1)	Substantial (5)	H16	CEMP (M5N-ES-PLN-PWD-0001), Construction Soil and Water Quality Sub-Plan (M5N-ES-PLN-PWD-0005) – Section 7.1 B1 – B5, Groundwater Plan and Tunnel Plan.	Rare (1)	Moderate (3)	M11

4.3 Summary of impacts relative to the Aquifer Interference Policy

The NSW Aquifer Interference Policy requires that potential impacts on groundwater sources, including their users and groundwater dependent ecosystems (GDEs), be assessed against minimal impact considerations. If the predicted impacts are less than the Level 1 minimal impact considerations then these impacts would be considered as acceptable. If there are any exceedances of the criteria then they would be considered potentially adverse and mitigation and monitoring measures would be implemented.

The majority of the subject area is considered to be within a “Less Productive Groundwater Source” within fractured rock, based on the low number of registered bores in the area. The groundwater within the Botany Sands is considered to be in a “Highly Productive Groundwater Source.”

An evaluation of the risks to groundwater resources, surface water resources and GDE as a result of groundwater inflow into the tunnel is provided in Table 6 and Table 7.

Table 6: Minimal Impact Considerations for a “Less Productive Fractured Rock Aquifer”

Type of Impact	Minimal impact considerations	Summary of impacts
Water table impacts	• If more than and/or less than or equal to 10% cumulative variation in the water table allowing for typical “post-water sharing plan” variations, 40m from any high priority GDE or high priority culturally significant site listed in the schedule of the relevant water sharing plan. • A maximum of a 2m decline cumulatively at any water supply work.	• No culturally significant sites were identified within the Greater Metropolitan Regional Groundwater Water Sharing Plan. • There are no high priority groundwater dependent ecosystems listed under Schedule 4 of the Greater Metropolitan Regional Groundwater Sources Water Sharing Plan that are within the Hawkesbury Sandstone or Ashfield Shale. • The predicted long term drawdown in industrial bore GW107993 is 5.7 metres. The bore is 186 metres deep with water table depth recorded at 93 metres. Groundwater will not be drawn down to 93 metres as this is below the tunnel at this location. It is considered unlikely that drawdown in the borehole due to the tunnel will impact the sustainability of the borehole. And it is predicted that two registered bores, with only one of these bores registered for water supply purposes (industrial),within the predicted 2 m drawdown impact zone. The approach to minimising impacts are outlined below in Section 7
Water pressure impacts	• A cumulative pressure head decline of no more than 2m decline at any water supply work.	• The groundwater modelling has included the cumulative impacts of the existing M5 East Motorway tunnel. For the bores where it has been predicted that the drawdown exceeds a water level decline of more than two metres the approach to minimising impacts are outlined below in Section 7.
Water quality impacts	• Any change in groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.	• The beneficial use category of groundwater will not be changed beyond 40m of the tunnel.

Table 7: Minimal Impact Considerations for a "Highly Productive Coastal Aquifer"

Type of Impact	Minimal impact considerations	Summary of impacts
Water table impacts	• If more than and/or less than or equal to 10% cumulative variation in the water table allowing for typical "post-water sharing plan" variations, 40m from any high priority GDE or high priority culturally significant site listed in the schedule of the relevant water sharing plan. • A maximum of a 2 m decline cumulatively at any water supply work.	• No culturally significant sites were identified within the Greater Metropolitan Regional Groundwater Water Sharing Plan. • There are no high priority groundwater dependent ecosystems listed under Schedule 4 of the Greater Metropolitan Regional Groundwater Sources Water Sharing Plan. There are two wetlands within the project corridor at Tempe known as the Eve Street Wetland and Landing Lights Wetland. Groundwater modelling indicates that the water table at these wetlands is unlikely to undergo a water level decline of more than 2m. • Groundwater modelling predicted that eight water supply bores within a one kilometre radius of the tunnels that intersect alluvium are likely to be drawn down by more than two metres. Three of these bores are registered for water supply purposes, the remaining being categorised as monitoring wells or other, The approach to minimising impacts are outlined below in Section 7.
Water pressure impacts	• A cumulative pressure head decline of no more than 2m decline at any water supply work.	• The groundwater modelling has included the cumulative impacts of the existing M5 East Motorway tunnel. For the bores where it has been predicted that the drawdown exceeds a water level decline of more than two metres the approach to minimising impacts are outlined below in Section 7.
Water quality impacts	• Any change in groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.	• The beneficial use category of groundwater will not be changed beyond 40m of the tunnel.

4.4 Potential for Streambed Fracture

Streambed fracture relates to the flow of creek water over rock outcrops and the possibility of creek bed joints opening due to tunnel construction; the impact of which is potential diversion of surface water to underground. The presence of rock outcrops within the active channel of waterways is not known to occur along the Project alignment. Wolli Creek, Bardwell Creeks and Cooks River flow over alluvium infilled valleys rather than rock outcrops. There are no known observable occurrences of rock outcrops along the active channels of Bardwell and Wolli Creeks.

Streambed fracture is a potential risk where tunnelling traverses a waterway. Streambed fracturing will be monitored by:

- Assessing water inflows to the tunnel excavation; and
- Visual surveillance of waterways when tunnelling in proximity of waterways (Section 6.2.5).

5. Water Quality Performance Standards

Receiving waterways for treated groundwater discharge and temporary sediment basin discharges from the project are classified as highly disturbed ecosystems (AECOM, 2015). The following water quality discharge criteria have been developed drawing on the information and studies in the project's EIS (Appendix N Surface Water Technical Report and Appendix Q Groundwater).

Discharge water quality will be consistent with improving the water quality within the receiving environment. The validity of trigger values and discharge parameters were confirmed by completing the baseline water quality monitoring for surface waters (Appendix F).

5.1 Temporary Sediment Basins water quality discharge criteria

Water quality will be sampled at construction sediment basins prior to any controlled discharges to confirm that discharge criteria (in Table 8) are met prior to the controlled discharge. Discharge of sediment basins will occur via a permit process as described in the CSWQSP and in accordance with the Environmental Protection Licenses (EPL 20772 and 4627).

Table 8: Sediment basin discharge water quality targets

Parameter	Discharge criteria
Oil and grease	Not Visible
pH	6.5-8.5
Total Suspended Solids (TSS)	<50mg/l

5.2 Construction Water Treatment Plants water quality discharge criteria

Construction Water Treatment Plants (WTPs) are proposed for the Kingsgrove North site compound (C1), Commercial Road site compound (C3), Bexley Road North site compound (C4), Arncliffe site compound (C7), Canal Road site compound (C8). Design specifications for these WTPs have been developed based on a combination of catchment- specific and default ANZECC/ARMCANZ (2000) trigger values. The target water quality and outflow velocities of the water from these treatment plants are based on the Project's Water Quality Reference Criteria and will be in accordance with the Project's Environment Protection Licence (EPLs 20772 and 4627).

The Arncliffe site compound's construction water treatment plant will discharge into the Cooks River, via stormwater infrastructure, downstream of the Marsh Street Bridge. The Canal Road site compound's WTP will discharge into the Alexandra Canal, via stormwater infrastructure, in the vicinity of Canal Road. The receiving waters at these sites are tidally influenced and the discharge values for these two WTPs (as shown in Table 9 and Table 10) are based on the Cooks River Recommended Water Quality Trigger Values determined in the Water Quality Reference Criteria.

The Kingsgrove North, Commercial Road and Bexley Road construction water treatment plants will all discharge into Wolli Creek, upstream of Bexley Road, which is upstream of tidal influences. These sites will discharge in accordance with the recommended Water Quality Trigger Values for Wolli Creek (in Table 9 and Table 10), as listed in the Water Quality Reference Criteria.

Table 9: Construction Water Treatment Plant discharge criteria

Parameter	Discharge criteria	
	Arncliffe & Canal Road site compounds (Estuary receiving environment)	Kingsgrove North, Commercial Road & Bexley site compounds (Freshwater receiving environment)
pH*	6.5-8.5	
Total Suspended Solids *	<50mg/l	

* At all times

Table 10: Construction Water Treatment Plant discharge targets

Parameter	Measurement & Assessment		Discharge criteria	
	Percentile Concentration Limit	Sample method & frequency	Arncliffe & Canal Road site compounds (Estuary receiving environment)	Kingsgrove North, Commercial Road, & Bexley site compounds (Freshwater receiving environment)
Copper	80	Quarterly grab sample	0.008(mg/l)	0.012(mg/l)
Iron	80	Quarterly grab sample	0.3(mg/l)	0.3(mg/l)
Nickel	80	Quarterly grab sample	0.560(mg/l)	0.017(mg/l)
Zinc	80	Quarterly grab sample	0.043(mg/l)	0.059(mg/l)
Manganese	80	Quarterly grab sample	2.5(mg/l)	3.6(mg/l)
Total Nitrogen	80	Quarterly grab sample	1.7(mg/l)	2.9(mg/l)
Total phosphorus	80	Quarterly grab sample	0.2(mg/l)	0.12(mg/l)
Dissolved oxygen	80	Quarterly field sample	39.8% (lower limit)	60% (lower limit)

5.3 Leachate Treatment Plant

The St Peters Interchange site compound is an above ground structure at the Alexandria Landfill. Contaminated stormwater and landfill leachate will continue to be directed to the landfill leachate treatment plant, in accordance with the landfill's existing EPL (EPL4627), where applicable and discharged to sewer in accordance with the trade waste agreement with Sydney Water (pending transfer to CDS-JV). This Water Quality Plan and Monitoring Program does not address the Alexandria Landfill leachate collection and treatment systems. Detail on these systems is provided in the St Peters Interchange - Landfill Closure Management Plan (M5N-GOL-TER-900-116-0012).

6. Pre-construction and Construction Water Quality Monitoring Program

The following monitoring program draws and builds on the water quality reference criteria and the water quality monitoring program for surface water (Appendix N Surface Water Technical Report) and groundwater (within Appendix Q Groundwater Technical Report), described in the New M5 EIS. Baseline water monitoring for the project commenced for groundwater in April 2015, and surface water in June 2015.

The baseline water monitoring report for surface water is presented in Appendix F. A baseline water monitoring report for groundwater will be completed prior to potential impacts to groundwater.

6.1 Introduction

The Water Quality Monitoring Program will be undertaken in three key phases:

- Pre-Construction phase (baseline).
- Construction phase.
- Operational phase (three years post completion).

Monitoring in each of these phases is discussed in the following sections. Monitoring will be undertaken in accordance with Australian Standards, ANZECC/ARMCANZ (2000), the CEMP and the CSWQSP, noting that:

- Physical parameters (i.e. pH and EC) and the dissolved metals will be used to assess basic water characteristics, as they provide good indicators of overall water quality.
- Turbidity will be a key parameter in assessing indications of potential impact.
- Nutrients such as ammonia, nitrates and phosphates provide an indication of the organic load present in the water.
- Total recoverable hydrocarbons (TRH) and BTEXN provide an indication of pollution from hydrocarbons e.g. from fuels, oils, solvents and grease.

6.2 Surface Water Monitoring

6.2.1 Surface Water Monitoring Locations

Water quality monitoring will be undertaken at eleven sites as listed in Table 11 and labelled in Figure 3. Additional monitoring sites may be added during the program if necessary, beneficial or as advised. Where possible, the selection of the monitoring locations has incorporated upstream (control) sites and downstream (impact) sites. This type of monitoring allows for the assessment trends in water quality, including natural variations, and will allow sufficient data to enable assessment of any potential impacts measured during construction. The surface water quality monitoring locations are generally consistent with the ten locations identified in the New M5 EIS Water Quality Monitoring Program (Appendix N Surface Water Technical Report). Minor amendments to some monitoring locations were adopted to provide suitable access for personnel and ensure coverage in waterways where discharge is proposed.

Table 11: Surface water quality monitoring sites before and during construction

Site ID	Location relative to site compounds	Watercourse name	Sampling Address	Eastings	Northings	Freshwater or estuarine / marine
LDS-SW-01	Upstream	Sheas' Creek	Access via Euston Road, Alexandria	332938	6246524	Freshwater
LDS-SW-02	Downstream	Alexandra Canal	Access via Burrows Road or Coward Street via cycleway, Alexandria	331540	6244935	Estuarine / marine
LDS-SW-03	Downstream	Eastern Channel	Sydenham Road, Marrickville.	330581	6245909	Freshwater
LDS-SW-04	Upstream	Eve St Wetlands	Eve St Cycleway, near the entrance to the Barton Park Driving Range	329292	6242429	Estuarine / marine
LDS-SW-05	Upstream	Cooks River	Richardsons Crescent Bridge	329491	6244746	Estuarine / marine
LDS-SW-06	Downstream	Cooks River	Rockwell Avenue	329895	6243716	Estuarine / marine
LDS-SW-07	Downstream	Cooks River	Eve Street near Cooks River M5 infrastructure overpass	329955	6242591	Estuarine / marine
LDS-SW-08*	Upstream	Wolli Creek	Footbridge at portion of Beverly Grove Park located south of the M5, access via Tallawalla Street	322993	6242760	Freshwater
LDS-SW-09*	Upstream	Wolli Creek	Footbridge at the end of Kooreela Street	324663	6243087	Freshwater
LDS-SW-10	Upstream	Wolli Creek	Bexley Rd bridge, near Bexley North Station	325577	6243239	Freshwater
LDS-SW-11	Downstream	Wolli Creek	Upstream of Henderson St footbridge, near 5-9 Henderson St	327910	6244087	Freshwater

Note:*Wet weather monitoring only, as there is an inadequate volume of water in the channel during dry weather to enable sampling to occur.

This page has been left blank intentionally.

Legend

- Surface Water Sample Locations
- Streambed Fracture Monitoring Locations
- Stations
- Watercourse
- Water Body
- Wetlands
- Regional Park
- Compound

Westconnex New M5 Footprint

- Above Ground Construction Footprint
- New M5 Tunnel

LDS-SW-01
LDS-SW-02
LDS-SW-03
LDS-SW-04
LDS-SW-05
LDS-SW-06
LDS-SW-07
LDS-SW-08
LDS-SW-09
LDS-SW-10
LDS-SW-11
LDS-SF-1
LDS-SF-2

Rev	Description	Date	Approved
2	Draft for Comment	29/11/2016	
1	Draft for Comment	13/10/2016	
0	Draft for Comment	18/11/2015	PF

Scale

0 500 1,000 1,500 m

Client: WestConnex

Status: For Information Only - NOT FOR CONSTRUCTION

Original Size	A3	Drawn	PB
Coordinate System	MGA ZONE 56	Requested by	JM
Height Datum	AHD	Date Printed	29-Nov-16
Filename:	Surface_Water_Sample.mxd		

WestConnex New M5

CPB CONTRACTORS | DRAGADOS | SAMSUNG C&T

aurecon | JACOBS | HASSELL | Golder Associates

WESTCONNEX New M5

Surfacewater Monitoring Locations

DOCUMENT NUMBER

This page has been left blank intentionally.

6.2.2 Water Quality Monitoring Parameters for surface water monitoring

The water quality monitoring parameters are drawn from the New M5 EIS Water Quality Monitoring Program (Appendix N Surface Water Technical Report) and are listed in Table 12.

Table 12: Water quality monitoring parameters for surface water monitoring

Parameter	Testing method
Total Nitrogen (includes Total Kjeldahl Nitrogen and Nitrogen oxides)	Sampled and laboratory test
Total Kjeldahl Nitrogen	Sampled and laboratory test
Nitrogen Oxide (NOx), Nitrite (NO_2), Nitrate (NO_3)	Sampled and laboratory test
Total Phosphorus	Sampled and laboratory test
Reactive Phosphorous	Sampled and laboratory test
Turbidity	Field test – probe/meter
Suspended solids	Sampled and laboratory test
Electrical Conductivity (salinity)	Field test – probe/meter
Temperature	Field test – probe/meter
pH	Field test – probe/meter
Dissolved oxygen	Field test – probe/meter
Oxygen Reduction Potential	Field test – probe/meter
Dissolved metals (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	Sampled and laboratory test
Additional metal (Fe and Mn)	Sampled and laboratory test
Organics, Total Recoverable Hydrocarbons (C6-C40)	Sampled and laboratory test
Iron - Ferrous (dissolved)	Sampled and laboratory test
Benzene, Toluene, Ethylbenzene, Xylene, Naphthalene	Sampled and laboratory test

6.2.3 Baseline Phase

The monitoring program during the preconstruction phase includes sampling at bi-monthly intervals (monitoring twice a month, once in dry conditions and once in wet conditions where possible) for 12 months during the preconstruction phase. Wet weather monitoring will happen once a month when more than ten millimetres of rain is received in the local catchment during a 24 hour period. For safety reasons sampling will not be undertaken during peak storm-flows. Sampling will be completed when flows are reasonably constant and safe.

Water quality monitoring parameters are as per Table 12. The baseline surface water monitoring report is provided in Appendix F.

6.2.4 Construction Phase

The monitoring program during the construction phase will continue monthly sampling during the construction phase.

Wet weather monitoring will be conducted quarterly (once every 3 months) when more than ten millimetres of rain is received in the local catchment during a 24 hour period. For safety reasons

sampling will not be undertaken during peak storm-flows. Sampling will be completed when flows are reasonably constant and safe.

Surface water quality parameters monitoring will be as per Table 12.

6.2.5 Visual surveillance procedure for potential streambed fracturing

Visual surveillance will be undertaken by the Environmental Advisor (EA) or as otherwise delegated by the Environment and Sustainability Manager. This surveillance would be in addition to monitoring of groundwater inflow to tunnels. Surveillance procedure to be implemented as follows:

1. Prior to the commencement of tunnelling, the EA will establish monitoring locations at the sites shown in Figure 3 to undertake surveillance of key waterway features, including photo points.
2. Undertake monthly baseline visual surveillance of the waterway prior to commencement of tunnelling. Identify and record key features including as a minimum:
   - Condition of banks,
   - Current water depth and relative high/low water marks.
3. Continue monthly surveillance at the monitoring sites throughout construction. Undertake a monthly review of visual surveillance between monitoring sites and relative to the baseline.
4. Commence further investigation into potential causes, where the visual surveillance identifies changes to flows in the waterway and/or key features.

6.3 Groundwater Monitoring

6.3.1 Groundwater monitoring locations

The proposed groundwater monitoring bores for preconstruction and construction phase monitoring are summarised in Table 13 and are labelled on Figure 4. This figure identifies boreholes for water quality monitoring and depth to groundwater. There is substantial site coverage both along the Project tunnels and adjacent to the alignment to monitor shallow and deep groundwater trends during the construction phase. Modelling predicts a maximum of two metres of groundwater drawdown in areas of retained Groundwater Dependent Ecosystems. This is unlikely to stress the community as the natural seasonal variation drawdown is within this parameter (CDM Smith, 2015).

The following locations and associated boreholes will be used to monitor potential impacts to Groundwater Dependent Ecosystems:

- Cooks River Castlereagh Ironbark Forest GDE at Kingsgrove
  - WCX-BH006
- Hinterland Sandstone Gully Forest GDE at Bardwell Valley Parkland and Broadford Street Reserve
  - LDS-BH-1033B and LDS-BH-1066
- Coastal Sandstone Ridgetop Woodland GDE at Stotts Reserve, Bexley North
  - LDS-BH-1044 and LDS-BH-1032
- Estuarine Fringe Forest and Mangrove Forest GDE between the southern bank of Wolli Creek and the rail line behind Wolli Creek Station
  - WCX-BH039

Groundwater quality will be monitored at the following locations:

- Cooks River adjacent to the Arncliffe construction compound
  - WCX-BH168
- Bardwell Park
  - LDS-BH-1066
- Cut-off wall for Alexandria Landfill

- LDS-BH-3045A, LDS-BH-3046A, LDS- BH- 3045A, LDS- BH- 3046A, LDS- BH- 3047A and LDS-BH-3907

Monitoring bores with screen sections at the depth of the tunnels and monitoring bores at shaft locations will closely monitor groundwater level changes due to localised dewatering through tunnel and shaft drainage. Some bores within the Hawkesbury Sandstone and the overlying alluvium are within close lateral proximity to each other to provide information on potential vertical head gradient between the alluvium and the sandstone. This is important in assessing the aquifer connectivity including recharge into deeper groundwater system intersected by the Project tunnels. Monitoring bores have also been placed at some distance to the alignment to better understand the development of a drawdown zone along the tunnel as tunnel construction progresses. Note, the final number and locations of bores are subject to access and security considerations.

Table 13: Groundwater quality and level monitoring locations

Bore ID	Hydrostratigraphic unit screened	Eastings	Northings	Water quality	Water level	Data logger
LDS-BH-1019	Alluvium	323844	6242879	✓	✓	✓
LDS-BH-1021	Hawkesbury Sst	323910	6242865		✓	✓
LDS-BH-1025A	Hawkesbury Sst	324230	6242852	✓	✓	✓
LDS-BH-1026	Hawkesbury Sst	324448	6242973	✓	✓	✓
LDS-BH-1027	Hawkesbury Sst	324475	6242852	✓	✓	✓
LDS-BH-1030	Hawkesbury Sst	325494	6243263		✓	✓
LDS-BH-1031	Hawkesbury Sst	325760	6243091		✓	✓
LDS-BH-1032	Hawkesbury Sst	326053	6243172		✓	✓
LDS-BH-1033B	Hawkesbury Sst	326949	6243223	✓	✓	✓
LDS-BH-1038	Hawkesbury Sst	329099	6243198	✓	✓	✓
LDS-BH-1041	Alluvium / Hawkesbury Sst	329465	6243437		✓	✓
LDS-BH-1044[1]	Alluvium	325714	6243233		✓	
LDS-BH-1066	Hawkesbury Sst	326531	6242873		✓	✓
LDS-BH-2001	Alluvium	329361	6243035	✓	✓	✓
LDS-BH-2003	Alluvium	329720	6242895		✓	✓
LDS-BH-2005	Alluvium / Hawkesbury Sst	329618	6243371	✓	✓	✓
LDS-BH-2007A[2]	Hawkesbury Sst	329789	6243546	✓	✓	✓
LDS-BH-2008A	Hawkesbury Sst	329891	6243883	✓	✓	✓
LDS-BH-2011A	Hawkesbury Sst	330097	6244325	✓	✓	✓
LDS-BH-2011B	Alluvium	330097	6244323	✓	✓	
LDS-BH-2015	Hawkesbury Sst	330176	6244776	✓	✓	✓
LDS-BH-2018	Hawkesbury Sst	330615	6245117	✓	✓	✓
LDS-BH-2019[3]	Hawkesbury Sst	330714	6245309		✓	
LDS-BH-2029[2]	Hawkesbury Sst	329560	6243397		✓	✓
LDS-BH-2029A[2]	Alluvium	329561	6243398		✓	✓
LDS-BH-2032[1]	Ashfield Shale	330286	6245563		✓	✓
LDS-BH-3045	Botany Sands Aquifer	331602	6245451	✓	✓	✓
LDS-BH-3045A	Ashfield Shale	331613	6245460	✓	✓	✓
LDS-BH-3046	Botany Sands Aquifer	331841	6245571	✓	✓	✓
LDS-BH-3046A	Ashfield Shale	331842	6245571	✓	✓	✓
LDS-BH-3047	Botany Sands Aquifer	332046	6245639		✓	✓

Bore ID	Hydrostratigraphic unit screened	Eastings	Northings	Water quality	Water level	Data logger
LDS-BH-3047A	Ashfield Shale	332046	6245640		✓	✓
LDS-BH-3082[4]	Botany Sands Aquifer	331437	6245751		✓	
LDS-BH-3097[4]	Botany Sands Aquifer	331822	6245596		✓	
LDS-BH-5007	Ashfield Shale	331811	6245941		✓	✓
LDS-BH-5010[1]	Ashfield Shale	331762	6245993		✓	✓
LDS-BH-5022	Botany Sands Aquifer	332211	6245657		✓	✓
WCX-BH006	Hawkesbury Sst	323555	6242880		✓	✓
WCX-BH018	Hawkesbury Sst	326717	6243422		✓	✓
WCX-BH024	Hawkesbury Sst	327222	6243306	✓	✓	✓
WCX-BH039	Hawkesbury Sst	329553	6244158		✓	✓
WCX-BH072	Hawkesbury Sst	325561	6243243	✓	✓	✓
WCX-BH088	Hawkesbury Sst	326182	6243434		✓	✓
WCX-BH093	Hawkesbury Sst	327657	6243183	✓	✓	✓
WCX-BH094	Hawkesbury Sst	327867	6243174		✓	✓
WCX-BH103	Hawkesbury Sst	330431	6245201	✓	✓	✓
WCX-BH109	Ashfield Shale	331220	6245632	✓	✓	✓
WCX-BH122	Ashfield Shale	332030	6245873		✓	✓
WCX-BH137	Hawkesbury Sst	324858	6243065	✓	✓	✓
WCX-BH153	Hawkesbury Sst	330468	6244766		✓	✓
WCX-BH157	Regentville Siltstone	331518	6245766		✓	✓
WCX-BH168	Hawkesbury Sst	329702	6243775	✓	✓	✓

Notes

1: Well destroyed

2: Well not currently accessible due to Marsh St widening construction activities

3: Due to grout infiltration during well installation, well to be used for monitoring groundwater levels only. Groundwater quality to be measured in nearby well WCX-BH-103

4: Monitoring well to be installed

6.3.2 Water Quality Monitoring Parameters for groundwater monitoring

The water quality monitoring parameters are as per the Draft Groundwater Monitoring Program as described in the New M5 EIS (Appendix Q Groundwater - Appendix E) and are listed in Table 14.

Table 14: Water quality monitoring parameters for groundwater bore monitoring

Parameter	Testing method
Turbidity	Field test – probe/meter
Electrical Conductivity (salinity)	Field test – probe/meter
Temperature	Field test – probe/meter

Parameter	Testing method
pH	Field test – probe/meter
Dissolved oxygen	Field test – probe/meter
Oxygen Reduction Potential	Field test – probe/meter
Ammonium	Sampled and laboratory test
Dissolved metals (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	Sampled and laboratory test
Additional metal (Fe and Mn)	Sampled and laboratory test
Organics, Total Recoverable Hydrocarbons (C6-C40)	Sampled and laboratory test
Iron - Ferrous (dissolved)	Sampled and laboratory test
Benzene, Toluene, Ethylbenzene, Xylene	Sampled and laboratory test
Polycyclic Aromatic Hydrocarbons (PAHs),	Sampled and laboratory test
Phenols	Sampled and laboratory test
Organochlorine Pesticides	Sampled and laboratory test
Organophosphorus Pesticides	Sampled and laboratory test
Polychlorinated Biphenyls	Sampled and laboratory test

6.3.3 Baseline and Construction Phase

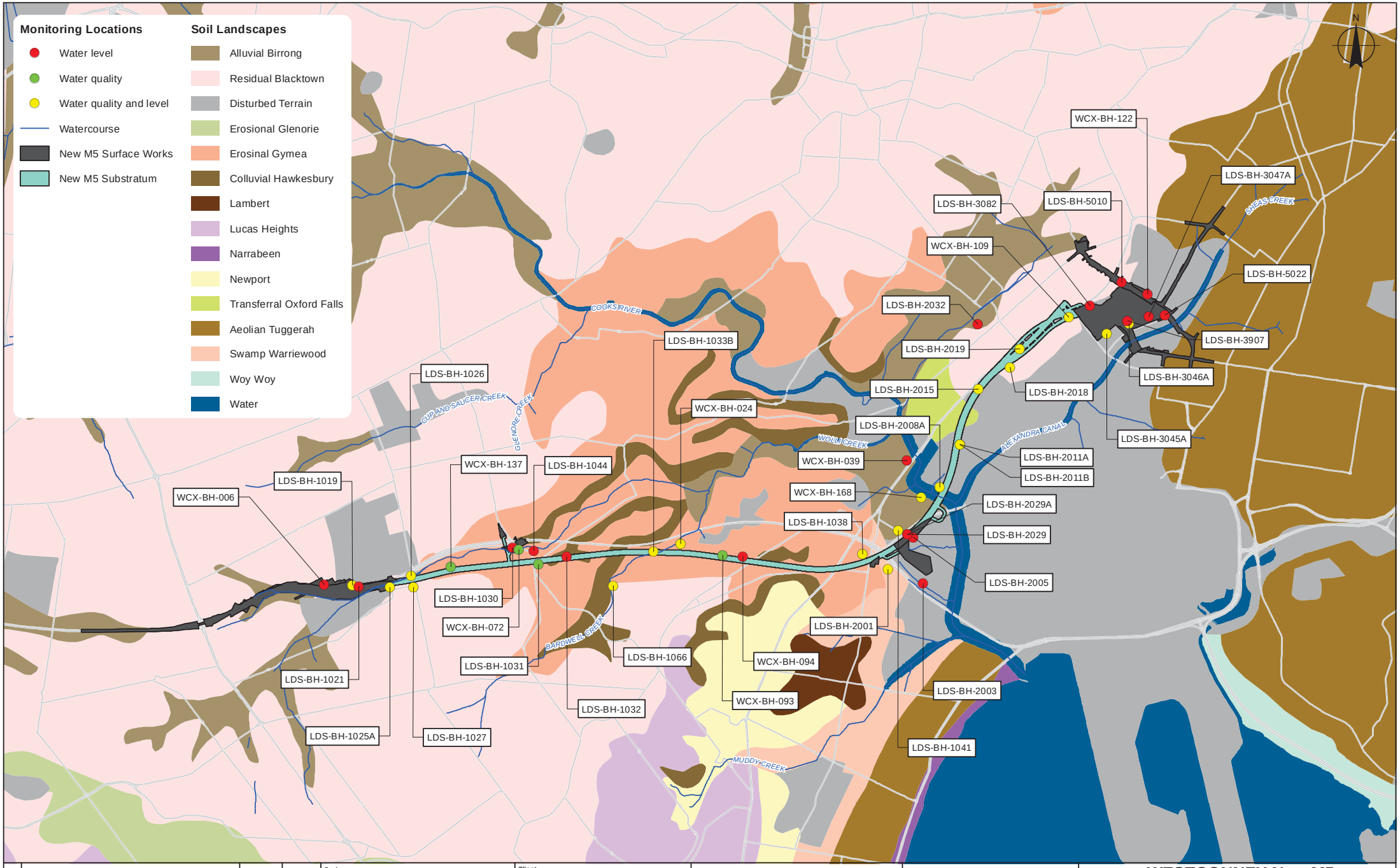
It is proposed to collect groundwater samples for water quality monitoring purposes from up to 20 locations and also for water levels from 32 locations, refer Table 13. Groundwater quality monitoring parameters will be as given in Table 14.

The proposed frequency for sampling groundwater is presented in Table 15. The sampling frequency may be modified once an appropriate database of groundwater water quality and level data has been obtained. As part of the ongoing review of monitoring data, the requirements to increase or to decrease, the number of sampling locations and/or the analytical suites may be proposed. Alterations to monitoring locations, analytical suites, or frequencies will be reported in the biannual monitoring reports (Section 8).

Table 15: Frequency of monitoring groundwater

Project Phase	Frequency
Construction (groundwater levels)	Monthly (Datalogger)
Construction (groundwater quality)	6 monthly

This page has been left blank



Rev	Description	Date	Approved
A	Preliminary Issue	31/05/2016	

Scales
0 1,200 m
1:35000

Client
WestConnex

Status
For Information Only - NOT FOR CONSTRUCTION

Original Size	A3	Drawn	DC
Coordinate System	MGA ZONE 56	Requested by	RB
Height Datum	AHD	Date Printed	31/05/2016
Filename:	Groundwater Monitoring Locations.mxd		

WestConnex New M5

CPB CONTRACTORS | DRAGADOS | SAMSUNG C&T
aurecon | JACOBS | HASSELL | Golder Associates

WESTCONNEX New M5

Groundwater Monitoring Locations

Figure: 4

This page has been left blank intentionally.

7. Management and Mitigation Measures

Measures to manage water quality impacts and reduce the risk of impact to water quality will be implemented prior to and during works. Elimination of the hazard is the first preference of control, followed by engineering, then administrative controls. Controls used on this Project are identified in Table 16. These controls include the relevant environmental mitigation measures identified in the New M5 EIS and the final REMMs from the WestConnex New M5 Submissions Report.

Table 16: Project controls associated with management of water quality

Reference	Control / Action	Timing	Responsibility	Source
Surface and groundwater – Water treatment				
WQ01	Measures relating to surface and groundwater during construction and operation, including water treatment, erosion and sediment control plans and stormwater management measures consistent with Water Sensitive Urban Design measures, where relevant, and consistent with the measures detailed in the documents listed in CoA A2, including the specifications and design details of the water treatment plants will be included in the Design Reports.	Design	EM,DM	B28(c)
Surface water – Incident triggers and potential responses				
WQ02	Spillage of hazardous materials: • Stop work • Activate Manage Hazardous Substances Procedure (M5N-ES-PRC-PWD-0041) and Spill Management Flowchart (M5N-ES-FLC-PWD-0003) immediately • Report the incident.	Pre-construction Construction	EM, EA, PM, SS	B28(c)
WQ03	Unanticipated discovery of contaminated soil/water: • Stop work • Activate the Manage Contaminated Land Procedure (M5N-ES-PRC-PWD-0036) and Unexpected Discovery of Contaminated Land Flowchart (M5N-ES-FLC-PWD-0001) immediately • Report the incident.	Pre-construction Construction	EM, EA, PM, SS	B28(c)
WQ04	Fish kill in receiving waters: • Stop work • Implement the Incident Response Plan (M5N-HS-PLN-PWD-0003) • Report and investigate the incident.	Construction	EM, PM	B28(c)
WQ05	Exceptional rainfall event • Restrict works in open areas, where appropriate • Inspect erosion controls (i.e. source controls) to ensure effectiveness • Maintain/manage erosion and sediment control devices, including sediment basins • Conduct ongoing monitoring and maintenance of controls.	Pre-construction Construction	PM, SS	B28(c)

Reference	Control / Action	Timing	Responsibility	Source
Surface water – Ambient surface water quality triggers – Using trigger values				
WQ06	Water Quality triggers will be used to identify potential Project impacts on the receiving waters, and to inform an appropriate response. A management response (refer to WQ08) will be instigated if any of the following occurs: • If, in the downstream monitoring location(s) there are exceedances of one or more of the trigger values for that catchment for three consecutive monthly sampling events and the upstream monitoring does not show the same exceedances. • If, in the downstream monitoring location(s) there are exceedances of one or more of the trigger values for that catchment for more than six sampling events in any one year and the upstream monitoring does not show the same exceedances. • If, in a downstream monitoring location there is a single exceedance of the trigger values for that catchment by more than 50% and the upstream monitoring location does not show the same exceedance. • An NTU result at a downstream location is more than 20% above that measured in the associated upstream location and is attributable to site works.	Pre-construction Construction	EM	B28(o)
Surface water – Site discharge triggers - Sediment basins				
WQ07	Water will not be actively discharged from a sediment basin unless it meets the EPL targets in Section 5.1. Rainfall events that exceed the design event may cause overtopping of a sediment basin. Such unconditional discharges are not subject to the same water quality targets or monitoring, but their date, time and duration will be documented.	Pre-construction Construction	EM	B28(c)
Surface Water – Management responses				
WQ08	Within two business days of receiving any round of surface water monitoring results, a review will be conducted against the agreed trigger values, and between comparison sites (i.e. upstream vs downstream). In the event that one or more of the triggers in section 5 (Table 8, Table 9, Table 10) was exceeded, and one or more of the scenarios listed in WQ06 applies, an investigation would be immediately commenced to determine the significance of the exceedance(s) and possible causes. If the exceedance is attributable to Project works, the project's Incident Response Plan (M5N-HS-PLN-PWD-0003) would be implemented. An investigation would be conducted and actions that	Pre-construction Construction	EM, EA	B28(o)

Reference	Control / Action	Timing	Responsibility	Source
	recommend any additional management measures, amelioration or monitoring required would be identified.			
Groundwater quality – Groundwater chemical triggers and management response				
WQ9	Monitoring to-date shows that some groundwater quality parameters currently exceed the default ANZECC/ARMCANZ 2000 water quality trigger values for slightly to moderately disturbed ecosystems. Therefore, site-specific groundwater trigger values will be developed using the baseline data. This data will provide a project-specific baseline for assessing potential impacts of the project on groundwater quality. A management response would be initiated if any of the following occurs: • There is an identified negative trend in any of the analytes measured over a period of any two sampling events; or • There is a peak in any single analyte which is more than 20% above the previous reading; or • An analyte result deviates negatively more than 20% from the rolling 80th percentile of all previous results. In the event that one or more of the above groundwater chemical triggers are observed, a review will be conducted against the trigger values, and against the results from surrounding monitoring bores. An investigation would be conducted to determine the significance of the exceedance(s) and possible causes. If the exceedance is determined to be attributable to Project works, an investigation would be conducted to determine any additional management measures required to be implemented. Groundwater quality monitoring data will be assessed and reported according to Section 8.	Pre-construction Construction	EM, EA	B28(o)
Groundwater quality – Groundwater elevation triggers				
WQ10	Identification of a groundwater decline (including a decline in quality and/or quantity) in a water supply bore (beyond seasonal fluctuations in nearby monitoring bores) will be assessed to determine whether the decline is attributable to dewatering from the project. The assessment will include a review of groundwater levels and groundwater quality in the relevant bore and surrounding monitoring bores. Where such an impact is confirmed, 'make good' provisions for the relevant groundwater users will apply. ['Make good' will only apply to registered bore users.]	Pre-construction Construction	EM, EA	B28(p)
WQ11	Implement measures identified in the Hydrogeological Design Report (M5N-GOL-DRT-100-200-GT-1525) to manage/mitigate identified potential groundwater impacts. Where groundwater drawdown is identified to occur beyond the modelled predictions of the Hydrogeological Design Report, an assessment will be conducted to determine whether the decline is attributable to	Construction	PM	B28(o)

Reference	Control / Action	Timing	Responsibility	Source
	dewatering from the project. Where the drawdown is determined to be project-related, a review and update of the groundwater model would be undertaken, and further consultation would be undertaken with DPI Water to determine an appropriate management response, where required.			
Groundwater Treatment and Discharge				
WQ11	Refer to Section 5 for details of treatment and discharge of tunnel inflows. Discharge points into watercourses will be designed to emulate a natural stream system where feasible and reasonable, or where emulation cannot be achieved, adequate scour protection measures are to be implemented.	Pre-construction Construction	EM, EA	B28(c) – (e)
Streambed Monitoring				
WQ12	Flow in-tunnel monitoring when operating in the vicinity of Wolli Creek, Bardwell Creek and Cooks River.	Construction	EM, PM	B28(q)
WQ13	Identification of risk and undertake visual surveillance (refer Section 6.2.5) for potential streambed fracture (beyond seasonal fluctuations in stream depth) and required mitigation measures associated with tunnelling works in the vicinity of Wolli Creek, Bardwell Creek and Cooks River.	Construction	EM, PM	B28(q)

CRM Community Relations Manager; DM – Design Manager; EA – Environmental Advisor; EM – Environmental Manager; PE – Project Engineer; PM – Project Manager; SS – Site Supervisor

8. Reporting

Reporting of the monitoring results to the Secretary, DPI Water and the relevant council is required as part of this Water Quality Plan & Monitoring Program. Table 17 details the proposed reporting schedule.

Table 17: Reporting schedule

Project Phase	Report Timing	Report Requirements
Prior to Construction	Within 3 months of completion of baseline monitoring	Surface water and groundwater data collected and tabulated. Progressive trends and rolling means to be identified as they emerge.
		A report on results obtained from the baseline monitoring period. This data will be used to confirm the site-specific water quality criteria/targets.
During Construction	Annual	Raw surface and groundwater data to be collected and tabulated. Progressive trends to be identified. Trigger exceedances to be highlighted.
		A brief report on the validation of groundwater modelling (once only, in the initial reporting period).
		Report on water quality results obtained during construction. Trigger values to be used and triggers and management responses to be documented. Determine the need for adjustments to the Water Quality Monitoring Program, if necessary.
		Detail and justification for any alterations to monitoring locations or frequencies.
		Document rainfall data

The operational elements of the Water Quality Plan and Monitoring Program will be submitted to the Secretary for approval six months prior to the commencement of operation of the Project, unless otherwise agreed by the Secretary. A copy of the Plan and Program shall be submitted to the DPI Water, Sydney Water and relevant councils prior to its implementation.

9. References

AECOM (2015), WestConnex The New M5 – Environmental Impact Statement. Prepared for Roads and Maritime Services, 20 November 2015.

AECOM (2015). WestConnex The New M5 – Appendix N Technical Working Paper Surface Water. Prepared for Roads and Maritime Services, 20 November 2015.

AECOM (2015). WestConnex The New M5 – Appendix Q Technical Working Paper Groundwater. Prepared for Roads and Maritime Services, 20 November 2015.

ANZECC/ARMCANZ (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (collectively known as the 'ANZECC Guidelines').

ANZECC/ARMCANZ (2000). *Australian and New Zealand Guidelines for Water Quality Monitoring and Reporting* (collectively known as the 'ANZECC Guidelines').

Bureau of Meteorology (BOM) 2015. Atlas of Groundwater Dependent Ecosystems. Available: http://www.bom.gov.au/water/groundwater/gde/map.shtml [Accessed 02 December 2015]

CDM Smith (2015). West Connex Stage 2 New M5 Groundwater Modelling Report. Prepared for AECOM, 28 September 2015.

Cooks River Valley Association, 2010/2011. Annual Water Quality Report.

DECC (2007). Department of Environment and Climate Change. (2007). Floodplain Risk Management Guide – Practical Considerations of Climate Change.

DECC (2008). *Managing Urban Stormwater: Soils and Construction.* Volume 2D: Main Road Construction. Department of Environment and Climate Change. NSW Government, Sydney.

Department of Primary Industries (2015). http://allwaterdata.water.nsw.gov.au/water.stm Accessed October 2015.

Equatica (2014). City of Rockdale Water Quality Monitoring Study - Part A: Report. Prepared for Rockdale City Council.

GHD (2012). Alexandra Canal, 61 Huntley Street, Stormwater Asset Renewal Program. Review of Environmental Factors. Prepared for Sydney Water. (NOTE: Referred to in EIS report body as GHD 2012, in reference section as GHD 2014. Cited in the WQMP as GHD 2012)

LDS (2015). LDS tender design (proprietary document).

Heuer R E (2005). Estimating Rock Tunnel Water Inflow - II. Rapid Excavation and Tunnelling Conference Proceedings, Seattle.

Landcom (2004). *Managing Urban Stormwater: Soils and Construction.* Volume 1, 4th Edition. NSW Government, Sydney.

Markich SJ & Jeffree RA (1994). Absorption of divalent trace metals as analogues of calcium by Australian freshwater bivalves: An explanation of how water hardness reduces metal toxicity. Aquatic Toxicology 29, 257–290.

National Uniform Drillers Licensing Committee (NUDLC) (2012). Minimum Construction Requirements for Water Bores in Australia 3rd Edition. National Uniform Drillers Licensing Committee 2011.

RTA (1999). Guideline for Construction Water Quality Monitoring. NSW Road and Traffic Authority

Appendix A – Registered Groundwater Bores

A.1. Groundwater Users

Groundwater users within a one kilometre radius of the Project area were identified in the New M5 EIS (AECOM 2015).

Sixty-one bores registered by DPI Water within a one kilometre radius of the Project area were idenfitied. The majority of the bores are located in the Tempe, St Peters and Alexandria area (43 bores), at or in the vicinity of Kogarah Golf Course (15 bores) and along the M5 East Motorway to the west of Arncliffe (three bores).

Refer to Figure 5 for an overview of the licensed bores within one kilometre of the Project. Table 18 provides the predicted drawdown at bores within 1km of the main tunnel alignments.

Table 18: Predicted drawdown at bores within 1 km of the main tunnel alignments

Bore_ID	Depth of Bore (m)	SWL	Purpose	From (mBGL)	To (mBGL)	Geology Screened	Easting	Northing	Location relative to M5 Alignment	Predicted drawdown (m)
GW013331	14.9	7.9-14.8	Industrial	0	1.52	Sand (yellow)	332767.30	6245196.24	King Georges Rd to Alexandria - Within alignment boundary, North of Gardener's Road	0.0
GW015954	20.1	6.7-19.2	Industrial	0	0.3	Sand	332869.39	6245175.85	King Georges Rd to Alexandria - North and East of alignment boundary, North of Gardener's Road	0.0
GW023191	3.7	1.20	Water Supply - Domestic	0	3.65	Sand	329042.25	6242522.89	South of Alignment - South East of Princes Highway, North of Spring St	0.4
GW023194	4.9	3.3	Water Supply - Domestic	0	0.91	Sand	329157.21	6242813.39	South of Alignment - South East of Princes Highway, North of Spring St	6.7
GW024109	2.1	2.1	Water Supply - Domestic	0	2.13	Sand	329430.77	6243539.39	King Georges Rd to Alexandria - Within alignment boundary, East of Princes Highway	2.2
GW024673	4.3	Not Available	Water Supply - Domestic	0	4.26	Loam	323239.13	6243337.24	King Georges Rd to Alexandria - North of alignment, West of Princes Highway	0.3
GW027248	4.9	2.4	Industrial	0	1.21	sand	332256.63	6244787.87	King Georges Rd to Alexandria - South of alignment, near Coward Street	0.0
GW027664	6.1	0.7	Irrigation	0	0.3	Sand	329534.65	6243419.23	King Georges Rd to Alexandria - within alignment boundary, East of Princes Highway	2.4

Bore_ID	Depth of Bore (m)	SWL	Purpose	From (mBGL)	To (mBGL)	Geology Screened	Easting	Northing	Location relative to M5 Alignment	Predicted drawdown (m)
GW040219	0	Not Available	Commercial and Industrial	-	-	Not Available	332130.36	6245129.53	King Georges Rd to Alexandria - South of Gardeners Road	0.0
GW072161	90.5	14	Other	0	16	Sandstone (grey, shale bands)	329636.13	6243432.15	King Georges Rd to Alexandria - Within alignment boundary, East of Princes Highway	1.0
GW072643	12	Not Available	Unknown	0	2	Shale (grey, clay bands)	331955.90	6245581.26	King Georges Rd to Alexandria - Within alignment boundary, South East of Princes Highway, North	0.1
GW100053	7	1	Other	0	0.95	Sand (white)	332163.64	6245862.27	King Georges Rd to Alexandria - Within alignment boundary, East of Princes Highway, North of	0.1
GW100209	108	42.00-43.00	Water Supply - Domestic	0	31	Sandstone (white)	329944.54	6243249.10	King Georges Rd to Alexandria - South east of alignment, East of Princes Highway	0.3
GW101533	20	4.4	Domestic	0	2	Sand	333060.41	6245356.71	King Georges Rd to Alexandria - North of alignment, North of Gardeners Road	0.0
GW103504	6.1	Not Available	Monitoring	0	0.5	Sand	333095.44	6245468.26	King Georges Rd to Alexandria - North of alignment, North of Gardeners Road	0.0
GW103505	6	Not Available	Monitoring	0	0.16	Sand	333095.64	6245457.17	King Georges Rd to Alexandria - North of alignment, North of Gardeners Road	0.0
GW103506	6	Not Available	Monitoring	0	0.17	Sand	333095.64	6245457.17	King Georges Rd to Alexandria - North of alignment, North of Gardeners Road	0.0

Bore_ID	Depth of Bore (m)	SWL	Purpose	From (mBGL)	To (mBGL)	Geology Screened	Easting	Northing	Location relative to M5 Alignment	Predicted drawdown (m)
GW103507	6	Not Available	Monitoring	0	0.16	Sand	333095.64	6245457.17	King Georges Rd to Alexandria - North of alignment, North of Gardeners Road	0.0
GW103508	6	Not Available	Monitoring	0	0.16	Sand	333095.64	6245457.17	King Georges Rd to Alexandria - North of alignment, North of Gardeners Road	0.0
GW104448	0	Not Available	Monitoring	-	-	Not Available	331717.68	6244933.63	King Georges Rd to Alexandria - South East of Princes Highway	0.0
GW104449	0	Not Available	Monitoring	-	-	Not Available	331680.31	6244955.16	King Georges Rd to Alexandria - East of Alexandra Canal, South of Ricketty Street	0.0
GW104450	0	Not Available	Monitoring	-	-	Not Available	331635.06	6244898.89	King Georges Rd to Alexandria - South East of Princes Highway	0.0
GW104988	7	Not Available	Domestic	0	7	Sand	333079.61	6244791.29	King Georges Rd to Alexandria - South East of alignment, West of Botany Road	0.0
GW106830	7	Not Available	Water Supply - Domestic	0	7	Sand	323793.20	6242382.39	King Georges Rd to Alexandria - South of alignment, West of Princes Highway	0.4
GW107993	13.6	1.95	Other-Test Bore	0	0.3	Sandstone (brown)	328239.95	6243429.15	King Georges Rd to Alexandria - North of alignment, West of Princes Highway	11.5
GW108104	Not	Not Available	Industrial	-	-	Not Available	333033.46	6245311.86	King Georges Rd to Alexandria - North of alignment, North of Gardeners Road	0.0

Bore_ID	Depth of Bore (m)	SWL	Purpose	From (mBGL)	To (mBGL)	Geology Screened	Easting	Northing	Location relative to M5 Alignment	Predicted drawdown (m)
GW108295	8	Not Available	Water Supply - Domestic	0	8	Sand	328904.61	6242464.94	Southern Alignment - South East of Princes Highway, near Coward St	0.2
GW108406	8	Not Available	Water Supply - Domestic	0	8	Sand	329506.32	6243452.00	King Georges Rd to Alexandria - Within alignment boundary, East of Princes Highway	2.4
GW108439	8	Not Available	Water Supply - Domestic	0	8	Sand	328895.17	6242475.86	Southern Alignment - South East of Princes Highway, near Coward St	0.3
GW108497	8	Not Available	Recreation	-	-	Not Available	332751.80	6245550.95	King Georges Rd to Alexandria - East of Alexandra Canal, North of Orchard Road	0.0
GW108588	8	Not Available	Water Supply - Domestic	0	8	Sand	329442.01	6243428.66	King Georges Rd to Alexandria - Within alignment boundary, East of Princes Highway	2.7
GW109191	186	93	Other	0	1	Sandstone (brown)	325257.73	6243186.07	King Georges Rd to Alexandria - North of alignment, West of Princes Highway	5.7
GW109821	35	14.5	Monitoring	0	2.2	Shale	331820.76	6245900.57	King Georges Rd to Alexandria - Within alignment boundary, East of Princes Highway, North of	0.0
GW109822	10.45	3	Monitoring	0	2.6	Sand	331807.77	6245589.73	King Georges Rd to Alexandria - Within alignment boundary, South East of Princes Highway, North	0.2
GW109823	29	12.5	Monitoring	0	3	Sand	331817.02	6245589.90	King Georges Rd to Alexandria - Within alignment boundary, South East of Princes Highway, North	0.2

Bore_ID	Depth of Bore (m)	SWL	Purpose	From (mBGL)	To (mBGL)	Geology Screened	Easting	Northing	Location relative to M5 Alignment	Predicted drawdown (m)
GW109824	20.7	4.51	Monitoring	0	4.5	Sandstone (brown)	331390.74	6245637.80	King Georges Rd to Alexandria - Within alignment boundary, South East of Princes Highway, North	0.0
GW109825	22	14.9	Monitoring	0	4.5	Shale	331692.11	6245853.92	King Georges Rd to Alexandria - Within alignment boundary, East of Princes Highway, North of	0.1
GW109963	8	Not Available	Water Supply - Domestic	0	8	Sand	329442.41	6243406.48	King Georges Rd to Alexandria - Within alignment boundary, East of Princes Highway	2.7
GW109964	8	Not Available	Water Supply - Domestic	0	8	Sand	329423.72	6243417.24	King Georges Rd to Alexandria - Within alignment boundary, East of Princes Highway	2.8
GW109965	8	Not Available	Water Supply - Domestic	0	8	Sand	329487.63	6243462.76	King Georges Rd to Alexandria - Within alignment boundary, East of Princes Highway	2.4
GW109966	3	Not Available	Water Supply - Domestic	0	3	Clay	329376.71	6243460.76	King Georges Rd to Alexandria - Within alignment boundary, East of Princes Highway	4.5
GW110456	3.6	2.3	Monitoring	0	0.3	Sand	332780.77	6246006.28	King Georges Rd to Alexandria - North of alignment, West of Princes Highway/North of Gardeners	0.0
GW110457	3.6	1.7	Monitoring	0	0.25	Sand	332818.92	6245940.40	King Georges Rd to Alexandria - North of alignment, West of Princes Highway/North of Gardeners	0.0
GW110458	2.8	2.3	Monitoring	0	0.7	Sandstone	332910.60	6245986.38	King Georges Rd to Alexandria - North of alignment, West of	0.0

Bore_ID	Depth of Bore (m)	SWL	Purpose	From (mBGL)	To (mBGL)	Geology Screened	Easting	Northing	Location relative to M5 Alignment	Predicted drawdown (m)
									Princes Highway/North of Gardeners	
GW110735	0	Not Available	Water Supply - Domestic	-	-	Not Available	328931.14	6242531.97	South East of Princes Highway, near Coward St	0.4
GW111316	162	4.000	Monitoring	0	37	Sandstone (brown)	329328.57	6242539.14	South East of Princes Highway, near Coward St	0.4
GW111320	5.2	2.52	Monitoring	0	0.18	Sand	332302.72	6245842.54	King Georges Rd to Alexandria - Within alignment boundary, East of Princes Highway, North of	0.0
GW111321	5	2.64	Monitoring	0	0.18	Sand	332322.98	6245743.06	King Georges Rd to Alexandria - Within alignment boundary, East of Princes Highway, North of	0.0

Legend

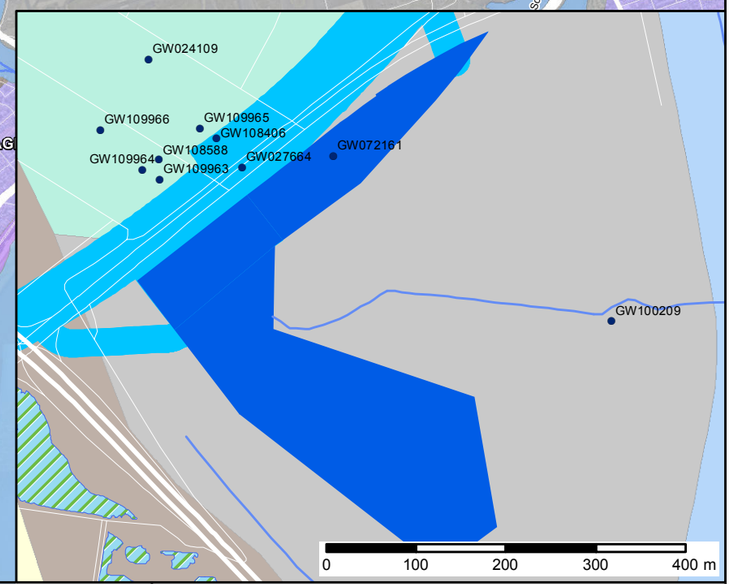
- Licensed Bores Within 1km of the Project
- Stations
- Watercourse
- Water Body
- Wetlands

Westconnex New M5 Footprint

- Above Ground Construction Footprint
- New M5 Tunnel

Soils Landscapes

- BIRRONG
- BLACKTOWN
- DISTURBED TERRAIN
- GLENORIE
- GYMEA
- HAWKESBURY
- LAMBERT
- LUCAS HEIGHTS
- NARRABEEN
- NEWPORT
- OXFORD FALLS
- TUGGERAH
- WARRIEWOOD
- WOY WOY



Rev	Description	Date	Approved
1	Draft for Comment	11/10/2016	
0	Draft for Comment	18/11/2015	PF

Scale: 0 500 1,000 1,500 m

Imagery © Nearmap 2016

Client: WestConnex

Status: For Information Only - NOT FOR CONSTRUCTION

Original Size	A3	Drawn	PB
Coordinate System	MGA ZONE 56	Requested by	CG
Height Datum	AHD	Date Printed	11-Oct-16
Filename:	Licensed Boreholes.mxd		

WestConnex New M5

CPB CONTRACTORS | DRAGADOS | SAMSUNG C&T

aurecon | JACOBS | HASSELL | Golder Associates

WESTCONNEX New M5

Licensed Groundwater Bores Within 1km of the Project

DOCUMENT NUMBER

This page has been left blank intentionally.

Appendix B – Risk Assessment

The following details the method in which the risk assessment in Section 4 of this plan was undertaken. The risk analysis involved:

- Ranking the risk of each identified potential impact by identifying the consequences of the impact and the likelihood of each impact occurring.
- Considering the probable effectiveness of the proposed mitigation measures to determine the likely residual risk of each impact.

The likelihood of the event occurring is detailed in Table 19 and the consequence in Table 20, Table 21 provides the risk rating.

Table 19: Likelihood criteria

Probability (likelihood)	Description (1)	Description (2)	Description (3)
Almost certain (5)	Common /Frequent Occurrence	Can be expected to occur 75% – 99%	More than 1 event per month
Likely (4)	Is known to occur or “It has happened regularly”	Can quite commonly occur 50% - 75%	More than 1 event per year
Possible (3)	Could occur or “I’ve heard of it happening”	May occasionally occur 25% - 50%	1 event per 1 to 10 years
Unlikely (2)	Not likely to occur very often	May infrequently occur 10% - 25%	1 event per 10 to 100 years
Rare (1)	Conceivable but only in exceptional circumstances	May occur in exceptional circumstances 0% - 10%	Less than 1 event per 100 years

Table 20: Consequence criteria relevant to environment and heritage

Consequence (impact)	Description
Negligible (1)	Short term ecological damage
Minor (2)	Limited but medium term ecological damage
Moderate (3)	Major but recoverable ecological damage
Major (4)	Heavy ecological damage, costly restoration
Substantial (5)	Permanent widespread ecological damage

Table 21: Risk rating

		Consequence				
		Negligible (1)	Minor (2)	Moderate (3)	Major (4)	Substantial (5)
Likelihood	Almost certain (5)	Low (5)	Moderate (10)	Very High (18)	Extreme (23)	Extreme (25)
	Likely (4)	Low (4)	Moderate (9)	Very High (17)	Very High (20)	Extreme (24)
	Possible (3)	Low (3)	Moderate (8)	High (13)	Very High (19)	Very High (22)
	Unlikely (2)	Low (2)	Low (7)	High (12)	High (15)	Very High (21)
	Rare (1)	Low (1)	Low (6)	Moderate (11)	High (14)	High (16)

Appendix C – Surface Water Sampling Methodology

Grab samples will be collected manually from the sampling locations identified in Table 11 of the Water Quality Plan and Monitoring Program. The volume of sample collected will be of sufficient volume for the required analyses, including any repeat analyses and will be collected into sampling battles and jars provided by the NATA accredited testing laboratory.

C.1 Sample Labeling

All samples will be clearly labeled with unique sampling identification nomenclature consisting of the sample date, location and sampler initials. All samples will be kept cool prior to dispatch to the NATA registered laboratory under chain of custody procedures.

C.2 Decontamination

Generally, sampling equipment will not require specific cleaning from rinsing the equipment well on return to the lab at the end of each sampling trip. The Field Sampling Guidelines (Department of Water, Western Australia 2009) suggest that where a sample site is particularly dirty (i.e. there is an algal bloom, or the site smells strongly of hydrocarbons, sewage or something else) equipment will need to be cleaned thoroughly. In addition, equipment will need to be cleaned periodically to prevent a build-up of dirt. To do this:

- Rinse the equipment well in tap water;
- Clean with De-Con 90 (a phosphate free detergent), or equivalent;
- Rinse well with tap water;
- Rinse three times with de-ionised water, and finally;
- Allow to dry.

De-ionised and tap water will be available for washing equipment in the field, in case a particularly dirty site is encountered during a sampling event.

C.3 In Situ Measurements

Field water quality parameters including temperature, electric conductivity (EC), pH, dissolved oxygen (DO) and redox potential (redox) will be measured at each sampling location with a multi-probe field water quality meter. Other observations including odour and colour will also be recorded.

The multi-probe field water quality meter will be calibrated against known standards, as supplied by the manufacturer, at the start and completion of each day of water quality sampling. Calibration records will be maintained in accordance with the appropriate standard.

C.4 Laboratory Analytical Program

A NATA accredited laboratory will be used for analyses of all grab samples. (the ALS laboratory in Smithfield, NSW has been nominated as the primary reporting laboratory for baseline samples).

C.5 General

Quality Assurance / Quality Control (QA/QC) samples are collected to ensure the quality of the investigation procedures and sampling program. QA/QC samples provide analytical information that may be used to investigate anomalous results.

QA/QC sampling will be undertaken in accordance with AS 5667.1:1998. Only NATA registered laboratories will be used to undertake analysis.

C.6 Replicate Samples

Replication is the collection and analysis of separate samples from the same sample site at the same time. This provides the experimental sampling error and thus a measure of the sampling precision.

Replicate samples will be collected at random at a rate of approximately 1 in 10 total samples collected.

C.7 Internal Laboratory Procedures

The Project laboratory (ALS Pty Ltd is currently used for baseline investigation) will undertake their normal internal QA/QC testing in accordance with their NATA registration and industry standards. ALS will provide evidence of the following QA/QC procedures:

- Sample receipt and registration documentation
- Instrument blank analyses
- Surrogate spike and matrix spike analyses
- Laboratory duplicates

Appendix D – Groundwater Sampling Methodology

D.1 Overview

The methodology for monitoring groundwater includes:

- Assessment of groundwater elevation (measurement prior to purging, if purging required by sampling method);
- Sampling of groundwater (sampling after purging, if sampling method requires purging) by qualified personnel; and
- Implementation of quality control plan including chain-of-custody for laboratory sampling and maintaining appropriate documentation.

D.2 Elevation Assessment and Purging

Groundwater monitoring is to be overseen by personnel with appropriate qualifications and experience, with field sampling undertaken by trained personnel using appropriate personal protective equipment (PPE) (note that gloves are to be changed for each sampling site to prevent cross-contamination).

The static groundwater elevation within each groundwater monitoring well will be measured prior to purging (if required) or sampling. The water level will be measured using a groundwater level dip metre from the Top of Casing (TOC) to the nearest millimetre.

Bottom of Casing (BOC) will be measured to the nearest millimetre as well by lowering the meter to the base of the well until it touches the bottom. These levels will be recorded.

Following measurements of water level, the monitoring well will be purged using a low flow pump prior to sampling to remove stagnant water within the well casing and ensure a representative sample can be collected. If use of Hydrosleeve sampling method is adopted purging will not be required.

Field water quality parameters will be measured using calibrated equipment including temperature, dissolved oxygen, pH, oxidation and reduction potential and electrical conductivity) during purging (if applicable).

The groundwater monitoring well will be considered to be purged when one of the following criteria is achieved (whichever occurs first):

- Three well volumes of water have been purged; or
- The well is purged until no more water can be removed (considered dry); or
- The water quality parameters are stabilised within 10% over three consecutive recorded measurements.

In the event that any water level logger is removed from the bore, it will be checked and maintained as necessary before being re-calibrated and then returned to the monitoring bore and at the known distance from the measuring point, but so as to not sit on the bottom of the bore.

D.3 Sample Collection

At the completion of purging (if relevant), groundwater samples will be collected into dedicated laboratory-supplied sampling bottles with sufficient volume to satisfy the requirements for all analytes.

The samples will be placed into a chilled ice-chest for transport to the nominated laboratory(s). Where required for some laboratory containers (metal analysis), the water sample will also be field filtered using a dedicated 0.45 µm water filter to remove fine suspended particles.

Cross-contamination of samples will be prevented through either dedicated tubing at the pump, dedicated Hydrosleeve sampling devices or by decontamination with phosphate-free detergent and clean water between sampling locations.

D.4 Quality Assurance and Documentation

As part of sampling, quality assurance and control samples during sampling will be undertaken to ensure the integrity of the dataset. These are to include:

- Rinsate blanks (one per sampling event only);
- Blind duplicates (at a rate not less than 20% of total samples); and
- Split duplicates (at a rate not less than 20% of total samples).

All containers are to be clearly labelled with the location, date/time, method, name and duplicate details, with the same documented on dedicated field sheets.

Samples are to be transported to a laboratory under documented chain-of-custody protocols.

Appendix E – Construction Water Treatment Plant Technical Details

Five construction water treatment plants have been initially designed for this project. The operational water treatment plant is still in concept design and details are not provided in this plan. The design of the five construction water treatment plants shall be based on the feed flow rates outlined below. The design (and flow process) will include:

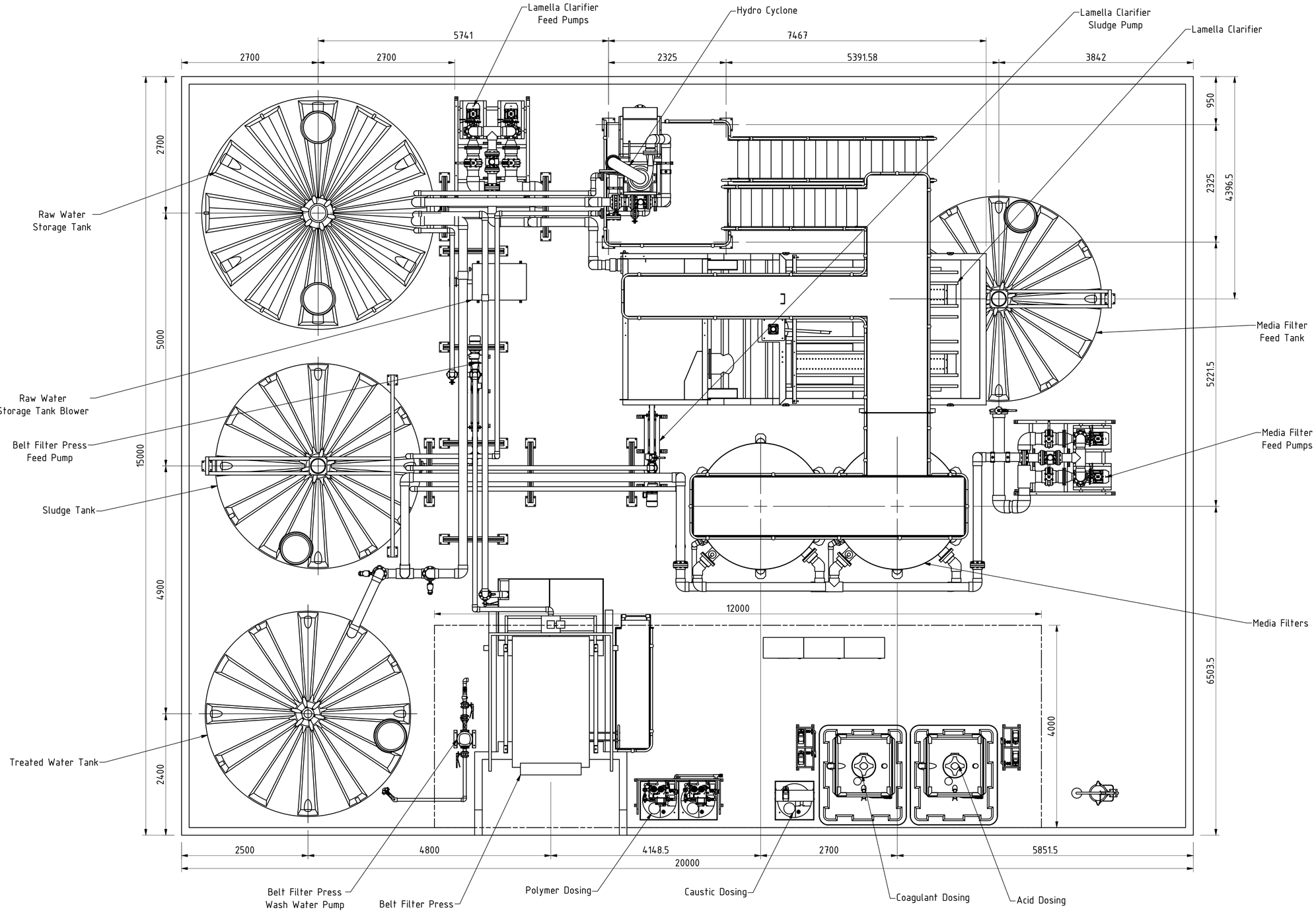
- Hydrocyclone and grit separation in pre-treatment,
- Chemical dosing,
- Clarification,
- pH correction, and
- Media filtration.

For the solid waste products, sludge dewatering will be employed.

The flow rates provided below are peak flows (maximum instantaneous rates). The detailed design process for these plants is continuing at the time of writing this plan. Typical general arrangement drawings are provided as part of this appendix. This plant layout is typical or each of the 5 water treatment plants, but is subject to alteration during detailed design.

- Kingsgrove North Water Treatment Plant (12L/s)
- Commercial Road Water Treatment Plant (12L/s)
- Bexley Water Treatment Plant (25L/s)
- Arncliffe Water Treatment Plant (36L/s)
- Canal Road Water Treatment Plant (25L/s)

This page has been left blank intentionally.



General Note:
All dimensions in mm. DO NOT SCALE. IF IN DOUBT ASK.

REV	DATE	PREPARED	CHECKED	APPROVED	DESCRIPTION
A	6/06/16	P.S.	G.M.	G.M.	Preliminary

REVISIONS

CRS INDUSTRIAL WATER TREATMENT SYSTEMS

CRS Industrial Water Treatment Systems - ABN 98 894 822 094
4/9 Packard Avenue, Castle Hill NSW 2154
PO Box 6020, Baulkham Hills BC NSW 2153
Phone: 61-2-9899 7811, Fax: 61-2-9899 7336
Web: www.watertreatment.net.au

572 - West Connex - New M5

Document Title: CPB Dragados Samsung Joint Venture
Arncliffe Site
General Arrangement Drawing
Sheet 1 of 4

Equipment/Tag No's

DRAWING NUMBER. 572-B01-GAD-01

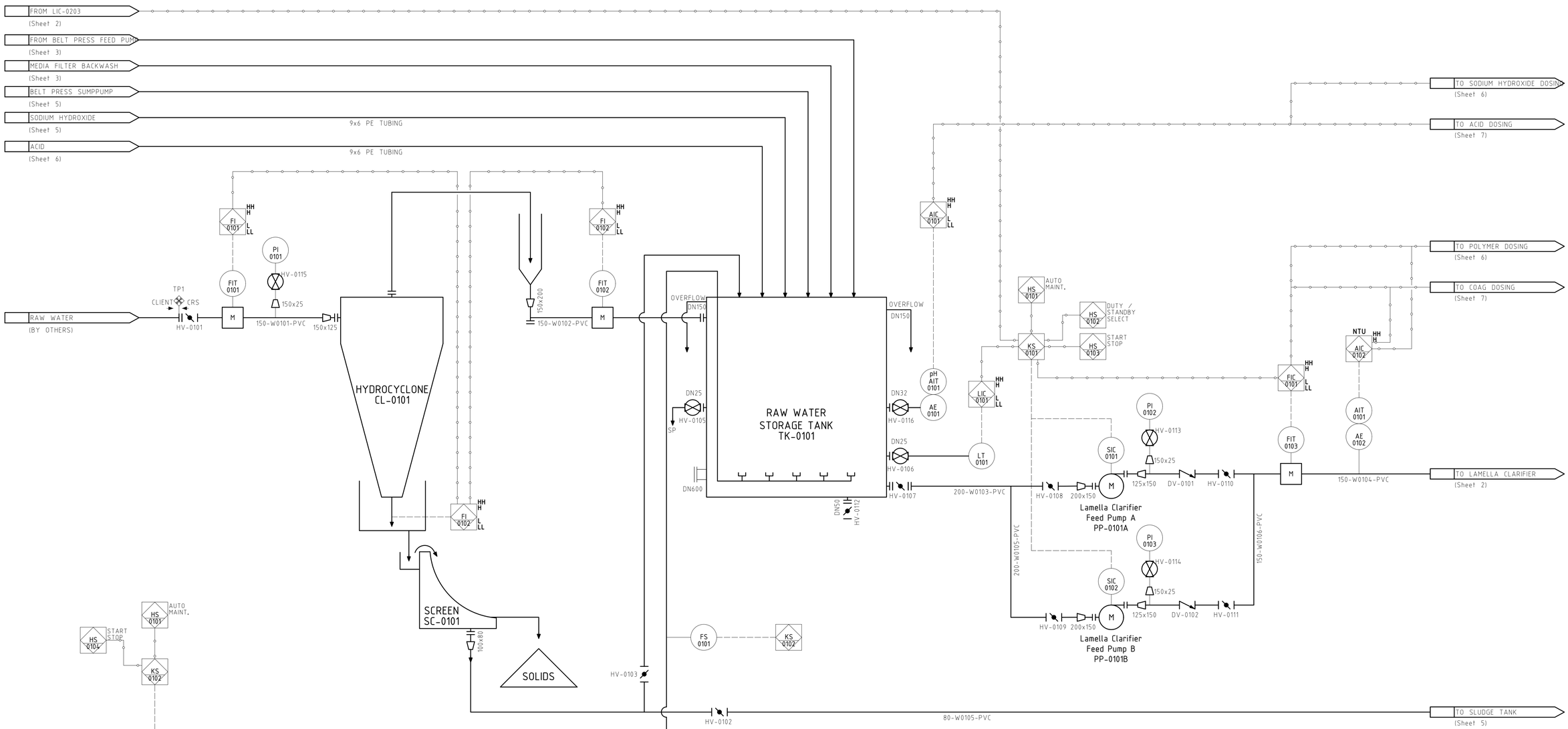
A1

Rev A

TK-0101	
RAW WATER STORAGE TANK	
DIMENSIONS:	4.6M ⌀ x 3.29M H
VOLUME:	50KL

PP-0101A/B	
LAMELLA CLARIFIER FEED PUMPS	
RATED CAPACITY:	90 m³/hr
INSTALLED POWER:	7.5 kW

BL-0101	
RAW WATER TANK BLOWER	
CAPACITY:	250 m³/hr
POWER:	5.5 kW



REV	DATE	PREPARED	CHECKED	APPROVED	DESCRIPTION
B	12/07/16	PS	GM	GM	UPDATED
A	6/06/16	PS	GM	GM	PRELIMINARY

REVISIONS

INDUSTRIAL WATER TREATMENT SYSTEPS

CRS Industrial Water Treatment SystePS - ABN 98 894 822 094
4/9 Packard Avenue, Castle Hill NSW 2154
PO Box 6020, Baulkham Hills BC NSW 2153
Phone: 61-2-9899 7811, Fax: 61-2-9899 7336
Web: www.watertreatment.net.au

572 - West Connex - New M5

Document Title:

CPB DRAGADOS SAMSUNG JOINT VENTURE
ARNCLIFFE SITE
PROCESS & INSTRUMENTATION DIAGRAM
SHEET 1 OF 7

DRAWING NUNMBER	A1	Rev
572-C01-PID-01		B

572-C01-PID-01-REVB

ABN 98 894 822 094

MX-0201	
FLASH MIXER	
POWER:	0.37kW

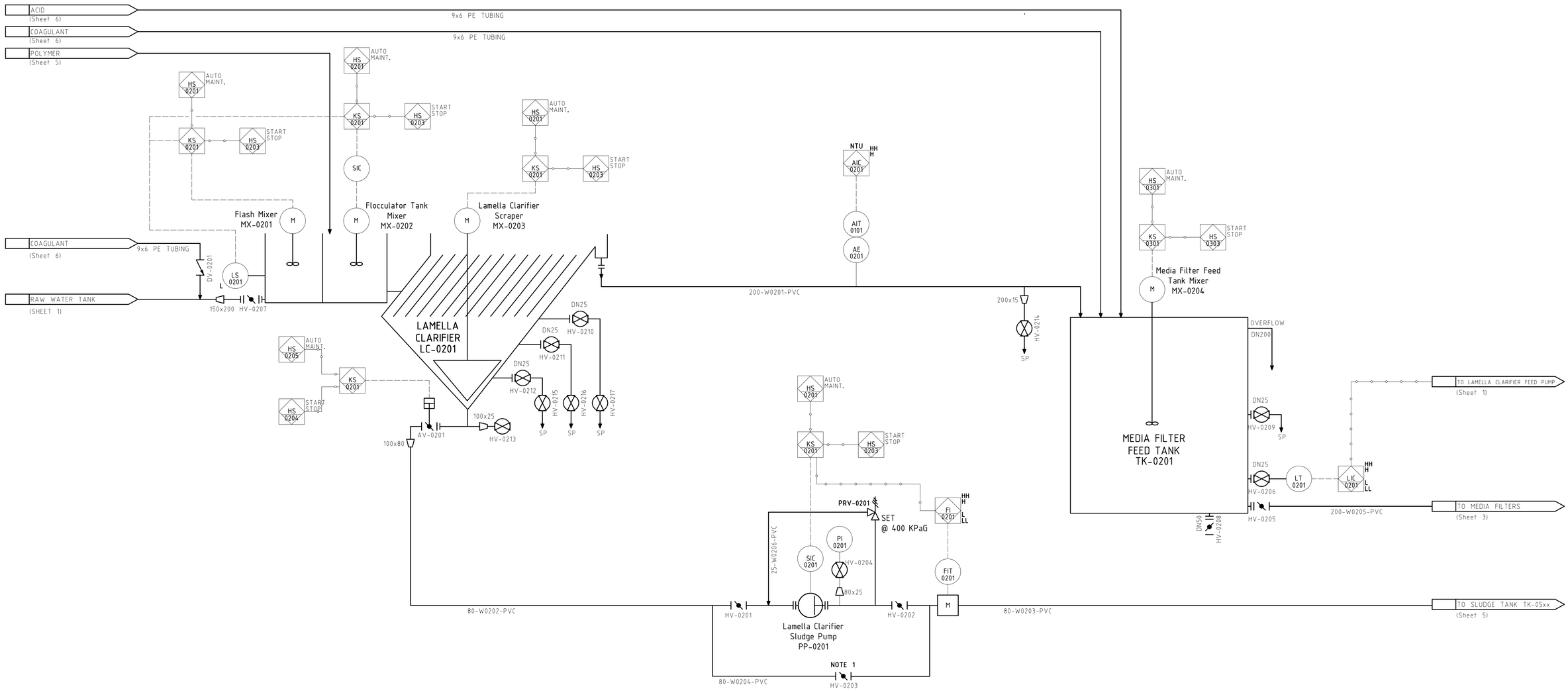
MX-0202	
FLOCCULATOR TANK MIXER	
POWER:	0.37kW

MX-0203	
LAMELLA CLARIFIER SCRAPER	
POWER:	0.18kW

MX-0204	
FILTER FEED TANK MIXER	
POWER:	1.1kW

PP-0201	
LAMELLA CLARIFIER SLUDGE PUMP	
CAPACITY:	10-30 m^3/hr
POWER:	7.5kW

TK-0201	
FILTER FEED TANK	
DIMENSIONS:	4.06M ø x 3.04M H
VOLUME:	30KL



NOTES:

1. Normally closed.

REV	DATE	PREPARED	CHECKED	APPROVED	DESCRIPTION
B	12/07/16	PS	GM	GM	UPDATED
A	6/06/16	PS	GM	GM	PRELIMINARY

REVISIONS

INDUSTRIAL WATER TREATMENT SYSTEPS

CRS Industrial Water Treatment SystePS - ABN 98 894 822 094
4/9 Packard Avenue, Castle Hill NSW 2154
PO Box 6020, Baulkham Hills BC NSW 2153
Phone: 61-2-9899 7811, Fax: 61-2-9899 7336
Web: www.watertreatment.net.au

572 - West Connex - New M5

Document Title:

CPB DRAGADOS SAMSUNG JOINT VENTURE
ARNCLIFFE SITE
PROCESS & INSTRUMENTATION DIAGRAM
SHEET 2 OF 7

DRAWING NUNMBER	A1	Rev
572-C01-PID-01		B

572-C01-PID-01-REVB

ABN 98 894 822 094

PP-0301 A/B	
MEDIA FILTER FEED PUMP	
CAPACITY:	130 m^3/hr
POWER:	7.5 kW

CSF-01/02	
CONTINUOUS SAND FILTER	
CAPACITY:	130 m^3/hr
DIMENSION:	2.5Ø x 6.24m H

TO ACID
(Sheet 6)

80-W0309-PVC

TO RAW WATER TANK
(SHEET 1)

CSF-01

CSF-02

HV-0307

HV-0308

200x150

150-W0303-PVC

150-W0302-PVC

Media Filter Control Panel

KS 0302

PS 0301

SET @ xxx KPaG

SV-0301

R-0301

PCV-0301

SV-0302

R-0302

HS 0304 AUTO MAINT.

HS 0305 START STOP

KS 0302

AV-0301

TO RAW WATER TANK
(SHEET 1)

NTU AIC 0303 HH H L LL

AIT 0101

AE 0303

HS 0306 AUTO MAINT.

HS 0307 START STOP

KS 0303

150-W0306-PVC

AV-0302

TO TREATED WATER TANK
(SHEET 4)

150-W0304-PVC

150x25

150x80

150x80

150x25

HV-0309

HV-0310

25-W0305-PVC

pH AIC 0107 HH H L LL

FI 0101 H L

AIT 0101

FS 0301

AE 0302

DN25

HV-0311

SP

TP4

CLIENT CRS

COMPRESSED AIR
(BY CLIENT)

20-A0301-PE

HS 0301 AUTO MAINT.

HS 0302 DUTY / STANDBY SELECT

KS 0301

HS 0303 START STOP

pH AIC 0301 HH H L LL

FIC 0301 HH H L LL

PI 0301 HH H L LL

PI 0301

HV-0305

SIC 0301

15x150

FIT 0301

AIT 0301

AE 0301

PT 0301

M

200x125

HV-0301

100x150

DV-0301

HV-0302

FROM MEDIA FILTER FEED TANK
(SHEET 2)

150-W0301-PVC

Media Filter
Feed Pump A
PP-0301A

200-W0307-PVC

150-W0308-PVC

PI 0302

HV-0306

SIC 0302

15x150

200x125

HV-0303

100x150

DV-0302

HV-0304

Media Filter
Feed Pump B
PP-0301B

TO BELT PRESS
(SHEET 5)

REV	DATE	PREPARED	CHECKED	APPROVED	DESCRIPTION
B	12/07/16	PS	GM	GM	UPDATED
A	6/06/16	PS	GM	GM	PRELIMINARY

REVISIONS

CRS INDUSTRIAL WATER TREATMENT SYSTEMS

INDUSTRIAL WATER TREATMENT SYSTEPS

CRS Industrial Water Treatment SystePS - ABN 98 894 822 094
4/9 Packard Avenue, Castle Hill NSW 2154
PO Box 6020, Baulkham Hills BC NSW 2153
Phone: 61-2-9899 7811, Fax: 61-2-9899 7336
Web: www.watertreatment.net.au

572 - West Connex - New M5

Document Title:

CPB DRAGADOS SAMSUNG JOINT VENTURE
ARNCLIFFE SITE
PROCESS & INSTRUMENTATION DIAGRAM
SHEET 3 OF 7

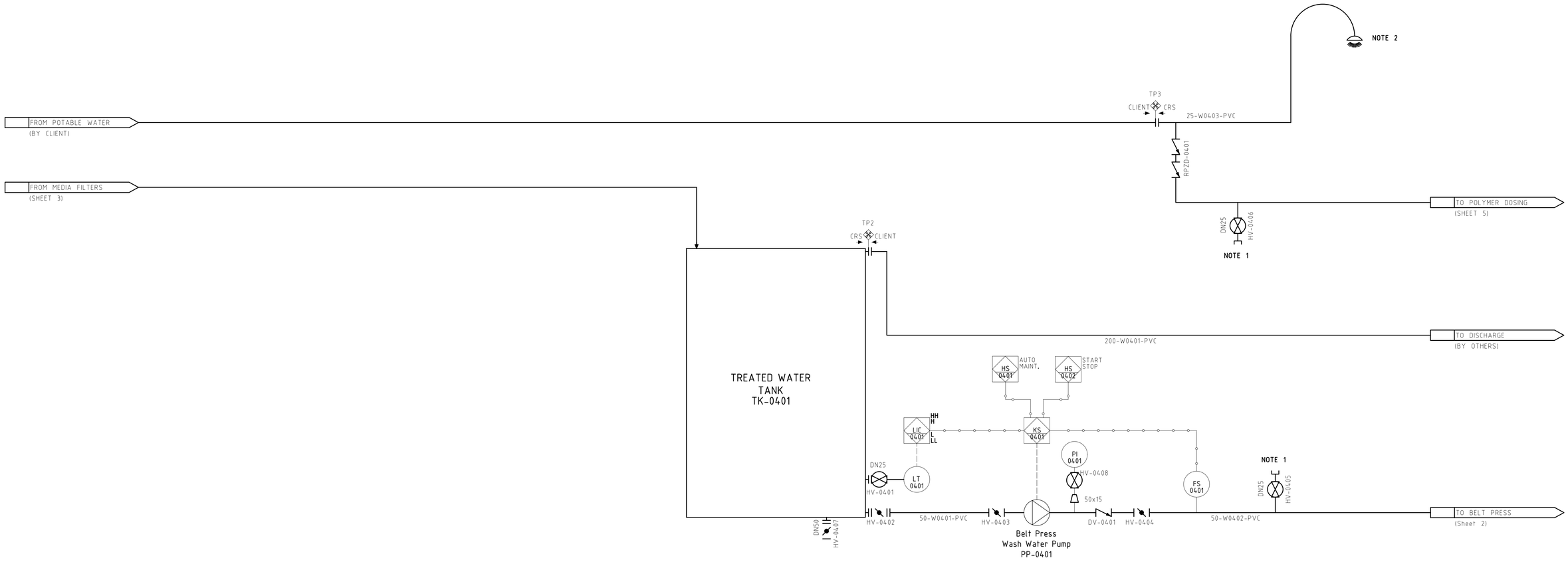
DRAWING NUNMBER	A1	Rev
572-C01-PID-01		B

572-C01-PID-01-REVB

ABN 98 894 822 094

PP-0401	
BELT PRESS WASH WATER PUMP	
CAPACITY:	13,6 m^3/hr
POWER:	5,5kW

TK-0401	
TREATED WATER TANK	
DIMENSIONS:	4,06M ø x 3,04M H
VOLUME:	30KL



NOTES:

1. Provision for Potable Water to Belt Press if required.
2. Safety Shower

REV	DATE	PREPARED	CHECKED	APPROVED	DESCRIPTION
B	12/07/16	PS	GM	GM	UPDATED
A	6/06/16	PS	GM	GM	PRELIMINARY

REVISIONS

INDUSTRIAL WATER TREATMENT SYSTEPS

CRS Industrial Water Treatment SystePS - ABN 98 894 822 094
4/9 Packard Avenue, Castle Hill NSW 2154
PO Box 6020, Baulkham Hills BC NSW 2153
Phone: 61-2-9899 7811, Fax: 61-2-9899 7336
Web: www.watertreatment.net.au

572 - West Connex - New M5

Document Title:

CPB DRAGADOS SAMSUNG JOINT VENTURE
ARNCLIFFE SITE
PROCESS & INSTRUMENTATION DIAGRAM
SHEET 4 OF 7

DRAWING NUNMBER	A1	Rev
572-C01-PID-01		B

572-C01-PID-01-REVB

ABN 98 894 822 094

TK-0501	
SLUDGE TANK	
DIMENSIONS:	4.06M Ø x 3.04M H
VOLUME:	30KL

TK-0502	
BELT PRESS SUMP	
DIMENSIONS:	1140x1998x1000
VOLUME:	1.4m³

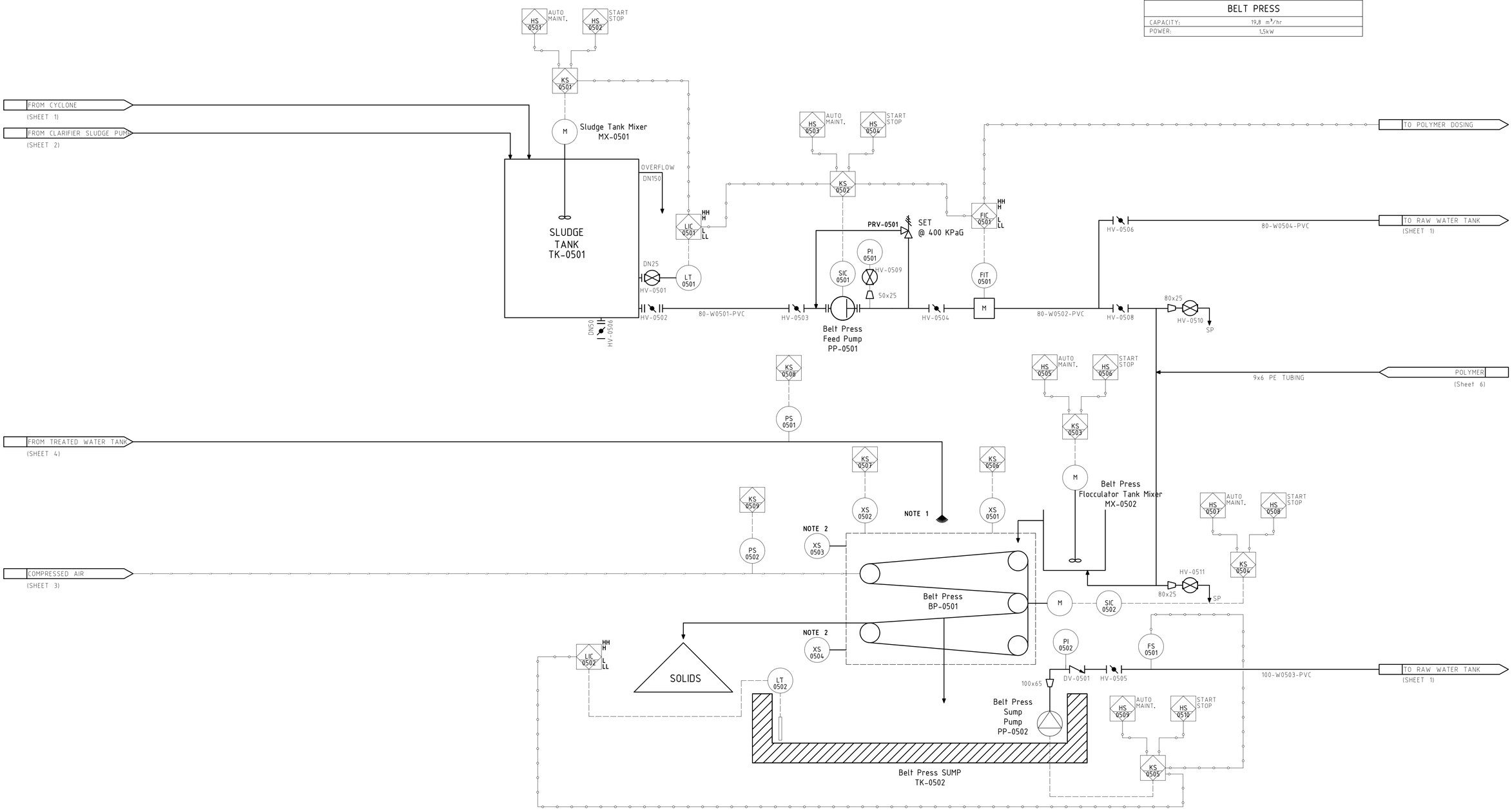
MX-0501	
SLUDGE TANK MIXER	
POWER:	1.1kW

MX-0502	
BELT PRESS FLOCCULATOR TANK MIXER	
POWER:	0.37kW

PP-0501	
BELT PRESS FEED PUMP	
CAPACITY:	10-25 m³/hr
POWER:	7.5kW

PP-0502	
BELT PRESS SUMP PUMP	
CAPACITY:	10-25 m³/hr
POWER:	2.2kW

BP-0501	
BELT PRESS	
CAPACITY:	19.8 m³/hr
POWER:	1.5kW



NOTES:

1. Belt Press Wash Water.
2. Belt Press Safety Pull Wire Switch.

REV	DATE	PREPARED	CHECKED	APPROVED	DESCRIPTION
B	12/07/16	PS	GM	GM	UPDATED
A	6/06/16	PS	GM	GM	PRELIMINARY

REVISIONS

INDUSTRIAL WATER TREATMENT SYSTEPS

CRS Industrial Water Treatment SystePS - ABN 98 894 822 094
4/9 Packard Avenue, Castle Hill NSW 2154
PO Box 6020, Baulkham Hills BC NSW 2153
Phone: 61-2-9899 7811, Fax: 61-2-9899 7336
Web: www.watertreatment.net.au

572 - West Connex - New M5

Document Title:

CPB DRAGADOS SAMSUNG JOINT VENTURE
ARNCLIFFE SITE
PROCESS & INSTRUMENTATION DIAGRAM
SHEET 5 OF 7

DRAWING NUNMBER	A1	Rev
572-C01-PID-01		B

TK-0601	
SODIUM HYDROXIDE STORAGE TANK	
VOLUME	200L
DESIGN PRESSURE	ATM

DP-0601	
SODIUM HYDROXIDE DOSING PUMP	
RATED CAPACITY:	17 L/hr
INSTALLED POWER:	0,024 kW

TK-0602	
POLYMER STORAGE TANK	
VOLUME	50L
DESIGN PRESSURE	ATM

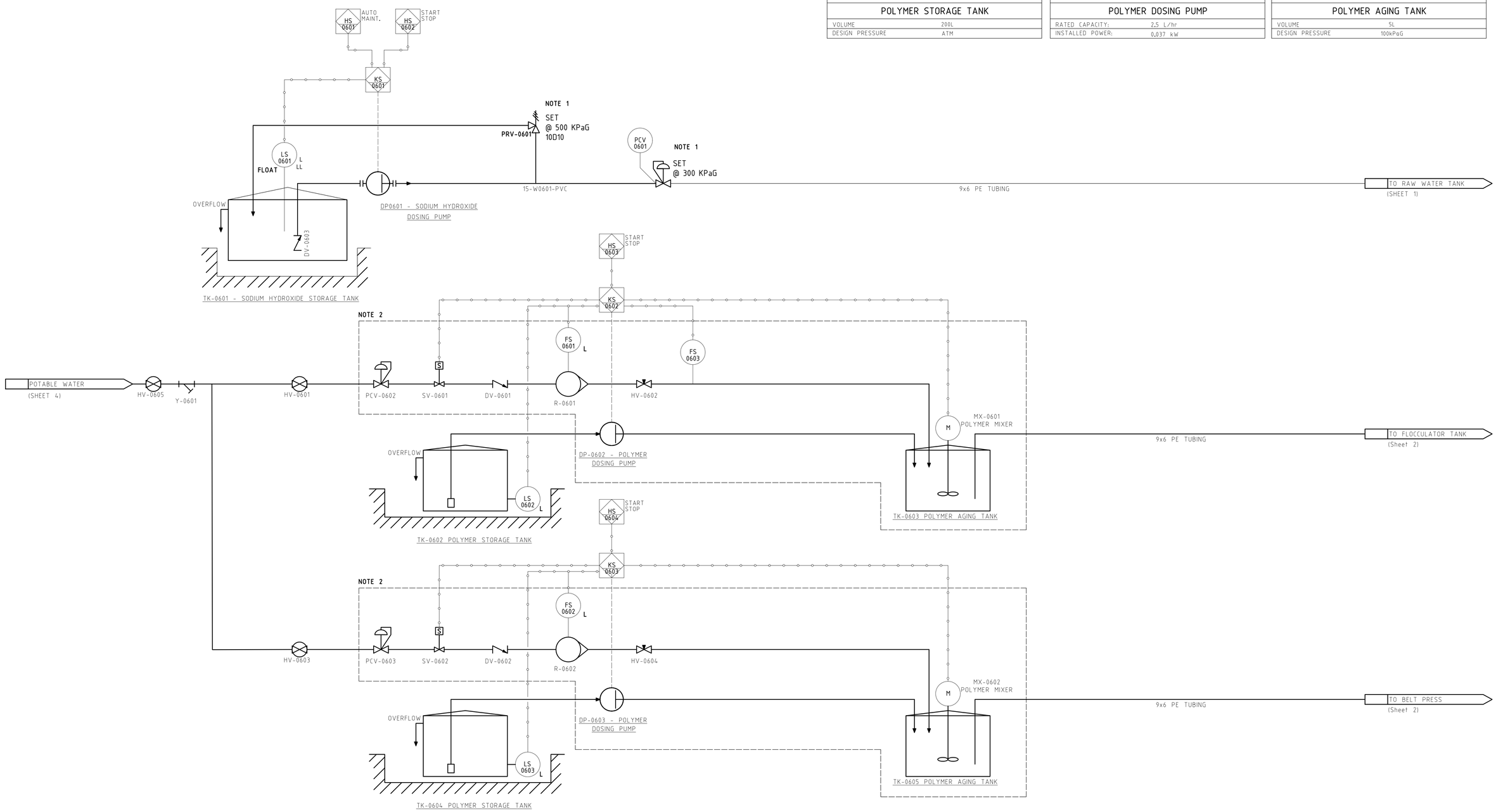
DP-0602	
POLYMER DOSING PUMP	
RATED CAPACITY:	2,5 L/hr
INSTALLED POWER:	0,037 kW

TK-0603	
POLYMER AGING TANK	
VOLUME	5L
DESIGN PRESSURE	100kPaG

TK-0604	
POLYMER STORAGE TANK	
VOLUME	200L
DESIGN PRESSURE	ATM

DP-0603	
POLYMER DOSING PUMP	
RATED CAPACITY:	2,5 L/hr
INSTALLED POWER:	0,037 kW

TK-0605	
POLYMER AGING TANK	
VOLUME	5L
DESIGN PRESSURE	100kPaG



NOTES:

1. Grundfos Multifunction valve.
2. TOMAL polymer dosing unit.

REV	DATE	PREPARED	CHECKED	APPROVED	DESCRIPTION
B	12/07/16	PS	GM	GM	UPDATED
A	6/06/16	PS	GM	GM	PRELIMINARY

REVISIONS

INDUSTRIAL WATER TREATMENT SYSTEPS

CRS Industrial Water Treatment SystePS - ABN 98 894 822 094
4/9 Packard Avenue, Castle Hill NSW 2154
PO Box 6020, Baulkham Hills BC NSW 2153
Phone: 61-2-9899 7811, Fax: 61-2-9899 7336
Web: www.watertreatment.net.au

572 - West Connex - New M5

Document Title:

CPB DRAGADOS SAMSUNG JOINT VENTURE
ARNCLIFFE SITE
PROCESS & INSTRUMENTATION DIAGRAM
SHEET 6 OF 7

DRAWING NUNMBER	A1	Rev
572-C01-PID-01		B

TK-0701	
COAGULANT STORAGE TANK	
VOLUME	200L
DESIGN PRESSURE	ATM

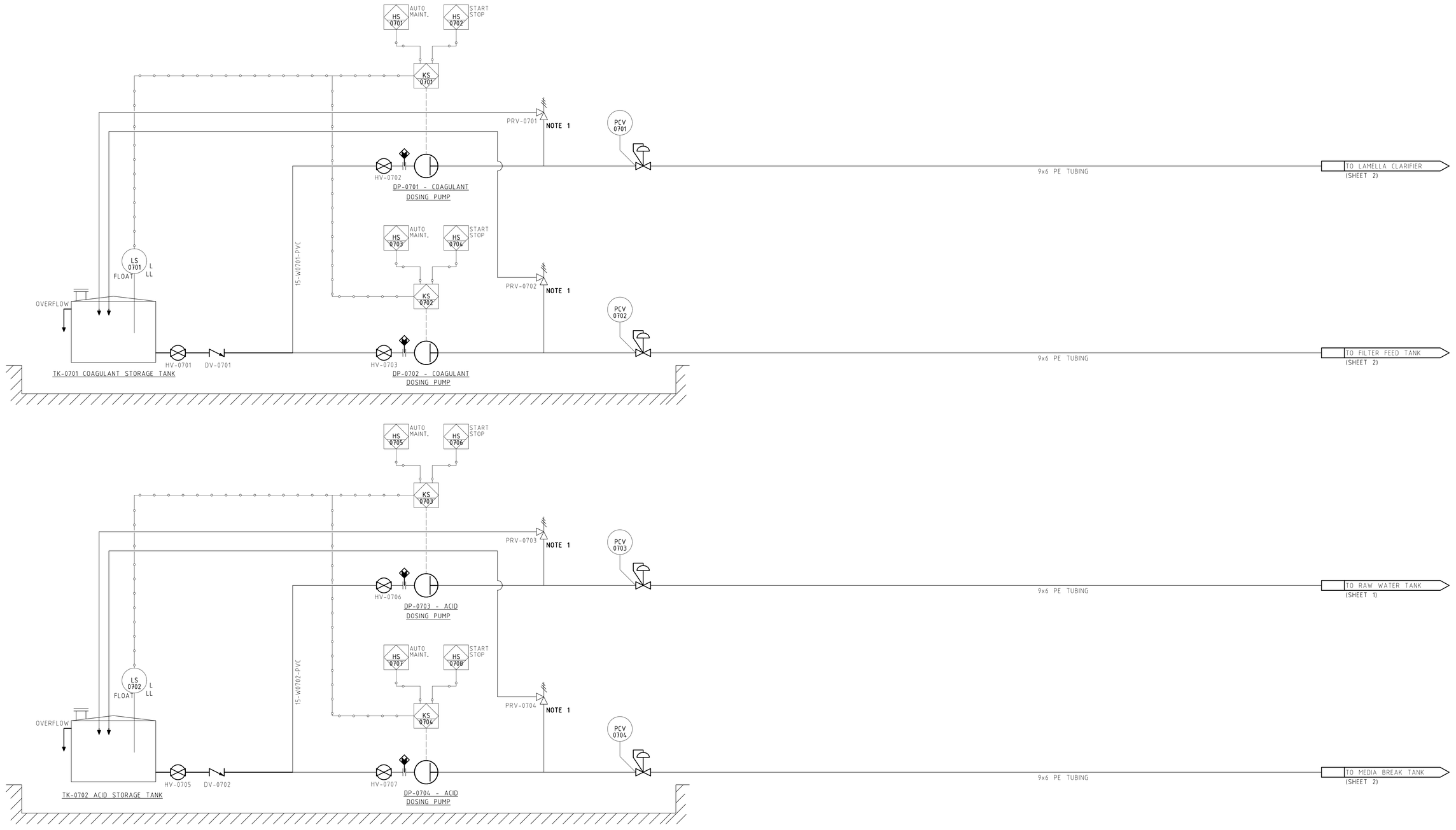
DP-0701	
COAGULANT PUMP	
RATED CAPACITY:	7.5 L/hr
INSTALLED POWER:	0.024 kW

DP-0702	
COAGULANT PUMP	
RATED CAPACITY:	7.5 L/hr
INSTALLED POWER:	0.024 kW

TK-0702	
ACID TANK	
VOLUME	200L
DESIGN PRESSURE	ATM

DP-0703	
ACID DOSING PUMP	
RATED CAPACITY:	0.3 m^3/hr
INSTALLED POWER:	0.024kW

DP-0704	
ACID DOSING PUMP	
RATED CAPACITY:	0.3 m^3/hr
INSTALLED POWER:	0.024kW



NOTES:

1. Grundfos Multifunction valve.

REV	DATE	PREPARED	CHECKED	APPROVED	DESCRIPTION
B	12/07/16	PS	GM	GM	UPDATED
A	6/06/16	PS	GM	GM	PRELIMINARY

REVISIONS

INDUSTRIAL WATER TREATMENT SYSTEPS

CRS Industrial Water Treatment SystePS - ABN 98 894 822 094
4/9 Packard Avenue, Castle Hill NSW 2154
PO Box 6020, Baulkham Hills BC NSW 2153
Phone: 61-2-9899 7811, Fax: 61-2-9899 7336
Web: www.watertreatment.net.au

572 - West Connex - New M5

Document Title:

CPB DRAGADOS SAMSUNG JOINT VENTURE
ARNCLIFFE SITE
PROCESS & INSTRUMENTATION DIAGRAM
SHEET 7 OF 7

DRAWING NUNMBER	A1	Rev
572-C01-PID-01		B

572-C01-PID-01-REVB

ABN 98 894 822 094

Appendix F – Baseline Surface Water Monitoring Report

Surface Water Quality Baseline Monitoring Report

Project Name: WestConnex New M5

Project number:	15.7020.2597
Document number:	M5N-ES-RPT-PWD-0005
Revision date:	20/07/2016
Revision:	01

Document Approval

Rev.	Date	Prepared by	Reviewed by	Recommended by	Approved by	Remarks
00	08/06/16	CDS-JV				
01	20/07/16	CDS-JV				
Signature:						

Purpose of Report

A Water Quality Plan and Monitoring Program has been prepared to address condition B28 of Infrastructure Approval SS6788. This Surface Water Quality Baseline Monitoring Report specifically addresses condition B28(h) which requires details on the current water quality, including at least 12 months of representative background monitoring data (including but not limited to representative data collected by the relevant councils, agencies and organisations where readily available) for surface water to establish baseline water conditions prior to the commencement of construction. A separate baseline report will be prepared for groundwater quality, levels and potentiometric pressures (in confined aquifers). Baseline groundwater monitoring will continue, and a baseline report will be submitted prior to construction works that have potential to impact or disturb groundwater.

Contents

1. Introduction

Baseline surface water quality monitoring has been undertaken along Wolli Creek, the Cooks River and Alexandra Canal since June 2015. Samples have been collected from locations described in the New M5 EIS Surface Water Technical Paper (Appendix N of the EIS). The parameters that have been assessed are listed in Appendix B (Water Quality Monitoring Program) of the above mentioned technical paper.

A Water Quality Plan and Monitoring Program (WQPMP: M5N-ES-PLN-PWD-0027) has been prepared and includes detail on previous water quality. This Baseline Monitoring Report has been prepared in accordance with the WQPMP with the specific objective of establishing baseline water quality conditions prior to the commencement of construction. This is achieved (in accordance with the WQPMP) by:

- Tabulating baseline surface water quality data;
- Identifying means and trends;
- Confirming site specific water quality criteria and targets

Section 2 of this document contains the tabulated data and summaries identifying means and trends, to establish the existing surface water quality conditions. Section 3 contains an assessment of the water quality criteria and targets and confirmation of appropriate targets.

2. Baseline Surface Water Quality Data

Surface water quality was sampled at locations in Wolli Creek, Alexandra Canal and the Cooks River (refer to Figure 2 of the Water Quality Plan and Monitoring Program). Sampling was also undertaken at the eastern stormwater channel at Sydenham, and in an unnamed channel near Muddy creek. During construction, water quality monitoring will also be undertaken at the Green and Golden Bell Frog habitat (the RTA ponds).

Data collected over the 12 month period from June 2015 to May 2016 is presented in Tables 1-4 for each discrete area and presented with trigger values from the Water Quality Reference Criteria from Appendix A of the Surface Water Technical Paper from the New M5 EIS. Where mean values over the 12 month period exceed the trigger values, these are highlighted. Summaries are provided for each discrete area, identifying significant trends.

2.1. Wolli Creek

Sampling was conducted from the four nominated sites along Wolli Creek (Table 1). Whilst exceedances of the established trigger values were recorded for many parameters on several occasions, the mean values for each parameter over the 12 month period were generally within the established trigger values. Notable exceptions include:

- Total suspended solids was consistently higher at the sampling location furthest upstream (SW08) and had a mean value of 27.8 (max 49) mg/l, which is above the established trigger value of 22.0.
- Turbidity was also elevated at the site furthest upstream (mean of 40.2NTU, trigger of 29.0NTU).
- Elevated levels of copper were detected and the mean values at each of the Wolli Creek sample locations were above the trigger value (refer to Table 1).
- Zinc was detected above the trigger value at each site, with the mean concentration of zinc for two of the four sites above the trigger value.
- Total nitrogen was detected above the trigger value at each location (more than 5 times the established trigger value). However, no exceedances for total nitrogen were recorded at the Bexley Road location.
- The pH at each of the sampling locations was elevated with a range from 6.22-10.58, with the mean for each site above the upper trigger limit of 7.7.

2.2. Sheas Creek/Alexandra canal

Sampling locations in the St Peters area include Sheas Creek, near the Huntley Road bridge, which is a concrete lined channel upstream of the Alexandra Canal, and a sampling location downstream of works which is in the tidally influenced Alexandra Canal (Table 2). Trigger values from the Water Quality Reference Criteria in the EIS were based on limited sampling for these areas.

Of the trigger values available, the trigger value for zinc was exceeded by a mean value of 0.044mg/l over the 12 month period (the trigger was 0.031mg/l). Whilst trigger values were not available, nutrient concentrations were comparatively elevated in Sheas Creek including levels for ammonia, nitrite, nitrate, nitrogen and phosphorous. Total nitrogen was also elevated within Alexandra Canal, and conductivity was above the trigger value (25.906ms/cm with trigger of 21.410ms/cm).

2.3. Cooks River

Water quality within the Cooks River was measured at three sites within the general vicinity of Tempe and Arncliffe (Table 3). Suspended solids were highest at the site furthest downstream. Total suspended solids ranged from near 0 to 437mg/l, with a mean value of 55mg/l at the sampling location downstream of the future Arncliffe site (no trigger was presented for this parameter in the Water Quality Reference Criteria). This trend was not observed for turbidity.

Large variation of detected levels and concentrations for a number of parameters were observed, particularly for nutrients and metals, with trigger levels exceeded on several occasions. However the mean values over the baseline period generally stayed within the trigger values. Total nitrogen peaked

at levels above the trigger value at each sampling location (max of 4.7mg/l, trigger of 1.04mg/l), and similar variations were identified with nitrite and nitrate.

2.4. Additional monitoring

Monitoring was undertaken at the Eastern Stormwater Drain at Sydenham, adjacent to Sydenham Road and Sydenham Station, and at Muddy Creek in Banksia (Table 4).

The Sydenham site is located near the western extent of the road widening works that will be associated with the St Peters Interchange. The waterway is highly variable in flow, but is predominantly stormwater from the adjacent industrial and commercial areas, without tidal influence. The list of chemical toxicants are the only applicable trigger values for this location from the EIS. High levels of copper (0.012mg/l mean, 0.0025 trigger value), lead (0.016mg/l mean, 0.009 trigger value) and zinc (0.031 mg/l, 0.044 trigger value) were recorded on several occasions. Nutrient levels were high, including levels of total nitrogen up to 12.4mg/l. Comparatively elevated levels for nitrite, nitrate and phosphorous were also detected. pH was measured between 7.3 and 8.6 which is also elevated for an urban catchment.

The unnamed tributary to Muddy Creek in Banksia was monitored during the baseline period near the intersection with West Botany Street. This is a concrete lined channel that is within the tidal reach of Muddy Creek. Nutrient levels including nitrate, nitrogen and phosphorous were all elevated in this waterway, as was pH (7.5 and 9.0).

Table 1. Wolli Creek baseline water quality data. Where the mean value over the 12 month period exceeds the established trigger, the value is in bold.

Wolli Creek Sampling Locations		SW08			SW09			SW10			SW11		
Upstream freshwater trigger from Water Quality Reference Criteria (New M5 EIS)		Upstream of Kingsgrove compounds			Between Kingsgrove and Bexley compounds			Immediately downstream of Bexley compounds			Downstream of Bardwell Creek		
Parameter	**Trigger***	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
Suspended Solids (TSS: mg/l)	22.0	**27.8**	0.0	49.0	13.0	6.0	24.0	4.8	0.0	10.0	7.2	0.0	13.0
Arsenic (mg/l)	0.360	0.001	0.000	0.004	0.001	0.000	0.002	0.001	0.000	0.002	0.000	0.000	0.002
Cadmium (mg/l)	0.0008	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0002
Chromium (mg/l)	0.040	0.000	0.000	0.002	0.000	0.000	0.002	0.000	0.000	0.002	0.000	0.000	0.001
Copper (mg/l)	0.0025	**0.006**	0.000	0.012	**0.011**	0.005	0.018	**0.006**	0.000	0.017	**0.004**	0.000	0.012
Lead (mg/l)	0.0094	0.003	0.000	0.015	0.002	0.000	0.013	0.002	0.000	0.014	0.002	0.000	0.005
Manganese (mg/l)	3.600	0.080	0.009	0.273	0.009	0.001	0.030	0.039	0.000	0.264	0.043	0.004	0.087
Nickel (mg/l)	0.017	0.002	0.000	0.004	0.001	0.000	0.002	0.002	0.000	0.004	0.001	0.000	0.003
Zinc (mg/l)	0.031	0.026	0.000	0.093	**0.037**	0.009	0.082	0.029	0.000	0.105	**0.033**	0.000	0.065
Iron (mg/l)	-	0.48	0.00	2.62	0.39	0.00	1.88	0.45	0.00	2.01	0.72	0.00	1.90
Mercury (mg/l)	0.0054	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0001	0.0000	0.0010	0.0000	0.0000	0.0001
Ferrous Iron (mg/l)	-	0.19	0.00	0.83	0.08	0.00	0.22	0.29	0.09	0.69	0.25	0.08	0.77
Ammonia (mg/l)	2.300	No data			0.083	0.037	0.128	0.017	0.000	0.052	No data		
Nitrite as N (mg/l)	-	0.019	0.000	0.060	0.021	0.000	0.060	0.021	0.000	0.156	0.048	0.010	0.214
Nitrate as N (mg/l)	17.000	0.505	0.000	0.920	0.624	0.000	1.750	0.273	0.000	0.770	0.455	0.180	1.070
Total Kjeldahl Nitrogen as N (mg/l)	-	0.65	0.00	1.60	1.27	0.04	9.50	0.76	0.09	1.72	1.12	0.43	2.80
Total Nitrogen as N (mg/l)	1.90	1.18	0.00	2.30	**1.93**	0.60	10.00	1.11	0.68	1.80	1.68	0.94	3.90
Total Phosphorus as P (mg/l)	0.120	0.098	0.000	0.330	0.117	0.020	0.650	0.080	0.020	0.250	0.085	0.012	0.250
Reactive Phosphorus as P (mg/l)	-	0.037	0.000	0.160	0.062	0.000	0.400	0.000	0.000	0.000	0.017	0.000	0.050
C6 - C10 Fraction (µg/l)	-	0	0	0	29	0	190	0	0	0	0	0	0
>C10 - C16 Fraction (µg/l)	-	0	0	0	2362	0	30300	0	0	0	29	0	440
>C16 - C34 Fraction (µg/l)	-	0	0	0	1917	0	21800	15	0	190	52	0	780
>C34 - C40 Fraction (µg/l)	-	0	0	0	115	0	1500	0	0	0	0	0	0
Benzene (µg/l)	-	0	0	0	0	0	0	0	0	0	0	0	0
Toluene (µg/l)	-	0	0	0	0	0	0	1	0	10	0	0	0
Ethylbenzene (µg/l)	-	0	0	0	0	0	0	0	0	0	0	0	0
Total Xylenes (µg/l)	-	0	0	0	1	0	14	0	0	0	0	0	0
Naphthalene (µg/l)	-	0	0	0	0	0	5	0	0	0	0	0	0
pH	6.5 - 7.7	**8.41**	6.22	9.59	**9.31**	8.89	10.58	**8.24**	6.55	9.63	**7.78**	7.14	8.93
ORP	-	82.6	0.1	163.9	48.9	0.1	165.8	39.8	0.1	188.5	53.2	0.1	209.4
Dissolved Oxygen (% Sat)	60.	97.3	69.0	123.9	125.9	103.2	166.5	110.5	87.3	140.1	**47.4**	19.5	67.3
Temperature (°C)	12.1 - 23.2	22.2	18.7	25.0	**25.7**	19.3	32.3	**24.5**	19.3	27.3	22.7	17.0	26.0
Conductivity (µS/cm)	310-1660	1503.8	3.0	4028.0	1152.0	201.0	1516.0	1269.1	1095.0	1684.0	774.1	305.6	1671.0
Turbidity (NTU)	29.0	**40.2**	0.0	161.0	10.1	0.0	43.7	7.9	0.0	19.8	6.6	0.0	12.3

* Trigger values sourced from the Water Quality Reference Criteria (New M5 EIS). Blank cells indicate that no trigger value was provided for the parameter.

Table 2. Sheas Creek/Alexandra Canal baseline water quality data. Where the mean value over the 12 month period exceeds the established trigger, the value is in bold.

Sheas Creek and Alexandra Canal Sampling Locations	SW01 Sheas Creek (near Huntley Road). Upstream of project area (freshwater)				SW02 Alexandra Canal (near Coward Street) Downstream of project area (estuarine)			
Parameter	**Trigger***	**Mean**	**Min**	**Max**	**Trigger***	**Mean**	**Min**	**Max**
Suspended Solids (TSS: mg/l)	-	33.9	0.0	186.0	-	10.8	6.0	21.0
Arsenic (mg/l)	0.360	0.001	0.000	0.002	-	0.001	0.000	0.003
Cadmium (mg/l)	0.0008	0.0000	0.0000	0.0004	0.0360	0.0000	0.0000	0.0000
Chromium (mg/l)	0.040	0.000	0.000	0.002	0.085	0.000	0.000	0.001
Copper (mg/l)	0.0025	0.008	0.000	0.022	0.008	0.005	0.000	0.054
Lead (mg/l)	0.009	0.003	0.000	0.022	0.012	0.003	0.000	0.030
Manganese (mg/l)	3.600	0.016	0.000	0.051	-	0.028	0.000	0.059
Nickel (mg/l)	0.017	0.001	0.000	0.002	0.560	0.000	0.000	0.002
Zinc (mg/l)	0.031	**0.044**	0.000	0.152	0.043	0.025	0.000	0.097
Iron (mg/l)	-	0.25	0.00	1.05	-	0.21	0.00	1.38
Mercury (mg/l)	0.0054	0.0000	0.0000	0.0000	0.0014	0.0000	0.0000	0.0002
Ferrous Iron (mg/l)	-	0.05	0.00	0.46	-	0.04	0.00	0.26
Ammonia (mg/l)	2.300	0.170	0.102	0.288	1.7	No data		
Nitrite as N (mg/l)	-	0.161	0.020	0.408	-	0.016	0.000	0.030
Nitrate as N (mg/l)	17	2.094	0.400	2.870	-	0.623	0.004	4.690
Total Kjeldahl Nitrogen as N (mg/l)	-	1.08	0.31	1.90	-	0.80	0.00	2.40
Total Nitrogen as N (mg/l)	-	3.16	1.10	4.90	1.38	**1.43**	0.00	5.40
Total Phosphorus as P (mg/l)	-	0.102	0.040	0.260	0.14	0.073	0.007	0.210
Reactive Phosphorus as P (mg/l)	-	0.050	0.010	0.110	-	0.009	0.000	0.030
C6 - C10 Fraction (µg/l)	-	0	0	0	-	0	0	0
>C10 - C16 Fraction (µg/l)	-	7	0	110	-	0	0	0
>C16 - C34 Fraction (µg/l)	-	0	0	0	-	0	0	0
>C34 - C40 Fraction (µg/l)	-	0	0	0	-	0	0	0
Benzene (µg/l)	-	0	0	0	-	0	0	0
Toluene (µg/l)	-	0	0	0	-	0	0	0
Ethylbenzene (µg/l)	-	0	0	0	-	0	0	0
Total Xylenes (µg/l)	-	0	0	0	-	0	0	0
Naphthalene (µg/l)	-	0	0	0	0	0	0	0
pH	-	8.30	7.84	9.09	7.3-7.9	7.61	7.38	8.04
ORP	-	60.7	0.1	201.8	-	80.1	0.1	259.7
Dissolved Oxygen (% Sat)	-	102.7	82.3	150.2	39	87.4	36.7	110.2
Temperature (°C)	-	22.7	19.3	25.9	14.3-23.0	**23.9**	20.0	26.6
Conductivity (µS/cm)	-	381.9	5.0	717.0	490-2140	**25906.0**	30.0	39266.0
Turbidity (NTU)	-	10.2	0.0	34.0	10.0	6.0	0.0	11.8

* Trigger values sourced from the Water Quality Reference Criteria (New M5 EIS). Blank cells indicate that no trigger value was provided for the parameter.

Table 3. Cooks River baseline water quality data. Where the mean value over the 12 month period exceeds the established trigger, the value is in bold.

Cooks River Sampling Locations		SW05			SW06			SW07		
Cooks River Lower Catchment estuarine triggers from Water Quality Reference Criteria (New M5 EIS)		Tempe - Upstream of Wolli Creek and Project Area			Near the Giovanni Brunetti Bridge, adjacent to Alexandra Canal and near the Arncliffe compound			Upstream of Muddy Creek, downstream of all sites		
Parameter	**Trigger***	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
Suspended Solids (TSS: mg/l)	-	2.7	0.0	14.0	1.2	0.0	7.0	55.0	5.0	437.0
Arsenic (mg/l)	-	0.001	0.000	0.013	0.002	0.000	0.028	0.008	0.001	0.010
Cadmium (mg/l)	0.036	0.000	0.000	0.000	0.000	0.000	0.006	0.001	0.000	0.001
Chromium (mg/l)	0.085	0.000	0.000	0.002	0.002	0.000	0.022	0.000	0.000	0.000
Copper (mg/l)	0.008	0.001	0.000	0.015	0.007	0.000	0.107	0.001	0.000	0.007
Lead (mg/l)	0.012	0.001	0.000	0.015	0.003	0.000	0.036	0.000	0.000	0.003
Manganese (mg/l)	-	0.012	0.000	0.044	0.012	0.000	0.049	0.009	0.000	0.049
Nickel (mg/l)	0.560	0.000	0.000	0.001	0.001	0.000	0.016	0.000	0.000	0.000
Zinc (mg/l)	0.043	0.004	0.000	0.062	0.010	0.000	0.120	0.005	0.000	0.030
Iron (mg/l)	-	0.08	0.00	0.56	0.14	0.00	0.74	0.06	0.00	0.24
Mercury (mg/l)	0.0014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002
Ferrous Iron (mg/l)	-	0.02	0.00	0.11	0.04	0.00	0.24	0.02	0.00	0.26
Ammonia (mg/l)	1.700	0.034	0.000	0.158	0.041	0.000	0.190	0.032	0.000	0.063
Nitrite as N (mg/l)	-	0.005	0.000	0.020	0.003	0.000	0.014	0.086	0.008	0.196
Nitrate as N (mg/l)	-	0.238	0.015	1.780	0.386	0.005	4.430	0.082	0.008	0.167
Total Kjeldahl Nitrogen as N (mg/l)	-	0.41	0.04	0.90	0.45	0.05	1.20	0.35	0.10	1.00
Total Nitrogen as N (mg/l)	1.04	0.65	0.00	2.40	0.82	0.00	4.70	0.49	0.19	1.10
Total Phosphorus as P (mg/l)	0.2	0.052	0.000	0.100	0.049	0.000	0.090	0.058	0.000	0.140
Reactive Phosphorus as P (mg/l)	-	0.023	0.000	0.060	0.018	0.000	0.041	0.021	0.000	0.038
C6 - C10 Fraction (µg/l)	-	0	0	0	0	0	0	0	0	0
>C10 - C16 Fraction (µg/l)	-	0	0	0	0	0	0	0	0	0
>C16 - C34 Fraction (µg/l)	-	0	0	0	0	0	0	0	0	0
>C34 - C40 Fraction (µg/l)	-	0	0	0	0	0	0	0	0	0
Benzene (µg/l)	-	0	0	0	0	0	0	0	0	0
Toluene (µg/l)	-	0	0	0	0	0	0	0	0	0
Ethylbenzene (µg/l)	-	0	0	0	0	0	0	0	0	0
Total Xylenes (µg/l)	-	0	0	0	0	0	0	0	0	0
Naphthalene (µg/l)	-	0	0	0	0	0	0	0	0	0
pH	7.0-8.5	7.65	7.14	7.99	7.81	7.70	7.94	7.80	7.43	8.04
ORP	-	75.0	0.1	280.0	42.6	0.1	230.2	51.6	0.1	228.2
Dissolved Oxygen (% Sat)	39.8	84.4	68.0	95.3	89.5	71.4	118.5	91.7	74.7	119.3
Temperature (°C)	15-23	**23.5**	20.9	25.3	**23.8**	20.7	25.8	**23.7**	21.2	25.9
Conductivity (µS/cm)	17540-54200	32192.5	23163.0	48713.0	29194.3	23576.0	44503.0	32474.0	23461.0	49028.0

Cooks River Sampling Locations	SW05				SW06			SW07		
Turbidity (NTU)	15.0	4.9	0.0	11.8	6.1	0.0	10.0	2.7	0.0	4.8

* Trigger values sourced from the Water Quality Reference Criteria (New M5 EIS). Blank cells indicate that no trigger value was provided for the parameter.

Table 4. Additional baseline water quality data. Where the mean value over the 12 month period exceeds the established trigger, the value is in bold.

Additional water monitoring will also occur at the RTA ponds (GGBF habitat) during construction	SW03 Eastern stormwater drain, Sydenham, adjacent to road widening project area (freshwater catchment)				SW04 Unnamed tributary to Muddy Creek (estuarine).			
Parameter	**Trigger***	**Mean**	**Min**	**Max**	**Trigger***	**Mean**	**Min**	**Max**
Suspended Solids (TSS: mg/l)	-	17.9	0.0	68.0	-	9.6	0.0	30.0
Arsenic (mg/l)	0.140	0.004	0.000	0.011	-	0.001	0.000	0.003
Cadmium (mg/l)	0.0008	0.0000	0.0000	0.0001	0.0360	0.0000	0.0000	0.0002
Chromium (mg/l)	0.040	0.001	0.000	0.004	0.085	0.000	0.000	0.000
Copper (mg/l)	0.0025	**0.012**	0.003	0.039	0.008	0.001	0.000	0.005
Lead (mg/l)	0.009	**0.016**	0.000	0.163	0.012	0.000	0.000	0.002
Manganese (mg/l)	3.600	0.036	0.000	0.069	-	0.017	0.000	0.050
Nickel (mg/l)	0.017	0.003	0.001	0.004	0.560	0.000	0.000	0.000
Zinc (mg/l)	0.031	**0.044**	0.006	0.267	0.043	0.008	0.000	0.040
Iron (mg/l)	-	0.75	0.00	4.11	-	0.02	0.00	0.13
Mercury (mg/l)	0.0054	0.0000	0.0000	0.0001	0.0014	0.0000	0.0000	0.0000
Ferrous Iron (mg/l)	-	0.12	0.00	0.45	-	0.08	0.00	0.25
Ammonia (mg/l)	2.300	0.049	0.000	0.103	1.700	0.325	0.192	0.470
Nitrite as N (mg/l)	-	0.181	0.000	0.900	-	0.025	0.000	0.043
Nitrate as N (mg/l)	17	0.738	0.000	1.530	-	1.815	0.060	5.610
Total Kjeldahl Nitrogen as N (mg/l)	-	2.52	0.04	10.00	-	1.31	0.00	2.90
Total Nitrogen as N (mg/l)	-	3.39	0.41	12.40	-	3.14	0.91	7.00
Total Phosphorus as P (mg/l)	-	0.089	0.024	0.300	-	0.087	0.039	0.151
Reactive Phosphorus as P (mg/l)	-	0.024	0.000	0.110	-	0.039	0.000	0.110
C6 - C10 Fraction (µg/l)	-	0	0	0	-	0	0	0
>C10 - C16 Fraction (µg/l)	-	0	0	0	-	0	0	0
>C16 - C34 Fraction (µg/l)	-	0	0	0	-	0	0	0
>C34 - C40 Fraction (µg/l)	-	0	0	0	-	0	0	0
Benzene (µg/l)	-	0	0	0	-	0	0	0
Toluene (µg/l)	-	0	0	0	-	0	0	0
Ethylbenzene (µg/l)	-	0	0	0	-	0	0	0
Total Xylenes (µg/l)	-	0	0	0	-	0	0	0
Naphthalene (µg/l)	-	0	0	0	-	0	0	0
pH	-	8.06	7.34	8.61	-	8.00	7.53	9.02
ORP	-	52.8	0.1	181.7	-	63.4	0.1	183.4
Dissolved Oxygen (% Sat)	-	95.6	59.3	127.3	-	102.6	78.1	129.0
Temperature (°C)	-	24.5	18.3	31.1	-	24.0	17.5	28.6
Conductivity (µS/cm)	-	852.5	79.0	1182.0	-	18949.9	177.0	43788.0
Turbidity (NTU)	-	7.5	2.2	13.7	-	6.7	0.0	18.4

* Trigger values sourced from the Water Quality Reference Criteria (New M5 EIS). Blank cells indicate that no trigger value was provided for the parameter.
NB. SW03 is a concrete lined stormwater drain. SW04 is a concrete lined stormwater drain that is tidally influenced by Muddy Creek.

3. Confirmation of water quality criteria and targets

Water Quality Reference Criteria within Appendix A of the Surface Water Technical Paper (New M5 EIS) were used to assess the data collected for the baseline monitoring program (Section 2). The criteria listed in the Technical Paper, for both the lower catchment of the Cooks River and the upper catchment of Wolli Creek, were based on long term monitoring programs and were confirmed broadly as suitable trigger values for these areas (in Section 2). The trigger values adopted in the Technical Paper for Alexandra Canal were based on limited data and the baseline monitoring program revealed some adaption is required for this catchment. Trigger values for Sheas Creek, Eastern Stormwater Drain (Sydenham) and the tributary to Muddy Creek (Banksia) were incomplete.

Due to the applicability of the trigger values established for Wolli Creek (freshwater) and the Cooks River (estuarine) areas, it is proposed to use these values more broadly. An assessment was completed that confirmed that the Wolli Creek triggers (with minor amendments) were suitable for application as project specific freshwater criteria (Table 6). These will be applied during construction to all freshwater sampling sites including Wolli Creek, Sheas Creek and Eastern Stormwater Drain. Triggers for total suspended solids (50mg/l) and pH (6.5-8.5) were adapted to be consistent with conditions associated with the Project's Environmental Protection Licences (EPLs). Modifications to the existing Wolli Creek criteria are proposed for copper, zinc, and total nitrogen due to consistent exceedances of these values during the baseline period at freshwater sampling sites. Suggested amendments to trigger values are provided in bold text in Table 6, and are based on the 80% percentile of samples collected during the period June 2015 to May 2016. A trigger value for ferrous iron of 0.3mg/l has been adopted from the Australian Drinking Water Guidelines (published by the National Health and Medical Research Council in 2011). Rolling means will be used during construction to further assess this parameter. Measured levels of conductivity, turbidity and dissolved oxygen also exceeded the criteria frequently during the baseline monitoring period; however the triggers adopted from the EIS will remain as the 80% value calculated from the data set was similar to the existing trigger.

An assessment of the Cooks River criteria for application as project specific estuarine triggers confirmed the suitability to apply these (with minor amendments in bold text in Table 7) to the Cooks River, Alexandra Canal, and tributary to Muddy Creek. Triggers for total suspended solids (50mg/l) and pH (6.5-8.5) were adopted to be consistent with conditions associated with the Project's (EPLs). A trigger value for ferrous iron of 0.3mg/l has been adopted from the Australian Drinking Water Guidelines (published by the National Health and Medical Research Council in 2011). Rolling means will be used to further assess this parameter during construction. Modification to the existing Cooks River criteria are proposed only for Total Nitrogen, which will be based on the 80% percentile of samples collected during the period June 2015 to May 2016 from estuarine sampling locations. New criteria are suggested for arsenic, manganese and total phospohorous, where triggers were not previously available. These are also based on the 80% percentile of samples collected during from estuarine sampling locations.

A number of additional parameters assessed during the baseline program do not have corresponding trigger values (Table 5). It is not appropriate to list trigger values for these as the majority of samples collected were below the limits of detection available from the laboratory, with some spikes in individual samples providing outliers and affecting reliability of data. No triggers are proposed for these parameters. Instead, rolling means will be used to assess results and assess any emerging trends for sites and locations.

Table 5: List of parameters where rolling means will be used in the absence of trigger values.

Parameters to be assessed against rolling means	
Reactive Phosphorus as P	Toluene
C6 - C10 Fraction	Ethylbenzene
>C10 - C16 Fraction	Total Xylenes
>C16 - C34 Fraction	Naphthalene
>C34 - C40 Fraction	Oxidation-reduction potential (ORP)
Benzene	

Table 6. Confirmation of water quality criteria and targets for freshwater sampling locations.

	Freshwater mean, criteria and targets						
Parameter	**Trigger**	**Mean**	**Min**	**Max**	**N**	**% trigger exceeded**	**Adopted trigger**
Suspended Solids (TSS: mg/l)	-	19.2	0.0	186.0	38	-	**50**
Arsenic (mg/l)	0.360	0.001	0.000	0.011	85	0	0.360
Cadmium (mg/l)	0.0008	0.0000	0.0000	0.0004	85	0	0.0008
Chromium (mg/l)	0.040	0.000	0.000	0.004	85	0	0.040
Copper (mg/l)	0.0025	0.008	0.000	0.039	85	88	**0.012**
Lead (mg/l)	0.0094	0.005	0.000	0.163	85	13	0.0094
Manganese (mg/l)	3.600	0.036	0.000	0.273	85	0	3.600
Nickel (mg/l)	0.017	0.001	0.000	0.004	85	0	0.017
Zinc (mg/l)	0.031	**0.037**	0.000	0.267	85	40	**0.059**
Mercury (mg/l)	0.0054	0.0000	0.0000	0.0010	85	0	0.0054
Ferrous Iron (mg/l)	-	0.17	0.00	0.83	83	-	**0.3**
Ammonia (mg/l)	2.3	0.081	0.000	0.288	14	0	2.3
Nitrate as N (mg/l)	17	0.820	0.000	2.870	82	0	17
Total Nitrogen as N (mg/l)	1.90	**2.12**	0.00	12.40	85	31	**2.89**
Total Phosphorus as P (mg/l)	0.12	0.095	0.000	0.650	85	21	0.12
pH	6.5 – 7.7	**8.31**	6.22	10.58	46	78	**6.5 – 8.5**
Dissolved Oxygen (% Sat)	60	95.1	19.5	166.5	46	15	60
Conductivity (µS/cm)	310-1660	953.2	3.0	4028.0	46	26	310-1660
Turbidity (NTU)	29	12.2	0.0	161.0	42	10	29

Table 7. Confirmation of water quality criteria and targets for estuarine sampling locations.

	Estuary mean, criteria and targets						
Parameter	**Trigger**	**Mean**	**Min**	**Max**	**N**	**% trigger exceeded**	**Adopted trigger**
Suspended Solids (TSS: mg/l)	-	16.3	0.0	437.0	41	-	**50**
Arsenic (mg/l)	-	0.003	0.000	0.028	66	-	**0.004**
Cadmium (mg/l)	0.036	0.0002	0.0000	0.0055	66	0	0.036
Chromium (mg/l)	0.085	0.000	0.000	0.022	66	0	0.085
Copper (mg/l)	0.008	0.003	0.000	0.107	66	5	0.008
Lead (mg/l)	0.012	0.002	0.000	0.036	66	5	0.012
Manganese (mg/l)	-	0.016	0.000	0.059	66	-	**0.026**
Nickel (mg/l)	0.56	0.000	0.000	0.016	66	0	0.56
Zinc (mg/l)	0.043	0.011	0.000	0.120	66	10	0.043
Mercury (mg/l)	0.0014	0.0000	0.0000	0.0002	66	0	0.0014
Ferrous Iron (mg/l)	-	0.04	0.00	0.26	66	-	**0.3**
Ammonia (mg/l)	1.7	0.108	0.000	0.470	20	0	1.7
Nitrate as N (mg/l)	-	0.538	0.004	5.610	66	-	**0.38**
Total Nitrogen as N (mg/l)	1.04	**1.16**	0.00	7.00	66	30	**1.7**
Total Phosphorus as P (mg/l)	0.2	0.062	0.000	0.210	66	2	0.2
pH	7.0-8.5	7.77	7.14	9.02	39	3	**6.5-8.5**
Dissolved Oxygen (% Sat)	39.80	91.1	36.7	129.0	39	3	39.80
Conductivity (µS/cm)	17540-54200	27706.1	30.0	49028.0	39	64	54200
Turbidity (NTU)	15	5.2	0.0	18.4	35	10	15

Appendix G – Glossary of Terms

Term / abbreviation	Definition
ANZECC/ARMCANZ	Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 (Agriculture and Resource Management Council of Australia and New Zealand and the Australian and New Zealand Environment and Conservation Council)
AHD	Australian Height Datum
As	Arsenic
BOC	Bottom of casing
BOD	Biochemical oxygen demand
BTEXN	Benzene, toluene, ethylbenzene, xylenes and naphthalene.
CCS	Community Communication Strategy
Cd	Cadmium
CEMP	Construction Environmental Management Plan
Chl-a	Chlorophyll a
CIP	Community Involvement Plan
CoA	Minister's Condition of Approval (to be obtained with Infrastructure Approval)
Construction Area	A separable portion of work that is identified early in construction planning to help drive early definition of construction methodology and alignment of design activities. Work Areas should be listed in the overall construction methodology. The planning document for a work area is called a Construction Area Plan
Construction Area Plan (CAP)	The main document prepared during the construction planning for that work area. Includes construction methodology, risk assessment, constructability reviews and Work Pack listing
Critical State Significant Infrastructure (CSSI)	Since finalisation of the Environmental Impact Statement, the Project has been declared by Ministerial Order to be State significant infrastructure and critical State significant infrastructure under sections 115U(4) and 115V of the Environmental Planning and Assessment Act 1979.
Cr	Chromium
Cr(V)	Hexavalent chromium
Cu	Copper
D&C	Design and Construction
Deed	As appropriate to the defined scope of the WestConnex New M5 D&C Deed
DO	Dissolved Oxygen
DP&E	Department of Planning and Environment

Term / abbreviation	Definition
DPI	Department of Primary Industries
EC	Electrical conductivity
EIS	Environmental Impact Statement
EMM	Environmental management measures (proposed in the Environmental Impact Assessment)
EMS	Environmental Management System
Environmental aspect	Element of an organisation's activities, products or services that can interact with the environment
Environmental impact	Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services.
EP&A Act	Environmental Planning and Assessment Act 1979
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999.*
EPL	Environment Protection Licence
ER	Environmental Representative
EWMS	Environmental Work Method Statement – a component of the environmental management system that addresses environmental management issues relevant to a specific site and/or activity
GDE	Groundwater Dependant Ecosystem
Hg	Mercury
IC	Independent Certifier
Infrastructure Approval	Approval under the *Environmental Planning & Assessment Act 1979* for SSI-6788 signed by the Minister for Planning on 20 April 2016
kms	kilometres
CDS-JV	CPB Contractors Dragados Samsung Joint Venture (Contractor)
mbtoc	metres below top of casing
mg/L	Milligrams per litre
mL	millilitre
MPN	Most probable number
mS/cm	milli Siemens per centimetre
NH_3	Ammonia
Ni	Nickel

Term / abbreviation	Definition
NO_x	Oxides of nitrogen
NOW	NSW Office of Water, now DPI Water
NTU	nephelometric turbidity unit
NUDLC	National Uniform Drillers Licensing Committee
OCP	Organochlorine pesticides
OEH	Office of Environment and Heritage
OEMP	Operational Environmental Management Plan
OPP	Organophosphate pesticides
Pb	Lead
POEO Act	*Protection of the Environment Operations Act 1997*
PPE	Personal Protective Equipment
Project	WestConnex New M5 Project
Project Company	WCX New M5 Pty Limited
Project requirements	The project requirements include all CoA (pursuant to Infrastructure Approval), REMMs, EMMs, SWTC and EPL.
REMM	Revised Environmental Management Measure (from the SPIR)
RMS, Roads and Maritime	Roads and Maritime Services
SMC	Sydney Motorway Corporation (formerly WestConnex Delivery Authority – WDA)
SP	Sustainability Plan
SPIR	Submission [and Preferred Infrastructure] Report
SVOC	Semivolatile organic compounds
SWL	Standing Water Level
CSWQSP	Construction Soil and Water Quality Sub-Plan
SWTC	As appropriate to the defined scope of the Scope of Works & Technical Criteria defined under the New M5 Main Works D&C Deed
TDS	Total dissolved solids
TKN	Total Kjeldahl nitrogen
TOC	Top of casing
TP	Total phosphorus

Term / abbreviation	Definition
TPH	Total petroleum hydrocarbons
TRH	Total recoverable hydrocarbons
TSS	Total suspended solids
VOC	Volatile organic compounds
WCX	WestConnex
WDA	WestConnex Delivery Authority now Sydney Motorway Corporation (SMC)
WHS	Work Health and Safety
WQP&MP	Water Quality Plan and Monitoring Program
CWRSP	Construction Waste and Resource Sub Plan
Work Pack	Assembly of documents that contain relevant information for the field delivery team to undertake a specific package of works. Inputs include safety, environment, design, temporary works, Project control, approvals/permits and community notices.
Work Procedure	A document that provides a detailed step-by-step description for how work activities will be carried out. May document Risks & Controls associated with each step
Zn	Zinc

Annexure B Environmental Protection Licence

Environment Protection Licence

Licence - 21351

Licence Details	
Number:	21351
Anniversary Date:	30-April

Licensee

CPB CONTRACTORS PTY LIMITED

PO BOX 6120

ALEXANDRIA NSW 2015

Premises

OPERATIONAL WATER TREATMENT PLANT

M8 - MOTORWAY OPERATIONS COMPLEX 3

ARNCLIFFE NSW 2205

Scheduled Activity

Contaminated groundwater treatment

Fee Based Activity	Scale
Contaminated groundwater treatment	Any annual handling capacity

Region

Metropolitan Infrastructure

Level 13, 10 Valentine Ave

PARRAMATTA NSW 2150

Phone: (02) 9995 5000

Fax: (02) 9995 6900

PO Box 668

PARRAMATTA NSW 2124

Environment Protection Licence

Licence - 21351

Environment Protection Licence

Licence - 21351

Environment Protection Licence

Licence - 21351

Information about this licence

Dictionary

A definition of terms used in the licence can be found in the dictionary at the end of this licence.

Responsibilities of licensee

Separate to the requirements of this licence, general obligations of licensees are set out in the Protection of the Environment Operations Act 1997 ("the Act") and the Regulations made under the Act. These include obligations to:

- ensure persons associated with you comply with this licence, as set out in section 64 of the Act;
- control the pollution of waters and the pollution of air (see for example sections 120 - 132 of the Act);
- report incidents causing or threatening material environmental harm to the environment, as set out in Part 5.7 of the Act.

Variation of licence conditions

The licence holder can apply to vary the conditions of this licence. An application form for this purpose is available from the EPA.

The EPA may also vary the conditions of the licence at any time by written notice without an application being made.

Where a licence has been granted in relation to development which was assessed under the Environmental Planning and Assessment Act 1979 in accordance with the procedures applying to integrated development, the EPA may not impose conditions which are inconsistent with the development consent conditions until the licence is first reviewed under Part 3.6 of the Act.

Duration of licence

This licence will remain in force until the licence is surrendered by the licence holder or until it is suspended or revoked by the EPA or the Minister. A licence may only be surrendered with the written approval of the EPA.

Licence review

The Act requires that the EPA review your licence at least every 5 years after the issue of the licence, as set out in Part 3.6 and Schedule 5 of the Act. You will receive advance notice of the licence review.

Fees and annual return to be sent to the EPA

For each licence fee period you must pay:

- an administrative fee; and
- a load-based fee (if applicable).

Environment Protection Licence

Licence - 21351

The EPA publication “A Guide to Licensing” contains information about how to calculate your licence fees. The licence requires that an Annual Return, comprising a Statement of Compliance and a summary of any monitoring required by the licence (including the recording of complaints), be submitted to the EPA. The Annual Return must be submitted within 60 days after the end of each reporting period. See condition R1 regarding the Annual Return reporting requirements.

Usually the licence fee period is the same as the reporting period.

Transfer of licence

The licence holder can apply to transfer the licence to another person. An application form for this purpose is available from the EPA.

Public register and access to monitoring data

Part 9.5 of the Act requires the EPA to keep a public register of details and decisions of the EPA in relation to, for example:

- licence applications;
- licence conditions and variations;
- statements of compliance;
- load based licensing information; and
- load reduction agreements.

Under s320 of the Act application can be made to the EPA for access to monitoring data which has been submitted to the EPA by licensees.

This licence is issued to:

CPB CONTRACTORS PTY LIMITED
PO BOX 6120
ALEXANDRIA NSW 2015

subject to the conditions which follow.

Environment Protection Licence

Licence - 21351

1 Administrative Conditions

A1 What the licence authorises and regulates

A1.1 This licence authorises the carrying out of the scheduled activities listed below at the premises specified in A2. The activities are listed according to their scheduled activity classification, fee-based activity classification and the scale of the operation.

Unless otherwise further restricted by a condition of this licence, the scale at which the activity is carried out must not exceed the maximum scale specified in this condition.

Scheduled Activity	Fee Based Activity	Scale
Contaminated groundwater treatment	Contaminated groundwater treatment	Any annual handling capacity

A2 Premises or plant to which this licence applies

A2.1 The licence applies to the following premises:

Premises Details
OPERATIONAL WATER TREATMENT PLANT
M8 - MOTORWAY OPERATIONS COMPLEX 3
ARNCLIFFE
NSW 2205
LOT 14 DP213314

A3 Information supplied to the EPA

A3.1 Works and activities must be carried out in accordance with the proposal contained in the licence application, except as expressly provided by a condition of this licence.

In this condition the reference to "the licence application" includes a reference to:
a) the applications for any licences (including former pollution control approvals) which this licence replaces under the Protection of the Environment Operations (Savings and Transitional) Regulation 1998; and
b) the licence information form provided by the licensee to the EPA to assist the EPA in connection with the issuing of this licence.

Environment Protection Licence

Licence - 21351

2 Discharges to Air and Water and Applications to Land

P1 Location of monitoring/discharge points and areas

P1.1 The following utilisation areas referred to in the table below are identified in this licence for the purposes of the monitoring and/or the setting of limits for any application of solids or liquids to the utilisation area.

P1.2 The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.

Water and land

EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
1	Discharge & Monitoring	Discharge & Monitoring	Water Treatment Plant discharge to Tidal Storage Basin

3 Limit Conditions

L1 Pollution of waters

L1.1 Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.

L2 Concentration limits

L2.1 For each monitoring/discharge point or utilisation area specified in the table\s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.

L2.2 Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.

L2.3 To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\s.

L2.4 Water and/or Land Concentration Limits

POINT 1

Pollutant	Units of Measure	50 Percentile concentration limit	90 Percentile concentration limit	3DGM concentration limit	100 percentile concentration limit
Aluminium	micrograms per litre	500	600		
Cobalt	micrograms per litre	2.8	8.0		
Copper	micrograms per litre	2.9	10.3		
Manganese	micrograms per litre	2000	10600		
pH	pH				6.5-8.5
TRH C10-C16	micrograms per litre	<100	<100		
TRH C16-C34 (F3)	micrograms per litre	<100	<100		
TRH C34-C40 (F4)	micrograms per litre	<100	<100		
Turbidity	nephelometric turbidity units				25
Zinc	micrograms per litre	48	150		

L3 Potentially offensive odour

L3.1 The licensee must not cause, permit or allow the emission of offensive odour beyond the boundary of the premises.

4 Operating Conditions

O1 Activities must be carried out in a competent manner

O1.1 Licensed activities must be carried out in a competent manner.
This includes:
a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and
b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.

O2 Maintenance of plant and equipment

O2.1 All plant and equipment installed at the premises or used in connection with the licensed activity:
a) must be maintained in a proper and efficient condition; and
b) must be operated in a proper and efficient manner.

5 Monitoring and Recording Conditions

M1 Monitoring records

M1.1 The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.

M1.2 All records required to be kept by this licence must be:
a) in a legible form, or in a form that can readily be reduced to a legible form;
b) kept for at least 4 years after the monitoring or event to which they relate took place; and
c) produced in a legible form to any authorised officer of the EPA who asks to see them.

M1.3 The following records must be kept in respect of any samples required to be collected for the purposes of this licence:
a) the date(s) on which the sample was taken;
b) the time(s) at which the sample was collected;
c) the point at which the sample was taken; and
d) the name of the person who collected the sample.

M2 Requirement to monitor concentration of pollutants discharged

M2.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:

M2.2 Water and/ or Land Monitoring Requirements

POINT 1

Pollutant	Units of measure	Frequency	Sampling Method
Aluminium	micrograms per litre	Monthly	Grab sample
Cobalt	micrograms per litre	Monthly	Grab sample
Copper	micrograms per litre	Monthly	Grab sample
Manganese	micrograms per litre	Monthly	Grab sample

pH	pH	Monthly	Probe
TRH C10-C16	micrograms per litre	Monthly	Grab sample
TRH C16-C34 (F3)	micrograms per litre	Monthly	Grab sample
TRH C34-C40 (F4)	micrograms per litre	Monthly	Grab sample
Turbidity	nephelometric turbidity units	Monthly	Grab sample
Zinc	micrograms per litre	Monthly	Grab sample

M3 Testing methods - concentration limits

M3.1 Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.

M4 Recording of pollution complaints

M4.1 The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.

M4.2 The record must include details of the following:
a) the date and time of the complaint;
b) the method by which the complaint was made;
c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
d) the nature of the complaint;
e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
f) if no action was taken by the licensee, the reasons why no action was taken.

M4.3 The record of a complaint must be kept for at least 4 years after the complaint was made.

M4.4 The record must be produced to any authorised officer of the EPA who asks to see them.

M5 Telephone complaints line

M5.1 The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.

M5.2 The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.

M5.3 The preceding two conditions do not apply until 5 business days after the date of the issue of this licence.

Environment Protection Licence

Licence - 21351

6 Reporting Conditions

R1 Annual return documents

R1.1 The licensee must complete and supply to the EPA an Annual Return in the approved form comprising:

1. a Statement of Compliance,
2. a Monitoring and Complaints Summary,
3. a Statement of Compliance - Licence Conditions,
4. a Statement of Compliance - Load based Fee,
5. a Statement of Compliance - Requirement to Prepare Pollution Incident Response Management Plan,
6. a Statement of Compliance - Requirement to Publish Pollution Monitoring Data; and
7. a Statement of Compliance - Environmental Management Systems and Practices.

At the end of each reporting period, the EPA will provide to the licensee a copy of the form that must be completed and returned to the EPA.

R1.2 An Annual Return must be prepared in respect of each reporting period, except as provided below.

Note: The term "reporting period" is defined in the dictionary at the end of this licence. Do not complete the Annual Return until after the end of the reporting period.

R1.3 Where this licence is transferred from the licensee to a new licensee:
a) the transferring licensee must prepare an Annual Return for the period commencing on the first day of the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and
b) the new licensee must prepare an Annual Return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period.

Note: An application to transfer a licence must be made in the approved form for this purpose.

R1.4 Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an Annual Return in respect of the period commencing on the first day of the reporting period and ending on:
a) in relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or
b) in relation to the revocation of the licence - the date from which notice revoking the licence operates.

R1.5 The Annual Return for the reporting period must be supplied to the EPA via eConnect *EPA* or by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').

R1.6 The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.

R1.7 Within the Annual Return, the Statements of Compliance must be certified and the Monitoring and Complaints Summary must be signed by:
a) the licence holder; or
b) by a person approved in writing by the EPA to sign on behalf of the licence holder.

R2 Notification of environmental harm

R2.1 Notifications must be made by telephoning the Environment Line service on 131 555.

Note: The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.

R2.2 The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.

R3 Written report

R3.1 Where an authorised officer of the EPA suspects on reasonable grounds that:
a) where this licence applies to premises, an event has occurred at the premises; or
b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence,
and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.

R3.2 The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.

R3.3 The request may require a report which includes any or all of the following information:
a) the cause, time and duration of the event;
b) the type, volume and concentration of every pollutant discharged as a result of the event;
c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event;
d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort;
e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants;
f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and
g) any other relevant matters.

R3.4 The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.

7 General Conditions

G1 Copy of licence kept at the premises or plant

G1.1 A copy of this licence must be kept at the premises to which the licence applies.

G1.2 The licence must be produced to any authorised officer of the EPA who asks to see it.

G1.3 The licence must be available for inspection by any employee or agent of the licensee working at the premises.

8 Pollution Studies and Reduction Programs

U1 Discharge Characterisation Assessment

U1.1 The Licensee must engage a suitably qualified and experienced person to prepare and implement a Discharge Characterisation Assessment. The Licensee must consult with the EPA on the analyte list and sampling methodology within four weeks of the issue date of this licence before implementing the Discharge Characterisation Assessment.

U1.2 The Discharge Characterisation Assessment, must be submitted to the EPA by 1 July 2021.

U1.3 The Discharge Characterisation Assessment must include, at a minimum:
a) water sampling for all identified potential pollutants of concern in site discharges, including but not limited to:
i. a full suite of key analytes from the report entitled “New M5 Discharge Impact Assessment, 14 November 2019, 57705 - 125,875 Rev 1”; and
ii. ammonia, total nitrogen and total phosphorus; and
iii. a full suite of dissolved metals, including but not limited to aluminium, cobalt, cadmium, copper, lead, nickel, zinc, arsenic, manganese, iron; and
iv. total residual hydrocarbons (fractions), polycyclic aromatic hydrocarbons and chlorinated hydrocarbons; turbidity, total suspended solids and pH.

b) an assessment of the discharge concentrations, dilution effectiveness and modelling predictions:
i. at the point of discharge; and
ii. within the mixing zone at the point where potential acute criteria may be achieved; and
iii. at the edge of the predicted near field mixing zone; and
iv. regarding the spatial extent of the predicted shore-hugging plume.

c) sufficient sampling to capture the full variability of water quality discharged from the Premises, including average or typical through to worst case scenarios, guided by protocols to ensure that sampling events are triggered by the full range of operational processes that would materially impact discharge water quality, and be linked to discharge events.

d) an assessment of the potential impact of discharges on receiving waters, based on the surface water

characterisation and with reference to ANZG (2018) assessment criteria (or relevant guidelines) for slightly-to moderately disturbed ecosystems or relevant international guidelines and relevant acute toxicity guidelines, including but not limited to ammonia and aluminium.

e) specify the analytical limits of reporting used for any existing and new data that is being assessed and:
i. compare that limit of reporting to the relevant ANZG (2018) assessment criteria (or relevant guidelines) for slightly-to moderately disturbed ecosystems; and
ii. where the limit of reporting does not provide a suitable basis for assessing risk of water pollution, propose alternative options to characterise the risk, including more sensitive laboratory testing or risk mitigation options.

Note: The level of reporting for concentrations of pollutants should be sensitive enough to detect pollutants at levels related to their environmental risk and ANZECC (2000) toxicant trigger value (where available) while having regard to the best available analytical practical quantification limits using available technology.

Note: Sampling and analysis for the characterisation must be in accordance with the *Approved Methods for the Sampling and Analysis of Water Pollutants in NSW* (2004).

U1.4 Water Treatment Plant (WTP) Performance Reporting

a) Where water samples have been undertaken in accordance with condition U1.3 a), the licensee must submit to the EPA a WTP Performance Report every three months from the date the licensee implements the Discharge Characterisation Assessment, unless otherwise agreed in writing by the EPA.
b) The WTP Performance Report must:
i) include results of all discharge and ambient water quality monitoring, and an interpretation of those results;
ii) review the performance of the WTP operating on the premises against requirements of the licence; and
iii) include details of any incidents and responses.

U2 Surface Water Mitigation and Monitoring Plan

U2.1 The Licensee must engage a suitably qualified and experienced person to prepare a Surface Water Mitigation and Monitoring Plan.

U2.2 The Surface Water Mitigation and Monitoring Plan, must be submitted to the EPA by 31 December 2021.

U2.3 The Surface Water Mitigation and Monitoring Plan must include, as a minimum, the following components:
a) an investigation of practical measures that could be taken to avoid or minimise pollution from ammonia and measures that may be needed based on the Surface Water Discharge Characterisation Assessment at U1. Consideration should include but not be limited to treatment and dilution options, including by not limited to:
i. dilution of discharges using near field mixing; and
ii. partial discharge to sewer on a permanent basis.

b) development of a program of a preferred mitigation measure(s) with proposed timeframes for

implementation.

c) establish an ongoing discharge monitoring program to validate outcomes of the proposed mitigation measures. The program must include at a minimum:
i. identification of pollutants to be monitored based on the Discharge Characterisation Assessment and mitigation measures proposed in U2.3; and
ii. identification of appropriate trigger values for pollutants and proposed actions and mitigation measures for managing pollutant exceedances; and
iii. monitoring of discharge frequency and volumes; and
iv. location of monitoring points; and
v. frequency of monitoring; and
vi. method of monitoring.

U2.4 Contingency options must be developed and included in the Surface Water Mitigation and Monitoring Plan to account for any mitigation options that do not adequately address the site water pollution risks.

U2.5 The Surface Water Mitigation and Monitoring Plan must be approved in writing by the EPA prior to implementation.

Note: Appropriate concentration discharge limits, volume discharge limits and ongoing monitoring requirements will be placed as conditions on the licence and the EPA will consider if additional performance criteria will require licence conditions.

U3 Surface Water Validation Report

U3.1 For any required mitigation measures identified under condition U2, the Licensee must engage a suitably qualified and experienced person to prepare a Surface Water Validation Report.

U3.2 The Surface Water Validation Report, must be submitted to the EPA by 31 December 2022.

U3.3 The Surface Water Validation Report must include, at a minimum:
a) the results of the Surface Water Mitigation and Monitoring Plan at U2; and

b) characterisation of the water discharge quality in accordance with ANZG (2018) assessment criteria (or relevant guidelines); and

c) demonstration that water quality is being managed in accordance with the discharge conditions of the licence; and

d) an assessment of the effectiveness of implemented mitigation options; and

e) demonstration that the licence regulates the discharge of all pollutants that pose a risk of non-trivial harm to human health or the environment; and

f) confirmation that the site water balance including validation of the predicted discharge volume is consistent with the potential pollutant risks; and

g) a representative ongoing monitoring program for site discharges.

U3.4 If monitoring shows that water quality or volume discharge is not being managed in accordance with discharge conditions of the licence, the Mitigation and Monitoring Plan must be updated to:
a) propose additional mitigation measures to control and / or treat all pollutants that represent a risk of non-trivial harm, including any relevant contingency options identified under U2.4; and

b) propose a timeframe for the implementation of these additional mitigation measures.

U3.5 The assessment of the monitoring results, any further contingency options as necessary and an updated Mitigation and Monitoring Plan must be submitted to the EPA within 3 months of the implementation of mitigation measures agreed to in the Surface Water Mitigation and Monitoring Plan at U2.

Environment Protection Licence

Licence - 21351

Dictionary

General Dictionary

3DGM [in relation to a concentration limit]	Means the three day geometric mean, which is calculated by multiplying the results of the analysis of three samples collected on consecutive days and then taking the cubed root of that amount. Where one or more of the samples is zero or below the detection limit for the analysis, then 1 or the detection limit respectively should be used in place of those samples
Act	Means the Protection of the Environment Operations Act 1997
activity	Means a scheduled or non-scheduled activity within the meaning of the Protection of the Environment Operations Act 1997
actual load	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
AM	Together with a number, means an ambient air monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
AMG	Australian Map Grid
anniversary date	The anniversary date is the anniversary each year of the date of issue of the licence. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
annual return	Is defined in R1.1
Approved Methods Publication	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
assessable pollutants	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
BOD	Means biochemical oxygen demand
CEM	Together with a number, means a continuous emission monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
COD	Means chemical oxygen demand
composite sample	Unless otherwise specifically approved in writing by the EPA, a sample consisting of 24 individual samples collected at hourly intervals and each having an equivalent volume.
cond.	Means conductivity
environment	Has the same meaning as in the Protection of the Environment Operations Act 1997
environment protection legislation	Has the same meaning as in the Protection of the Environment Administration Act 1991
EPA	Means Environment Protection Authority of New South Wales.
fee-based activity classification	Means the numbered short descriptions in Schedule 1 of the Protection of the Environment Operations (General) Regulation 2009.
general solid waste (non-putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997

Environment Protection Licence

Licence - 21351

flow weighted composite sample	Means a sample whose composites are sized in proportion to the flow at each composites time of collection.
general solid waste (putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environmen t Operations Act 1997
grab sample	Means a single sample taken at a point at a single time
hazardous waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
licensee	Means the licence holder described at the front of this licence
load calculation protocol	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
local authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
material harm	Has the same meaning as in section 147 Protection of the Environment Operations Act 1997
MBAS	Means methylene blue active substances
Minister	Means the Minister administering the Protection of the Environment Operations Act 1997
mobile plant	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
motor vehicle	Has the same meaning as in the Protection of the Environment Operations Act 1997
O&G	Means oil and grease
percentile [in relation to a concentration limit of a sample]	Means that percentage [eg.50%] of the number of samples taken that must meet the concentration limit specified in the licence for that pollutant over a specified period of time. In this licence, the specified period of time is the Reporting Period unless otherwise stated in this licence.
plant	Includes all plant within the meaning of the Protection of the Environment Operations Act 1997 as well as motor vehicles.
pollution of waters [or water pollution]	Has the same meaning as in the Protection of the Environment Operations Act 1997
premises	Means the premises described in condition A2.1
public authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
regional office	Means the relevant EPA office referred to in the Contacting the EPA document accompanying this licence
reporting period	For the purposes of this licence, the reporting period means the period of 12 months after the issue of the licence, and each subsequent period of 12 mo nths. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
restricted solid waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
scheduled activity	Means an activity listed in Schedule 1 of the Protection of the Environment Operations Act 1997
special waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
TM	Together with a number, means a test method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.

Environment Protection Licence

Licence - 21351

TSP	Means total suspended particles
TSS	Means total suspended solids
Type 1 substance	Means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements
Type 2 substance	Means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements
utilisation area	Means any area shown as a utilisation area on a map submitted with the application for this licence
waste	Has the same meaning as in the Protection of the Environment Operations Act 1997
waste type	Means liquid, restricted solid waste, general solid waste (putrescible), general solid waste (non-putrescible), special waste or hazardous waste

Ms Aleksandra Young

Environment Protection Authority

(By Delegation)

Date of this edition: 30-April-2020

End Notes