AW EDWARDS

Construction Groundwater Management Plan

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AW EDWARDS acknowledges the Traditional Owners of Country throughout Australia and recognises the continuing connection to lands, waters and communities.
We pay our respect to Aboriginal and Torres Strait Islander people and culture, and to their Elders past and present.

"COMMUNITY"
Artwork by Raechel Saunders

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1 INTRODUCTION

1.1 BACKGROUND

The Sydney Metro City & Southwest is a 30 kilometre metro rail between Chatswood and Bankstown, including; 17 kilometres of new tunnel from Chatswood, under the harbour to Sydenham connecting seven new underground stations at Crows Nest, Victoria Cross (North Sydney), Barangaroo, Pitt Street, Martin Place, Central and Waterloo. Upgrading 13 kilometres of the Bankstown line, including 11 existing stations; Sydenham, Marrickville, Dulwich Hill, Hurlstone Park, Canterbury, Campsie, Belmore, Lakemba, Wiley Park, Punchbowl and Bankstown plus southern service facilities.

Several separate environmental impact assessments of the project were progressed by Transport for NSW (TfNSW). In May 2016, an environmental impact statement (EIS) for the Chatswood to Sydenham section of the project was placed on public exhibition. A preferred infrastructure report on the Chatswood to Sydenham component (the PIR) was then prepared and publicly released in October 2016. The project was approved on 9 January 2017 (SSI 15_7400) (project planning approval). Following approval, eight modifications have been approved by NSW Department of Planning, Infrastructure and Environment (DPIE).

A W Edwards has been appointed by Sydney Metro to construct the Crows Nest Integrated Station Development (the project).

1.2 PURPOSE

This Construction Groundwater Management Plan (CGWMP) describes how A W Edwards will avoid, minimise and manage impacts to and from groundwater which seeps through bedrock, as well as rainfall and surface water which infiltrates the below ground station box during construction of the project.

This CGWMP forms part of the Construction Environmental Management Plan (CEMP) for the project and was prepared in accordance with:

- The relevant planning approvals and conditions of approval (CoA) for the project (refer to Chapter 2);
- Applicable legislation and regulatory requirements;
- Sydney Metro Construction Environmental Management Framework – Chatswood to Sydenham (CEMF).
- Revised environmental mitigation measures (REMMs); and
- Sydney Metro contractual requirements, including the project deed and scope of work and technical criteria.

As this plan describes the avoidance, minimisation and management of impacts caused by rainfall and surface water, it should be read in conjunction with the Construction Soil and Water Management Procedure.

1.3 PROJECT OVERVIEW

Crows Nest Station will be between the Pacific Highway and Clarke Lane (eastern side of the Pacific Highway) and between Oxley Street and south of Hume Street. It will be strategically located to the south of the existing station at St Leonards and close to the leisure and retail strip along Willoughby Road.

Crows Nest Station will support the St Leonards specialised centre as a southern gateway to commercial and mixed-use activities. The station will also improve access to the restaurants and specialist shops in the Crows Nest village. Crows Nest Station will:

- Create a new transport focus on the southern side of the St Leonards specialised centre.
- Maximise legibility and connectivity with the local urban structure.
- Integrate the station with local improvement plans and make a positive contribution to the sense of place.

Refer to Chapter 2 of the CEMP for detailed scope of work and construction method.

1.4 OBJECTIVES AND ENVIRONMENTAL PERFORMANCE OUTCOMES

The following groundwater management objectives, consistent with those described in Section 7.1 of the CEMF (Doc. No. SMCSW1NL-SMC-1NL-EM-PRO-000003) will be applied to the project:

- Reduce the potential for drawdown of surrounding groundwater resources.
- Prevent the pollution of groundwater through appropriate controls.
- Reduce the potential impacts of groundwater dependent ecosystems.

The following construction groundwater environmental performance outcomes identified in the PIR have been considered in the preparation of the CGWMP:

- The project would make good any impacts on groundwater users.
- The project would avoid any damage to buildings from settlement.

1.5 CONSULTATION

Per CoA C3 and C9 for the project, the CGWMP and construction groundwater monitoring program was prepared in consultation with NSW EPA, North Sydney Council and DPIE Water.

Consultation on the CGWMP (inclusive of construction groundwater monitoring program) with NSW EPA, North Sydney Council and DPIE Water began on the 27/11/2020 and ended on the 18/12/2020 with no additions being requested of the plan or program as a result of consultation.

1.6 ENVIRONMENTAL MANAGEMENT STRUCTURE

This CGWMP is part of A W Edward's environmental management framework for the project and is supported by other documents such as:

- CEMP;
- Construction Soil and Water Management Procedure;
- Community and Stakeholder Engagement Plan; and
- Environmental control maps (ECMs), inclusive of relevant groundwater management measures.

1.7 APPROVAL

This CGWMP and the construction groundwater monitoring program will be reviewed by Sydney Metro, endorsed by the independent Environmental Representative (ER) and submitted to the Secretary of DPIE for approval in accordance with CoA C8 and C13.

This CGWMP and the construction groundwater monitoring program will be submitted for approval to the Secretary of DPIE no later than one month before commencement of construction of the project.

Per C14, baseline monitoring from the EIS and monitoring data provided by previous contractors has been reviewed and deemed sufficient. A W Edwards does not propose to collect additional baseline data prior to construction commencing.

Construction will not commence until the CEMP and sub-plans (including this CGWMP and the construction groundwater monitoring program) have been approved.

2 LEGAL AND APPROVAL REQUIREMENTS

2.1 PLANNING APPROVALS

Sydney Metro City & Southwest has been declared as critical State significant infrastructure (CSSI) under Division 5.2 of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act) and State Environmental Planning Policy (State and Regional Development) 2011. There are two CSSI planning approvals for Sydney Metro City & Southwest:

- Construction and operation of the section between Chatswood and the Sydenham dive site known as "CSSI_7400", which was granted on 9 January 2017. Several modifications to CSSI_7400 have since been approved. A W Edwards will be required to comply with CSSI_7400, including the modifications to this approval, to the extent required by Sydney Metro.
- The section of the rail corridor between Sydenham and Bankstown and is known as "CSSI_8256" and does not have any requirements that are relevant to the project.

Any future amendments to the CSSI approval (Chatswood to Sydenham) will be subject to Sydney Metro approval and will continue to be managed and lodged by Sydney Metro.

The environmental assessments relevant to the project, which have been referenced during the preparation of this CGWMP are:

- Sydney Metro City & Southwest – Chatswood to Sydenham – Environmental Impact Statement (TfNSW, 2016).
- Sydney Metro City & Southwest – Crows Nest Over Station Development – Environmental Impact Statement (TfNSW, 2018).
- Minor Works Approval for Enabling Works (CN-PCMW-001 Site Establishment Works) – April 2020.

2.2 LEGISLATION AND REGULATORY REQUIREMENTS

Applicable legislation relevant to water management are summarised in Table 2.2.

Table 2.2 Legislative requirements

LEGISLATION	DESCRIPTION	RELEVANCE
NSW Environmental Planning and Assessment Act 1979	This Act establishes a system of environmental planning and assessment for development of the State.	The approval conditions and obligations are incorporated into this CGWMP.
NSW Protection of the Environment Operations Act 1997	This Act includes all the controls necessary to regulate pollution and reduce degradation of the environment, provides for licensing of scheduled development work, scheduled activities and for offences and prosecution under this Act.	This plan defines how A W Edwards will manage works to comply with this Act and minimise the potential for a pollution event to occur.
NSW Water Management Act 2000 NSW Water Management (General) Regulation 2004	This Act and Regulation provide for the protection, conservation and ecologically sustainable development of water sources of the State and in particular to protect, enhance and restore water sources and their associated ecosystems.	The project is assessed under Part 5.1 of the EP&A Act and is exempt from obtaining water use approval under section 89, a water management work approval under section 90 or an activity approval (other than

LEGISLATION	DESCRIPTION	RELEVANCE
		an aquifer interference approval) under section 91.
NSW Sydney Water Act 1994	This Act establishes the Sydney Water Corporation as a statutory State owned corporation. The functions of the Sydney Water Corporation is to supply and store water, provide sewerage services, provide stormwater drainage and dispose of waste water within its area of operations.	Coordination may be required with Sydney Water during the works if a permit to discharge treated groundwater to a Sydney Water stormwater drain or wastewater network, or a permit to use approved metered standpipes on Sydney water hydrants is required.
NSW Protection of the Environment Operations (Waste) Regulation 2014;	This Act includes additional provisions to protect human health and the environment for a modern and fair waste industry in NSW. Changes within this regulation includes amended thresholds for environment protection licences and reforms to the waste levy system.	This plan outlines how A W Edwards will manage waste disposal in accordance with the new waste reforms.
NSW Waste Avoidance and Resource Recovery Act 2001	The purpose of the Act is to encourage the most efficient use of resources and to reduce environmental harm in accordance with the principles of ecological sustainable development. The Act provides for the making of policies and strategies to achieve these ends. It is an offence under the Protection of the Environment Operations Act to wilfully or negligently dispose of waste in a manner that harms or is likely to harm the environment.	The relevance of the Act to this project is to implement the strategies by adopting the hierarchy of avoidance; avoidance of unnecessary resource consumption; resource recovery (including reuse, reprocessing, recycling and energy recovery), disposal (as a last resort).

2.3 GUIDELINES

The following guidelines may be of relevance to the project:

- EPA (2014) Waste Classification Guidelines
- ANZECC (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality (collectively known as the ‘ANZECC Guidelines’).
- ANZECC (2018). Guidelines for Fresh and Marine Water Quality (The 2018 revision of the Water Quality Guidelines is presented as an online platform).
- ANZECC (2000). Australian and New Zealand Guidelines for Water Quality Monitoring and Reporting (collectively known as the ‘ANZECC Guidelines’).
- Sydney Metro’s Water Discharge and Re-use Procedure.
- NSW Office of Water (2012). NSW Aquifer Interference Policy.
- Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources (2011).

2.4 PROJECT APPROVAL REQUIREMENTS

This CGWMP has been produced to demonstrate compliance with the relevant CoA stipulated in SSI_7400, as summarised in Table 2.4.

The CoA relevant to the project have been confirmed via the Sydney Metro Chatswood to Sydenham Staging Report (Sydney Metro, 2019)

Table 2.4: CoA requirements

ITEM	REQUIREMENT	DOCUMENT REFERENCE
C3	The following CEMP sub-plans must be prepared in consultation with the relevant government agencies identified for each CEMP sub-plan and be consistent with the CEMF and CEMP referred to in Condition C1. (e) Groundwater - DPI Water	Section 1.5
C4	The CEMP sub-plans must state how: (a) the environmental performance outcomes identified in the EIS as amended by the documents listed in A1will be achieved; (b) the mitigation measures identified in the EIS as amended by documents listed in A1 will be implemented; (c) the relevant terms of this approval will be complied with; and (d) issues requiring management during construction, as identified through ongoing environmental risk analysis, will be managed.	This CGWMP
C5	The CEMP sub-plans must be developed in consultation with relevant government agencies. Where an agency(ies) request(s) is not included, the Proponent must provide the Secretary justification as to why. Details of all information requested by an agency to be included in a CEMP sub-plan as a result of consultation and copies of all correspondence from those agencies, must be provided with the relevant CEMP sub-plan.	Section 1.5
C6	Any of the CEMP sub-plans may be submitted to the Secretary along with, or subsequent to, the submission of the CEMP but in any event, no later than one (1) month before commencement of construction.	Section 1.7
C7	The CEMP must be endorsed by the ER and then submitted to the Secretary for approval no later than one (1) month before the commencement of construction or within another timeframe agreed with the Secretary.	The ER endorsed this plan in a letter dated 15 January 2021.
C8	Construction must not commence until the CEMP and all CEMP sub-plans have been approved by the Secretary. The CEMP and CEMP sub-plans, as approved by the Secretary, including any minor amendments approved by the ER (or AA in regards to the Noise and Vibration sub-plan), must be implemented for the duration of construction. Where the CSSI is being staged, construction of that stage is not to commence until the relevant CEMP and subplans have been approved by the Secretary.	Section 1.7
C9	The following Construction Monitoring Programs must be prepared in consultation with the relevant government agencies identified for each Construction Monitoring Program to compare actual performance of construction of the CSSI against predicted performance. (d) Groundwater – DPI Water.	Section 1.5 and 4.6
C10	Each Construction Monitoring Program must provide: (a) details of baseline data available; (b) details of baseline data to be obtained and when; I details of all monitoring of the project to be undertaken; (d) the parameters of the project to be monitored the frequency of monitoring to be undertaken; (f) the location of monitoring; (g) the reporting of monitoring results; (h) procedures to identify and implement additional mitigation measures where results of monitoring are unsatisfactory; and	Section 4.6

ITEM	REQUIREMENT	DOCUMENT REFERENCE
	(i) any consultation to be undertaken in relation to the monitoring programs.	
C12	The Construction Monitoring Programs must be developed in consultation with relevant government agencies as identified in Condition C9 of this approval and must include, to the written satisfaction of the Secretary, information requested by an agency to be included in a Construction Monitoring Programs during such consultation. Details of all information requested by an agency including copies of all correspondence from those agencies, must be provided with the relevant Construction Monitoring Program.	No responses received during consultation period. Section 1.5
C13	The Construction Monitoring Programs must be endorsed by the ER (or AA in regards to the Noise and Vibration Construction Monitoring Program) and then submitted to the Secretary for approval at least one (1) month before commencement of construction or within another timeframe agreed with the Secretary.	Section 1.7
C14	Construction must not commence until the Secretary has approved all of the required Construction Monitoring Programs, and all relevant baseline data for the specific construction activity has been collected.	Section 1.7
C15	The Construction Monitoring Programs, as approved by the Secretary including any minor amendments approved by the ER (or AA in regards to the Noise and Vibration Construction Monitoring Program), must be implemented for the duration of construction and for any longer period set out in the monitoring program or specified by the Secretary, whichever is the greater.	Section 4.6
C16	The results of the Construction Monitoring Programs must be submitted to the Secretary for information, and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program.	Section 5.4
C17	Where a relevant CEMP sub-plan exists, the relevant Construction Monitoring Program may be incorporated into that CEMP sub-plan.	The Construction Groundwater Monitoring Program has been incorporated into this sub-plan. Section 4.6
E59	Before commencement of construction, all property owners of buildings identified as being at risk of damage must be offered a building condition survey. Where an offer is accepted a structural engineer must undertake the survey. The results of the surveys must be documented in a Building Condition Survey Report for each building surveyed. Copies of Building Condition Survey Reports must be provided to the owners of the buildings surveyed, and if agreed by the owner, the Relevant Council within three weeks of completing the Survey Report and no later than one month before the commencement of construction.	Section 4.5
E60	Within three (3) months of the completion of construction, all property owners of buildings for which a building condition survey was carried out in accordance with Condition E59 must be offered a second building condition survey. Where an offer is accepted, building condition surveys must be undertaken by a structural engineer. The results of the surveys must be documented in a Building Condition Survey Report for each building surveyed. Copies of Building Condition Survey Reports must be provided to the owners of the buildings surveyed within one (1) month of the survey being completed.	Section 4.5

ITEM	REQUIREMENT	DOCUMENT REFERENCE
E61	The Proponent must install appropriate equipment to monitor areas in proximity to construction sites and the tunnel route during construction and for a period of not less than six (6) months after settlement has stabilised with particular reference to risk areas identified in the building and infrastructure condition surveys required by conditions E59 and E60 and/or the geotechnical analysis as required. If monitoring during construction indicates exceedance of the criteria, then all construction affecting settlement must cease immediately and must not resume until fully rectified or a revised method of construction is established that will ensure protection of affected buildings.	CEMP (Section 9.3.7 – building condition survey)
E107	The CSSI must be constructed and operated so as to maintain the NSW Water Quality Objectives where they are being achieved as at the date of this approval, and contribute towards achievement of the NSW Water Quality Objectives over time where they are not being achieved as at the date of this approval, unless an EPL in force in respect of the CSSI contains different requirements in relation to the NSW Water Quality Objectives, in which case those requirements must be complied with.	Section 4
E108	Drainage feature crossings (permanent and temporary watercourse crossings and stream diversions) and drainage swales and depressions must be undertaken in accordance with relevant guidelines and designed by a suitably qualified and experienced person.	There are no temporary or permanent watercourse crossings or stream diversions applicable to this site.

2.5 CONSTRUCTION ENVIRONMENTAL MANAGEMENT FRAMEWORK

This CGWMP has been produced to demonstrate compliance with the CEMF as summarised in Table 2.5.

Table 2.5: CEMF requirements

ITEM	REQUIREMENT	DOCUMENT REFERENCE
3.4 (a)	Subject to Section 3.3(b) and Section 3.2(b) the Principal Contractor will prepare issue specific environmental sub plans to the CEMP and SMP which address each of the relevant environmental impacts at a particular site or stage of the project. Issue specific sub plans will include: groundwater management	This plan
7.2 (b)	Principal Contractors will develop and implement a Groundwater Management Plan for their scope of works. The Groundwater Management Plan will include as a minimum:	-
	i) The groundwater mitigation measures as detailed in the environmental approval documentation;	Section 4
	ii) The requirements of any applicable licence conditions;	No EPL required
	iii) Details of proposed extraction, use and disposal of groundwater, and measures to mitigate potential impacts to groundwater sources, incorporating monitoring, impact trigger definition and response actions for all groundwater sources potentially impacted by the SSI;	Chapter 4
	iv) Evidence of consultation with the NSW Office of Water;	Section 1.5
	v) The responsibilities of key project personnel with respect to the implementation of the plan;	Section 5.1
	vi) Procedures for the treatment, testing and discharge of groundwater from the site;	Chapter 4
	vii) Compliance record generation and management; and	Section 5.7
	viii) Details of groundwater monitoring if required.	Section 4.6
7.1 (a)	The following groundwater management objectives will apply to construction:	Section 1.4
	i) Reduce the potential for drawdown of surrounding groundwater resources.	
	ii) Prevent the pollution of groundwater through appropriate controls.	
	iii) Reduce the potential impacts of groundwater dependent ecosystems.	
7.3 (a)	Examples of groundwater mitigation measures include:	-
	i) Implementing all feasible and reasonable measures to limit groundwater inflows to stations and crossovers; and	Section 3.2.1; Section 4.6.2
	ii) Undertaking groundwater monitoring during construction (levels and quality) in areas identified as ‘likely’ and ‘potential’ groundwater dependent ecosystems.	N/A- no groundwater dependent ecosystems to be impacted.

3 GROUNDWATER CONTEXT AND POTENTIAL IMPACTS

3.1 EXISTING ENVIRONMENT

The project area traverses seven regional geological units identified by the Sydney 1:100,000 Geological Sheet 9130 (Herbert, 1983). Geology at Crows Nest Station comprises fill, residual soils, Ashfield Shale, Mittagong Formation and then Hawkesbury Sandstone. The permeability of shale, siltstone and sandstone is generally low to very low, with most of the groundwater flow transmitted through joints and fractures rather than via the porous nature of the material.

There are two monitoring piezometers at Crows Nest Station:

- BH019 – 36.1 m deep, screening the residual soil unit.
- BH018 – 46.5 m deep, screening the Mittagong Formation unit.

The groundwater level at Crows Nest Station is:

- Residual soil –2.5 m below ground level (BGL).
- Ashfield Shale – 6-8 m BGL.
- Mittagong Formation – 12.9 m BGL.
- Hawkesbury Sandstone – 20 m BGL.

The predicted groundwater inflow at Crows Nest Station is 0.12 litres per second (L/s).

Groundwater that flows into existing underground structures in Sydney is generally high in iron, may contain manganese or contaminants, and has a relatively high salinity (as total dissolved salts) and a slightly acidic pH.

Groundwater is expected to be brackish within Ashfield Shale with neutral pH. Groundwater within Mittagong Formation and Hawkesbury Sandstone is expected to be fresh to brackish with neutral pH and slightly elevated levels of iron and manganese. The concentration of dissolved metals and nutrients in the Ashfield Shale, Mittagong Formation and Hawkesbury Sandstone, including residual soils, is expected to be naturally very low. Organic compounds are not naturally associated with Ashfield Shale, Mittagong Formation or Hawkesbury Sandstone.

Default water quality trigger criteria for freshwater and marine ecosystems are provided in Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000a). Measured groundwater quality, apart from pH, meets the ANZECC 95th percentile default trigger values for marine environments, with treatment (minor) required to meet ANZECC 95th percentile default trigger values for freshwater in relation to pH.

There is limited groundwater use near the project due to the presence of low permeability shale, siltstone and sandstone. There are no known groundwater users near Crows Nest Station.

3.2 POTENTIAL IMPACTS

3.2.1 Groundwater drawdown

Cut-and-cover stations, such as Crows Nest Station, would be drained structures and would have an ongoing inflow of groundwater. The target changes to groundwater levels generally aim to keep the project related changes to within natural variation of groundwater level encountered in the past. They were determined as follows:

- The two metre drawdown criteria from the NSW Aquifer Interference Policy (NSW Office of Water, 2012) (which applies, cumulatively, at nearby water supply works) was adopted as a general guide for changes at surrounding land uses.
- Recognising that the contribution of drawdown to subsidence in hard rock is minor to negligible, a four-metre drawdown was allocated to project activity at depth.
- Where masonry structures (rather than slab on ground structures) are located near to the station shafts, a 0.5 metre drawdown target was adopted for residual soils and a one metre target was adopted for Ashfield Shale and Mittagong Formation. For nearby commercial premises or high-rise residential premises (which will have foundations to competent rock) the adopted target changes are less conservative (four metres).

The target change to groundwater levels at surrounding land uses around Crows Nest Station are:

- Drained station shaft – <1.0 m (residual soil), <2.0 m (Ashfield Shale and Mittagong Formation).
- Drained station – <2.0 m (Mittagong Formation).

The station box has been previously designed and constructed to mitigate drawdown effects. In addition, the scope of work of this portion of the project is unlikely to result in groundwater drawdown as there is no requirement for bulk excavation or interaction with the aquifer and an impermeable waterproofing membrane will be installed on the walls and floor of the excavated station surface to mitigate groundwater ingress. Therefore, the existing design of the station box is expected to be effective at preventing any significant effects of drawdown on the water table.

3.2.2 Ground movement

Ground movement (or settlement) refers to a localised lowering of the ground level due to construction activities. It can affect nearby buildings and other structures. Movement typically results from either the release or redistribution of stress in rock formations during tunnelling and excavation, or from ground consolidation following the drawdown of groundwater (during construction and/or operation). Movement caused by stress redistribution in rock generally occurs shortly after excavation, while consolidation settlement from groundwater drawdown can occur over a longer period.

For the project, most of the underground excavation would be within rock that has low permeability, and it is therefore expected that settlement associated with groundwater drawdown would be minimal. Some settlement could occur as a result of groundwater drawdown associated with open excavations and this would be greatest in soft superficial surface deposits, if the perched water table is lowered.

The specific risk to buildings and structures due to ground movement depends on geotechnical conditions, distance from construction activities and building characteristics including condition and type of masonry. However, for the purposes of a screening assessment the risk-based criteria in Table have been used (Construction Industry Research and Information Association, 1996).

These criteria specify the maximum settlement of the building and the maximum slope of the ground below building foundations for each risk level. Buildings and structures assessed as having a risk level of two or greater would be subject to more detailed building strain and potentially a structural assessment later in the design process.

Table 3.2: Ground movement risk levels

RISK LEVEL	DESCRIPTION	MAX BUILDING SLOPE	MAX BUILDING SETTLEMENT (MM)
1	Negligible – superficial damage unlikely.	<1:500	<10
2	Slight – possible superficial damage which is unlikely to have structural significance.	1:500 to 1:200	10 to 50
3	Moderate – expected superficial damage and possible structural damage to buildings, and possible damage to relatively rigid pipelines.	1:200 to 1:50	50 to 75
4	High – expected structural damage to buildings, expected damage to rigid pipelines, and possible damage to other pipelines.	>1:50	>75

The assessment of potential ground movement included consideration of open-cut excavation from the surface using conventional excavation techniques.

The EIS provided three-millimetre, five millimetre and ten-millimetre ground movement contours. The three-millimetre contour defines what is considered to be the extent of the project's influence, while the ten-millimetre contour defines the point at which more detailed future assessment is required. The project site falls within the three-millimetre contour and is therefore considered to have a negligible ground movement risk, with superficial damage to buildings unlikely.

The scope of work to be completed for the project is unlikely to result in ground movement as there is no requirement for bulk excavation or interaction with the aquifer. The station box has been previously designed and constructed to mitigate ground settlement and is therefore expected to be effective at preventing any effects of potential settlement and subsequent impacts upon buildings and structures.

3.2.3 Groundwater inflow

Groundwater inflows were estimated as part of the design process. The inflow rate of 0.12 litres/second at Crows Nest Station is an indicative maximum construction related dewatering estimate (after initial works).

Based on the inflow rate, groundwater inflow or seepage of approximately 10 kL/day may be expected due to discrete geological defects encountered in the excavation (e.g. open joints).

As the station box is designed as a 'drained' structure, to alleviate water pressure on the station box, two sumps will be constructed at strategic points at the base of the station excavation. The sumps will collect water which runs off the base of the station excavation.

Groundwater inflow and surface water within the station box is not easily separated. Water collected in the sump will be pumped to the surface and managed via settling tanks and/or the existing water treatment plant (WTP) prior to discharge offsite (refer to Chapter 4).

4 GROUNDWATER MANAGEMENT

4.1 TREATMENT

As outlined in Section 3.2.3, any groundwater that seeps into the site, together with rainfall infiltration will be directed to a designated sump before being pumped to the existing above ground WTP. The existing WTP has been designed and manufactured to treat the water generated by excavation and tunnelling operations on the Crows Nest site, before being discharged into the stormwater network. The WTP has been designed specifically for ultra-filtration and the process consists of the following steps:

- Collection (and return of off-specification water) and pre-treatment.
- Ultra-filtration, chemical dosing, carbon filtering.
- Discharge of treated water to stormwater.
- Filter press, filter cake transferred to sludge bin.

As identified in Section 3.1, the water quality is expected to be fresh to brackish with neutral pH and slightly elevated levels of iron and manganese. The concentration of dissolved metals and nutrients is expected to be naturally very low. Organic compounds are not naturally associated with Ashfield Shale, Mittagong Formation or Hawkesbury Sandstone. The WTP which involves medial filtration will be utilised during construction to reduce iron and manganese concentrations prior to discharge.

The following process will be implemented during construction for water that accumulates in the sump(s):

- Water sampling and testing of water within the sumps will be undertaken during construction to determine the most suitable treatment processes to meet the required water quality standards for discharge (refer Table 4.1). Sampling and testing will be undertaken at commencement of construction and at regular intervals or as activities change.
- As outlined in Section 4.2, all feasible and reasonable opportunities for water reuse for construction purposes will be utilised in the first instance. Should water inflows and required treatment volumes be surplus to onsite construction purposes, the treated water product would be discharged into stormwater drainage as per the process outlined in Section 4.3. All accumulated water shall be treated to ensure that water quality guidelines are met, prior to re-use or discharge.

Discharges of water from the WTP will be subject to hold points and be monitored to ensure compliance with the discharge parameters (refer to Section 4.3). Water quality parameters to be periodically observed, measured, sampled and/or analysed at sumps prior to pumping to the WTP and/or settlement tanks for treatment are identified in Table 4.1. These parameters will assist with determining appropriate treatment at the WTP and/or settling tanks prior to discharge. The parameters to be assessed in the sump have been determined with reference to the ANZECC Guidelines. Quarterly grab samples will be taken from the WTP and sent to an accredited laboratory for analysis.

Table 4.1: Sump water quality criteria

PARAMETER	CRITERIA	SAMPLING METHOD	ANALYTICAL METHOD
pH	6.5 – 8.5	Probe or grab sample	Field analysis, with confirmation via NATA accredited laboratory assessment as required.
Turbidity	50 Nephelometric Tur bidity Units (NTU) (visibly clean)	Grab sample	Field analysis using either a portable probe or turbidity tube. A portable probe is preferred to a turbidity tube as the results obtained from using a turbidity tube may be limited by the variability of the eyesight of users and may not be highly accurate. Confirmation of turbidity would be supported via NATA accredited laboratory assessment as required.
Total suspended solids (TSS)*	50 mg/L	Grab sample	NATA accredited laboratory analysis Turbidity measurements may be substituted for TSS analysis provided a correlation has been established between the two parameters on a site-specific basis for the project
Oil and grease*	No visible oil or fuel (hydrocarbon) sheen	Grab sample	If oils and grease are visually evident, a sample will be forwarded to a NATA accredited laboratory for analysis
Odour, slime and scum	Free from unusual odour, coloured slime or other foamy scum	Grab sample	If odours are observed or other slime or scum visible, a sample will be forwarded to a NATA accredited laboratory for analysis

**ANZECC & ARMCANZ. 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment and Conservation Council, and Agriculture and Resource Management Council of Australia and New Zealand, Canberra.*

It should be noted that TSS is a dry weight measurement of particulate matter in the water column. Analysing TSS directly can take up to 24 hours by an approved laboratory to complete, and requires the water samples to be filtered and the resulting material to be dried and weighed. The process must be conducted under laboratory conditions and requires specialised equipment.

An alternative measure of water quality is turbidity, measured in NTU. Turbidity when compared to TSS does not always provide a good correlation with environmental impact as it is affected by individual soil type, dissolved substances (e.g. tannins), and is especially affected by dispersible soils. In contrast with TSS, NTU readings can be taken in the field in only 2-3 minutes thus reducing analysis time and increasing efficiency with which water can be discharged off-site making it a preferential method of testing in a dynamic construction environment.

Laboratory testing will be undertaken in conjunction with field testing initially prior to the operation of the WTP to establish a correlation between TSS and turbidity (NTU). The correlation between TSS and turbidity may be specific portions of the site and as such there may be multiple correlations developed depending on the discharge locations. Once the statistical correlation is established, NTU measurements will be undertaken to demonstrate that TSS is below the discharge criteria.

To ensure the ongoing accuracy of the correlation between NTU and TSS, water samples

will be collected quarterly and tested at a NATA accredited laboratory for both NTU and TSS under laboratory conditions.

4.2 REUSE

On site re-use of water detained in sumps should be considered a priority. Examples of on-site re-use include the utilisation of water for dust suppression or cooling of equipment and machinery. The re-use of accumulated water must not cause further ponding or result in surface runoff leaving the construction site, which would be considered an unauthorised discharge from site.

Any surface water which enters the excavation and comes in potential contact with groundwater will be managed as per groundwater.

The Sydney Metro Water Discharge and Reuse Procedure (March 2019) regulates both onsite reuse and offsite point source discharge. Prior to any discharge off the premises, or reuse within the premises, the water is to be tested in accordance with Section 4.3 and the Planning and Environment Manager is to sign off that the water is suitable for reuse or discharge.

4.3 DISCHARGE

Condition E107 requires the project to meet the NSW water quality objectives where they are being achieved at the date of the approval and contribute towards achievement of the NSW Water Quality Objectives over time where they are not being achieved.

The NSW Water Quality Objectives are the agreed environmental values and long-term goals for NSW's surface waters. The Objectives are consistent with the agreed national framework for assessing water quality set out in the ANZECC 2000 Guidelines. These guidelines provide an agreed framework to assess water quality in terms of suitability for a range of environmental values (including human uses).

The Water Quality Objectives provide environmental values for NSW waters and the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000) Guidelines provide the technical guidance to assess the water quality needed to protect those values. To determine the receiving water quality criteria, the ANZECC 2000 guidelines provide standardised criteria relevant to achieving the public health and environmental water quality for that water body (Sydney Harbour). Despite the ultimate receiving waters being a marine environment, the immediate receiving environment would be creeks and drainage lines following discharge to the stormwater network. As such the trigger values for lowland rivers have been adopted under ANZECC 2000.

As outlined in Section 3.1, historically measured groundwater quality, apart from pH, meets the ANZECC 95th percentile default trigger values for marine environments, with treatment (minor) required to meet ANZECC 95th percentile default trigger values for freshwater in relation to pH.

Typical water quality parameters to be measured, sampled and/or analysed at the WTP prior to discharge are identified in Table 4.1. Additional parameters to be analysed at the WTP prior to discharge are outlined in Table 4.2. These parameters have been formulated to be consistent with the EIS, water quality objectives and baseline water quality monitoring. The parameters in Table 4.1 and 4.2 form the discharge criteria for the project and all water to be discharged to the stormwater network must meet these criteria, with evidence documented prior to discharge.

The trigger values specified in Table 4.2 are generally set as the 80th percentile of the median background value. Trigger values may be updated to reflect ongoing groundwater data collection as required.

Quarterly grab samples will be collected from the WTP as per the previous Sydney Metro contractor and analysed at a NATA accredited laboratory against the historical baseline water quality monitoring data.

It is an offence under section 120 of the POEO Act to pollute waters. The project does not trigger an Environment Protection Licence and therefore the water quality criteria adopted for the project are per the EIS, NSW Water Quality Objectives, ANZECC guidelines, Blue Book and Sydney Metro Water Discharge and Reuse Procedure.

Table 4.2: Discharge water quality criteria

PARAMETER	WATER QUALITY OBJECTIVE TRIGGER VALUE
Total phosphorus	25 ug/L
Total nitrogen	350 ug/L
Dissolved oxygen	85 – 110%
Electrical conductivity	125 - 2200 µS/cm
Chlorophyll-a	5 ug/L

In addition to the above parameters, the following analytes would also be analysed at a NATA accredited laboratory. The results would be compared against historical grab sample data obtained by the previous Sydney Metro contractor (refer to Section 4.6) to ensure that water quality remains consistent and is not detrimentally affected by A W Edward's work activities.

- Copper (mg/L)
- Lead (mg/L)
- Iron (mg/L)
- Manganese (mg/L)
- Zinc (mg/L)
- Nickel (mg/L)
- TRH -C10 -C14 (ug/L)
- OCP -Endosulfan I (ug/L)
- OCP -Endrin (ug/L)
- VOC - 1,1,2 - Trichloroethane (ug/L)
- VOC - Styrene (mg/L)
- VOC - 1,2,4 - Trichlorobenzene (mg/L)
- BTEX Benzene (mg/L)
- PAH Naphthalene (mg/L)

It should be noted that, compliance with the criteria in Table 4.1 and 4.2 does not provide a defence to an alleged breach of section 120 of the POEO Act if other pollutants are determined to have been discharged. For example, water discharged with TSS below 50 mg/L may still cause pollution and breach section 120 of the POEO Act, if the receiving waters have a TSS less than 50 mg/L at the time the discharge occurs.

4.4 CONTINGENCY MEASURES

If the WTP is unavailable, offline or decommissioned, contingency measures would be implemented for discharge water as outlined below:

- The Linewide contractor would provide a discharge point for water to be discharged into the rail tunnel system for transportation and treatment at Chatswood by the Linewide contractor.
- A W Edwards would direct all accumulated water into a centralised sump adjacent to the discharge point for subsequent discharge.
- Prior to discharge, A W Edwards would test the water against the parameters nominated in Table 4.1. If the water complies with these water quality criteria, the water would be discharged into the rail tunnel system for transportation and treatment by the Linewide contractor at Chatswood.
- The Linewide contractor would be responsible for the subsequent treatment and ultimate discharge of the water to the stormwater network. It is assumed by A W Edwards the Linewide contractor would accept full responsibility for the discharge water and treatment would be undertaken as required to ensure that subsequent discharge of the water by the Linewide contractor is compliant with the water quality objectives set forth in Table 4.1 and 4.2 and all CoA and project approval requirements.

4.5 GROUNDWATER DRAWDOWN IMPACTS

Before commencement of construction, all property owners of buildings identified as being at risk of damage will undergo a building condition survey in accordance with CoA E59. Appropriate monitoring equipment will be installed in proximity to the construction site in areas of risk as identified by the geotechnical analysis in accordance with CoA E61. Refer to Section 9.3.7 of the CEMP for details. A building condition survey will be offered to property owners who accepted the offer for an initial survey within 3 months of construction completion in accordance with CoA E60.

An Independent Property Impact Assessment Panel will be established in accordance with CoA E62 with geotechnical engineers and engineering experts who will verify the condition surveys carried out and resolve any property damage disputes associated with construction. Monitoring which occurs as part of CoA E61 will be carried out in a timeframe determined by the Independent Property Impact Assessment Panel in accordance with CoA E63.

4.6 WATER MONITORING

A construction groundwater monitoring program will be implemented to monitor potential impacts to groundwater during construction. The groundwater monitoring program will also measure the effectiveness of the mitigation measures applied as part of the project.

Consultation with DPIE Water regarding the construction groundwater monitoring program has been in accordance with C9.

The below method describes the program to comply with CoA C10, being that the groundwater monitoring program is to compare actual performance against predicted performance.

4.6.1 Background data and baseline monitoring

A W Edwards has reviewed the available baseline groundwater monitoring data reported in the EIS and from previous Sydney Metro Contractors.

Based on the information available, the average standing groundwater level for BH018 and BH019 are:

- BH018 – 77.67 m AHD; and

- BH019 – 78.02 m AHD.

These two groundwater monitoring locations will not be impacted during construction and will continue to be sampled as required. These groundwater levels are the adopted project groundwater baseline levels.

Previous contractors undertook water quality monitoring data for samples taken from the WTP prior to discharge for the following parameters: pH, turbidity and a visual inspection for the presence of oil and grease. The results of this baseline water quality monitoring is reported in Table 4.3 and is the basis of parameters that will be sampled prior to discharging any treated water.

Table 4.3: Baseline Water Quality Monitoring Data

Date Sampled	pH	Turbidity	Oil/Grease (Y/N)	Compliant (Y/N)
12-Feb-18	7.8	1.7	N	Compliant
28-Feb-18	8	25	N	Compliant
13-Jun-18	6.5	10.0	N	Compliant
21-Jun-18	6.7	20.0	N	Compliant
22-Jun-18	6.5	0.5	N	Compliant
29-Jun-18	6.5	0.5	N	Compliant
02-Nov-18	7.3	2.3	N	Compliant
28-Nov-18	N/A	N/A	N	Compliant
11-Dec-18	7.7	1	N	Compliant
08-Jan-19	7.70	1.3	N	Compliant
04-Feb-19	7.7	1.3	N	Compliant
01-Mar-19	7.7	1.3	N	Compliant
04-Apr-19	7.7	1.3	N	Compliant
06-May-19	7.6	1.5	N	Compliant
03-Jun-19	7.6	1.5	N	Compliant
30-Jul-19	7.8	<1	N	Compliant

Water quality monitoring data for event-based grab samples taken from receiving waters was recorded in Q2 and Q4 of 2018 and Q1 and Q2 of 2019. The grab samples taken from the receiving waters were tested for a suite of parameters which are reported in Table 4.4.

Table 4.4: Grab Sample Water Quality Data

Parameter	2019				2020	
	Q1	Q2	Q3	Q4	Q1	Q2
TSS (mg/L)		<5		<5	8	<5
pH		6.5		7.3	7.5	7
Copper (mg/L)		<0.01		<0.01	0.002	0.002
Lead (mg/L)		<0.03		<0.03	<0.001	<0.001
Iron (mg/L)		0.2		0.05	Not analysed	<0.05
Manganese (mg/L)		0.02		0.01	Not analysed	<0.005
Zinc (mg/L)		<0.02		<0.02	0.021	<0.005
Nickel (mg/L)		<0.02		<0.02	0.017	<0.001

TRH -C10 -C14 (ug/L)					<50	<50
OCP -Endosulfan I (ug/L)					<0.1	<0.1
OCP -Endrin (ug/L)					<0.1	<0.1
VOC - 1,1,2 - Trichloroethane (ug/L)					<1	<1
VOC - Styrene (mg/L)					<1	<1
VOC - 1,2,4 - Trichlorobenzene (mg/L)					Not analysed	<0.005
BTEX Benzene (mg/L)					<1	<1
PAH Naphthalene (mg/L)					<10	<1

The baseline data reviewed to date is comprehensive and relevant. The station is also not impacting groundwater levels and has no groundwater outflows other than through groundwater which may collect in the sump and mix with rainwater before being pumped to the WTP. A W Edwards therefore does not intend to obtain any additional baseline data prior to commencing construction.

4.6.2 Construction groundwater monitoring

The standing groundwater levels at piezometers BH018 and BH019 will be monitored every month for the duration of construction to monitor for potential groundwater drawdown and settlement which may arise from the project.

An impermeable waterproof membrane will be installed during the very early stages of construction, mitigating potential negative water quality interactions with the aquifer. A W Edwards therefore does not propose undertaking external groundwater quality sampling. Water which collects in the sumps at the bottom of the station “box” will be regularly sampled for pH, turbidity, TSS, oil and grease, odour, slime and scum.

Data from the construction groundwater monitoring will be compared against the findings of the previous baseline groundwater data. If groundwater drawdown risks/impacts to the surrounding environment are identified, the groundwater monitoring program will be amended as appropriate. This will include where necessary, the installation of new groundwater monitoring wells.

The construction groundwater monitoring program will inform additional contingency measures to appropriately in vestigate/model and subsequently manage any emerging impacts identified during construction works. This could include measures, such as drawdown minimisation at the site by increased grouting of seepage points.

Monitoring reports will be reviewed by the Planning and Environmental Manager, Sydney Metro, and the Independent ER and issued to DPIE, DPIE Water, EPA and North Sydney Council for information every six months.

5 COMPLIANCE MANAGEMENT

5.1 ROLES AND RESPONSIBILITIES

The overall roles and responsibilities for A W Edwards personnel are outlined in Chapter 4 of the CEMP. Responsibilities for the implementation of groundwater mitigation measures are detailed in Table 5.1 below.

Table 5.1: Roles and responsibilities

ROLE	RESPONSIBILITY
Project Director	Managing the delivery of the project including overseeing implementation of groundwater management measures.
Planning and Environment Manager	Oversee the implementation of all groundwater management initiatives. Responsible for managing ongoing compliance with the CoA and environmental document requirements. Manage the on-ground application of groundwater management measures during construction. Monitor and report on groundwater management during construction.
Construction Manager, Site Manager and Foreman	Ensure that relevant groundwater management requirements are considered in procuring materials and services. Manage the delivery of the construction process, in relation to groundwater management across all sites in conjunction with the Planning and Environment Manager.
Project Engineer	Implement groundwater management activities during construction works.

5.2 TRAINING

All employees, contractors and staff working on site will undergo site induction training relating to groundwater management issues, including:

- Requirements of this CGWMP;
- Relevant legislation;
- The use of sampling equipment;
- Water sampling and subsequent determination of re-use options and/or discharge;
- Roles and responsibilities for groundwater management; and
- Disciplinary action around non-compliance with this plan.

Further details regarding staff induction and training are outlined in Chapter 8 of the CEMP.

5.3 MONITORING AND INSPECTIONS

General requirements and responsibilities in relation to inspections and compliance monitoring are documented in Chapter 9 of the CEMP. Routine environmental inspections will include determination of compliance with this CGWMP.

Groundwater aspects will be inspected as follows:

- Daily inspections of sumps by the Foreman for visible indicators of contamination (e.g. oil sheens, odours).
- Weekly inspections, including groundwater management controls, will be documented on the Hazard and Observation Sheet (SE6301).
- Inspections by the ER.

A summary of groundwater monitoring requirements established by this CGWMP is as follows:

- Periodic water quality sampling from the sumps and/or settling tanks prior to pumping to the WTP to determine adequate treatment options prior to re-use and/or discharge (refer to Section 4.1).
- Water quality from the WTP for physical and chemical parameters to confirm NSW water quality objectives are being achieved as required by CoA E107. Laboratory samples will be sent to a NATA accredited laboratory (refer to Section 4.3).
- Site specific water quality objectives will be confirmed during the commissioning of the WTP which will occur once access to the site is granted by Sydney Metro.
- The WTP monitors pH and turbidity continuously. Following commissioning, laboratory samples of discharge water will be collected on a quarterly basis or when construction activities change that have the potential to impact on water quality. The results will be compared with the NSW water quality objectives established for the site (refer to Table 4.2). This analysis will confirm that the water discharged has not resulted in pollution of waters as required by Section 120 of the POEO Act.
- Groundwater levels will be monitored using the nearest existing piezometers to the site previously installed by the Sydney Metro and monitored by the previous Sydney Metro Contractor. The monitoring will determine any potential for groundwater drawdown associated with the project, and potential for any damage to occur as a result of settlement. If groundwater drawdown is observed, further contingency measures would be appropriately investigated and subsequently manage any emerging impacts identified during construction works (refer to Section 4.7.2)

Every month the Planning and Environmental Manager will provide the results from construction groundwater monitoring to Sydney Metro and the Independent ER.

Every six months the Planning and Environmental manager will prepare and issue a construction groundwater monitoring report to DPIE, DPIE Water, EPA and North Sydney Council for information every six months.

Environmental reporting will be in accordance with Sydney Metro City & Southwest Environmental Reporting Template SM ES-FT-421. Additional reporting requirements are in the CEMP.

5.4 NON-CONFORMANCES

Non-conformances will be identified, managed and documented in accordance with Section 9.4 of the CEMP.

Any non-compliances arising out of the above monitoring, inspections and audits would be made aware to Sydney Metro, the Independent ER and DPIE Water. A review of the appropriate documentation would be undertaken by A W Edwards management to determine the\corrective actions to ensure the non-compliance does not happen again.

Sydney Metro, the Independent ER and DPIE Water will be notified of any non-compliances and emerging impacts identified in the monitoring data as soon as practical, and will be reported in the Independent ER monthly reports that are submitted to DPE.

A register would also be kept, identifying any non-compliances and documenting the corrective and preventative actions.

5.5 COMPLAINTS

Complaints will be recorded and addressed in accordance with Section 7.4.2 of the CEMP and the Community and Stakeholder Engagement Plan.

5.6 AUDITS

Audits (both internal and external) will be undertaken to assess the effectiveness of management and mitigation measures, compliance with this plan, planning approval conditions and relevant guidelines. Audit requirements are detailed in Section 9.3 of the CEMP.

5.7 RECORD MANAGEMENT

Compliance records would be maintained as detailed in Section 11.2 of the CEMP and may include the following aspects regarding groundwater management:

- Monitoring records from the WTP.
- Records of groundwater inspections.
- Observations and works to repair and/or maintain groundwater management works.
- Records of testing of any water prior to discharge.
- Records of the release of the hold point to discharge water from the construction site to the receiving environment.
- Records for contamination management – groundwater monitoring results, disposal dockets, remedial action plans, occupational hygienist clearances, and site auditor sign-offs (where required).

The above records will be made available to Sydney Metro.

5.8 HOLD POINTS

Prior to the re-use or discharge of any water, appropriate water quality testing is to be carried out and the Planning and Environment Manager or delegate will verify compliance and approval to re-use and/or discharge the water.

6 REVIEW AND IMPROVEMENT

The CGWMP will be reviewed annually to ensure compliance with legislative requirements and its suitability and effectiveness for the project.

The review may be in the form of:

- A formal management review;
- A second party audit; and/or
- Inclusion as a separate item at a site meeting.

The Planning & Environmental Manager may review and update the plan more regularly where:

- Significant changes in design or construction activities occur;
- Where targets are not being achieved; or
- In response to lessons learned, audits and non-conformity reports.

Any changes to the CEMP and sub-plans may be approved by the independent ER where they are only minor amendments, significant changes will need to be consulted on with relevant stakeholders and approved by the secretary.

AW EDWARDS

APPENDIX A – WATER DISCHARGE AND REUSE PROCEDURE

Water Discharge & Reuse Procedure

SM-17-00000098

Sydney Metro Integrated Management System (IMS)

Applicable to:	Sydney Metro
Document Owner:	Manager, Environment
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1. Purpose & Scope

The purpose of this Procedure is to provide guidance to site personnel for managing, discharging and reusing excess water on Sydney Metro construction sites. This Procedure includes references to relevant industry guidelines but is not intended to replace them, nor does it override the relevant legislative and regulatory requirements.

Principle Contractors may be required to develop their own procedure that is consistent with this document via clause 3.1(f) of the Construction Environmental Management Framework (CEMF).

2. Accountabilities

The Executive Director, Safety, Sustainability & Environment is accountable for this Procedure. Accountability includes authorising the document, monitoring its effectiveness and performing a formal document review.

Direct Reports to the Chief Executive are accountable for ensuring the requirements of this document are implemented within their area of responsibility.

The Direct Reports to the Chief Executive who are accountable for specific projects/programs are accountable for ensuring associated contractors comply with the requirements of this document.

3. Definitions

All terminology in this Procedure is taken to mean the generally accepted or dictionary definition. Terms and jargon specific to this Procedure are defined within the Sydney Metro Glossary, or are listed below.

	Definitions
The Blue Book	*Managing Urban Stormwater: Soils & Construction* 2004, Landcom.
CEMP	*Construction Environmental management plan*
Environment Manager	Contractor Environment Manager.
EPA	NSW Environment Protection Authority
EPL	Environment protection licence issues in accordance with the POEO Act by the EPA
pH	The measure of the acidity or alkalinity of a solution.
POEO Act	Protection of the Environment Operations Act 1997.
NATA	National Association of Testing Authorities, Australia
NTUs	Nephelometric turbidity units
TSS	Total Suspended Solids.
Waters	(as defined in the POEO Act) means the whole or any part of: a) any river, stream, lake, lagoon, swamp, wetlands, unconfined surface water, natural or artificial watercourse, dam or tidal waters (including the sea), or b) any water stored in artificial works, any water in water mains, water pipes or water channels, or any underground or artesian water.

Water pollution or Pollution of waters	As defined in the POEO Act water pollution or pollution of waters means: a) placing in or on, or otherwise introducing into or onto, waters (whether through an act or omission) any matter, whether solid, liquid or gaseous, so that the physical, chemical or biological condition of the waters is changed, or b) placing in or on, or otherwise introducing into or onto, the waters (whether through an act or omission) any refuse, litter, debris or other matter, whether solid or liquid or gaseous, so that the change in the condition of the waters or the refuse, litter, debris or other matter, either alone or together with any other refuse, litter, debris or matter present in the waters makes, or is likely to make, the waters unclean, noxious, poisonous or impure, detrimental to the health, safety, welfare or property of persons, undrinkable for farm animals, poisonous or harmful to aquatic life, animals, birds or fish in or around the waters or unsuitable for use in irrigation, or obstructs or interferes with, or is likely to obstruct or interfere with persons in the exercise or enjoyment of any right in relation to the waters, or c) placing in or on, or otherwise introducing into or onto, the waters (whether through an act or omission) any matter, whether solid, liquid or gaseous, that is of a prescribed nature, description or class or that does not comply with any standard prescribed in respect of that matter, and, without affecting the generality of the foregoing, includes: d) placing any matter (whether solid, liquid or gaseous) in a position where: i. it falls, descends, is washed, is blown or percolates, or ii. it is likely to fall, descend, be washed, be blown or percolate, into in to any waters, onto the dry bed of any waters, or into any drain, channel or gutter used or designed to receive or pass rainwater, floodwater or any water that is not polluted, or e) placing any such matter on the dry bed of any waters, or in any drain, channel or gutter used or designed to receive or pass rainwater, floodwater or any water that is not polluted, if the matter would, had it been placed in any waters, have polluted or have been likely to pollute those waters.

4. Water Discharge and Reuse Procedure

4.1. Water Management

During construction there is the potential for sediment laden water to be generated on construction sites. In particular in areas where there is no ground cover, where earthworks have been carried out and in low lying points on the site. It is essential that this sediment laden water is contained and managed on site through suitable erosion and sediment controls and only discharged once it has been treated and tested to ensure there is no harm caused to surrounding waterways and ecosystems.

4.2. Legislative Requirements

The Protection of the Environment Operations Act 1997 (POEO Act) is the key piece of environmental legislation in NSW administered by the Environment Protection Authority (EPA). Offences under this Act are classified into three tiers, with Tier 1 offences being the most serious – attracting up to $5 million in the case of a corporation and $1 million for an individual and seven years imprisonment for wilful or negligent harm to the environment.

Table 1: POEO classification of offences

Classification of offence	Description
Tier 1	These offences are the offences under Part 5.2 of the POEO Act 1997 and. include the wilful or negligent disposal of waste causing or likely to cause harm to the environment (section 115), wilfully or negligently causing a substance to leak, spill or otherwise escape in a manner that harms or is likely to harm the environment (section 116), and the wilful or negligent emission of an ozone-depleting substance in breach of the Ozone Protection Regulations in a manner that harms or is likely to harm the environment (section 117).
Tier 2	Tier 2 offences are all other offences under this Act or the regulations. This includes carrying out a scheduled activity without an environment protection licence (EPL) (section 49(2)), failing to comply with a condition of an EPL (section 64(1), pollution of waters (section 120) and failing to notify a pollution incident (section 152). The maximum penalties for the Tier 2 offence of failing to notify a pollution incident are $2 million in the case of a corporation and $500,000 in the case of an individual. The maximum penalties for Tier 2 offences other than failure to notify pollution incidents are $1 million in the case of a corporation and $250,000 in the case of an individual. Further daily penalties apply to continuing offences.
Tier 3	Tier 3 offences are tier 2 offences that may be dealt with under Part 8.2 by way of penalty notice

Under section 120 of this Act, any unlicensed water pollution event, no matter how minor, is illegal It is a defence against prosecution under section 120 of the POEO Act if the pollution was regulated by an Environment Protection Licence (EPL) and the conditions of that EPL relating to pollution of waters were not contravened. In the absence of any specific EPL provision, however, to avoid causing pollution and breaches of Section 120, any water discharged from site must be of the same quality, or better, than the quality of the receiving waters at the time of discharge.

Offences attracting special executive liability are dealt with under Section 169 of the POEO Act. Section 169 specifically states that if a corporation wilfully or negligently causes any substance to leak, spill or otherwise escape (whether or not from a container) in a manner that harms or is likely to harm the environment or pollutes any waters each person who is a director of the corporation or who is concerned in the management of the corporation is taken to have contravened the same provision, unless the person satisfies the court that the person, if in such a position, used all Due Diligence to prevent the contravention by the corporation.

4.3. Water Management and Discharge

It is essential that the quality of the receiving waters is established through background monitoring and sampling, prior to any discharge from site, so that the potential impact of discharge water can be determined. Monitoring of the receiving waters must be undertaken prior to any land disturbance works (to establish a baseline) as well as during construction.

It is also essential that water management standards, and particularly erosion and sediment controls, are implemented to control and treat water. Landcom's Managing Urban Stormwater: Soils & Construction 2004 (The Blue Book) is considered a best practice guideline for erosion and sediment control on construction sites in NSW. If implemented, The Blue Book will help mitigate the impacts of land disturbance activities on soils, landforms and receiving waters and minimise the potential for water pollution events to occur.

The Water quality criteria and testing and treatment techniques in this procedure are based on The Blue Book. However, compliance with The Blue Book does not, of itself, provide any defence to an alleged breach of section 120 of the POEO Act. Examples of situations where compliance with The Blue Book could still lead to a breach of section 120 are as follows:

- Water discharged with TSS below 50mg/L may still cause pollution and breach section 120, if the receiving waters have a TSS less than 50mg/L at the time the discharge occurs.
- Appropriate erosion and sediment controls are in place, but a rainfall event occurs beyond the design capacity of those controls.
- Should a water pollution incident occur, being able to demonstrate due diligence in the implementation of environmental controls, and particularly erosion and sediment controls, may provide a defence against prosecution. Due diligence may be recognised if the proponent is able to demonstrate that erosion & sediment controls have been implemented in accordance with the requirements of The Blue Book. The Contractor must satisfy itself that appropriate management controls have been developed, implemented, maintained and documented to establish a due diligence defence.

All water discharges must be documented using the Water Discharge or Reuse Approval Form or site-specific equivalent. Discharge is not permitted until the Contractor Environment Manager or nominated representative has signed the discharge form. Note that in some cases the Sydney Metro Manager Environment or the Environmental Representative may be required to sign off the discharge form.

This procedure is not used for discharging water where the activity is covered by an EPL. The licence holder will have their own procedure covering the process for discharging water that addresses any site specific environmental conditions.

4.4. Requirements for Discharge to Waters

Water to be discharged must be tested and, if required, treated to ensure that it meets water quality criteria and that pollution of the receiving waters does not occur. Results of testing and details of any treatment undertaken must be noted on Water Discharge or Reuse Approval Form.

Note that an EPL may authorise discharge of water from specific locations or premises, and establish criteria that differ from those given in this Procedure. In such circumstances the EPL, and any conditions and criteria of that EPL, take precedence over this Procedure. Before water can be discharged to any receiving waters (whether on or off site), it must as a minimum meet the following criteria.

Table 2: Criteria for Discharge to Waters

Parameter	Criterion	Method	Time prior to discharge
Oil and grease	No visible	Visual inspection	< 1 hour
pH	6.5-8.5	Probe/meter [1]	< 1 hour
Total Suspended Solids (TSS)	< 50mg/L [2]	Meter/grab sample [3]	< 1 hour/< 24 hours

If the criteria above are not met, the water will have to be treated and retested prior to discharge (see Water Management and Discharge). If all criteria above are met then the water may be authorised for discharge by the Manager Environment (refer to Calibration).

Table 3: Salinity and TSS

1. Salinity	Salinity is determined by measuring the electrical conductivity (EC) of the water, using a meter. Setting an acceptable criteria range for salinity of discharge water is dependent on the salinity of the receiving waters and must be determined and applied on a site-specific basis following background water quality monitoring. Measuring discharge waters for salinity shall only be undertaken if required by: • the Conditions of Approval; • an EPL; or • the particular conditions of the site (soil or geology) or the receiving waters.
2. Correlating Total Suspended Solid (TSS) with Turbidity	• Consideration may be given to establishing a site-specific relationship between total suspended solids concentration (TSS) and turbidity, measured in nephelometric turbidity units (NTU). This allows the TSS to be inferred from an NTU reading. The benefit of using NTU is that it can be quickly measured on site with a hand-held meter, whereas water quality meters that measure TSS are expensive and the results from samples sent for laboratory analysis will not be available immediately. However, the relationship between TSS and NTU is highly dependent on soil type and site activities (i.e. earthmoving, extractive works, rock cutting or grinding) and NTU is affected by factors other than suspended solids, such as colour (e.g. tannins may alter the NTU reading). • As such, a correlation curve (i.e. across a range of readings) must be determined between TSS and NTU that is specific to the site and cannot be applied to other sites. The correlation must be determined via laboratory analysis, by a NATA-accredited laboratory. Thorough records of the site-specific correlation must be kept, and any recommendations and/or limitations should be documented as part of the CEMP (For further information and guidance on correlating TSS with NTU refer to Appendix E of *The Blue Book*.).

[1] Litmus paper and pool testing kits are not to be used.
[2] As discussed in Section 4, a more stringent TSS criterion may need to be adopted in certain situations.
[3] Samples must be analysed at a NATA accredited laboratory.

4.5. Calibration

The goal of calibration is to minimise any measurement uncertainty by ensuring the accuracy of testing equipment which may drift over time. To be confident in the results being measured there is an ongoing need to service and maintain the calibration of equipment for reliable, accurate and repeatable measurements.

Due to the variety of water quality instruments available, it is not practical to provide instrument specific advice on storage, calibration and maintenance in this procedure. Before taking an instrument into the field, the operator should be familiar with the contents of the operating manual for that specific instrument, and ensure that it is stored, calibrated, maintained and used as per manufacturer's instructions. Detailed records of calibration and maintenance must be kept.

4.5.1. Treating Water Prior to Discharge

In order to meet EPA guidelines, TSS, pH levels and oil and grease must meet the required levels listed in table 4 below. Further water treatment may be required for other impurities not listed which may exist due to soil contamination or other factors. Based on the volume of water output and levels of contamination, methods used to treat water can vary in complexity and should be risk assessed and implemented by a competent person.

Best practice methods for water treatment of stormwater for construction sites can be found in Managing Urban Stormwater Soils and Construction Volume 1 (the Blue Book). The method for water treatment selected by the contractor must be documented in a procedure which includes any relevant Safety Data Sheets and safe handling and storage requirements for the substances used. All hazardous substances and contaminants must be subject to a health risk assessment. For further details please refer to the Principal Contractor Health and Safety Standard for occupational health and hygiene requirements.

Table 4: Treating water to discharge

1. Oil and grease	• Examine surface of water immediately prior to discharge for evidence of oil and grease (e.g. sheen, discolouration).
2. pH Levels	• If pH is outside the range 6.5-8.5 the water will need to be neutralised. • Re-test the water pH following treatment – repeat as necessary, until the acceptable pH 6.5 – 8.5 range is reached.

3. Total Suspended Solids (TSS)	• If TSS are greater than 50mg/L, the sediments need to settle to the bottom or be removed. This can be achieved via the following methods:
	  ○ Natural settlement – this could take a long time or not occur at all (e.g. with dispersible clay soils). dependent on soil type and other characteristics, (refer to *The Blue Book*, Chapter 3 for further information).
	  ○ Flocculation – chemical treatment with a flocculant (e.g. gypsum). If the flocculant is being applied manually, an even application over the surface of the water is essential. If an automated dosing basin is used other flocculants such as Polyaluminium Chloride (PAC) and alum (aluminium sulphate) might also be suitable for use in this system. Only environmentally safe flocculants are to be used, based on the Environment Manager's review of Safety Data Sheet (SDS) information.
	  ○ Filtration – pumping or gravity feeding the water through a filter medium (e.g. geofabric) to another storage area (e.g. container or sediment basin) to remove sediment. The filter medium should be disposed of to a suitable facility.
	• Re-testing of water is required once treatment has been undertaken to ensure criterion for TSS is met.

Following treatment and retesting to ensure compliance with the criteria the water may be authorised for discharge by the Environment Manager (see section 4.5).

4.6. Requirements for Discharge to Land

The objective of discharging water to land (within the site boundary) is to allow the water to infiltrate into the ground, thus avoiding direct discharge to, or pollution of, waters. Any suspended solids in the water are deposited either on the surface or retained in underlying soil layers, so the TSS criterion does not apply. However, to avoid impacts to vegetation or soil contamination pH testing and a visual inspection for oil or grease must be undertaken (refer to Criteria for Discharge to Waters for criteria and testing methods).

4.6.1. Determining a Suitable Discharge Location

Consideration must be given to the following factors when determining a suitable offsite location:

(a) Direction of groundwater flow – recharging groundwater that will subsequently flow either back onto site, into excavations or low lying areas should be avoided. This information should be available in the contamination site investigation reports and groundwater monitoring data if undertaken as part of planning approval.

(b) Erosion – the receiving area must have complete groundcover (e.g. grass) and established vegetation to minimise the risk of erosion. Guidance on best practice for reducing the risk of erosion can be found in Managing Urban Stormwater available here: https://www.environment.nsw.gov.au/resources/water/BlueBookVol1.pdf.

(c) Flora and fauna – water must not be discharged to areas where there is potential to have an adverse effect on any flora or fauna species. Information on ecological surveys for flora and fauna can be found in the Environmental Impact Statement and the Fauna and Flora Management Plan.

(d) Flooding – the receiving area must have the infiltration capacity to receive the volume of water to be discharged, without causing flooding or significantly increasing the risk of flooding should subsequent rainfall occur. This information can be found in the Flood Modelling undertaken for the Environmental Impact Statement.

4.6.2. Criteria for Discharge to Land

Discharge to land within the site boundary shall only occur if:

(a) There is no visible oil or grease (otherwise treat in accordance with Treating Water Prior to Discharge).

(b) The pH levels are between 6.5 and 8.5 (otherwise treat in accordance with Treating Water Prior to Discharge).

(c) No surface runoff will be generated from the discharge and there is no potential for discharged water to reach any watercourse (within or outside the site).

(d) No erosion is caused from the discharge and appropriate erosion and sediment control are installed in accordance with *The Blue Book*.

(e) All discharge water can be wholly contained within the site boundary.

If all criteria above are met then the water may be authorised for discharge to land by the Environment Manager – go to Reuse on Site.

4.7. Reuse on Site

Water may be reused on site, for example, for dust suppression, to assist with compaction or for watering landscape/bush regeneration areas. As with discharges to land, the TSS criterion does not apply as water will not be discharged to any watercourse. However, pH testing and a visual inspection for oil or grease must be undertaken (refer to Criteria for Discharge to Waters see section 4.4.1.1for criteria and testing methods).

4.7.1. Criteria for Reuse on Site

Reuse on site shall only occur if:

(a) There is no visible oil or grease (otherwise treat in accordance with Treating Water Prior to Discharge.

(b) The pH levels are between 6.5 and 8.5 (otherwise treat in accordance with Treating Water Prior to Discharge).

(c) No erosion is caused from the discharge.

(d) Any runoff generated by the reuse is controlled entirely within the site boundary and appropriate sediment controls are installed and maintained in accordance with *The Blue Book*.

If all criteria above are met then the water may be authorised for reuse by the Environment Manager – go to Reuse on Site.

4.8. Discharging Water

Once water has been tested and meets all the criteria for discharge to either waters or land, or for reuse on site, the Nominated Representative must authorise the discharge by signing the Water Discharge or Reuse Approval Form. If required, the Sydney Metro Manager Environment or the Environmental Representative may also sign off the form prior to commencing the discharge.

Discharge can use a siphon system or a pump, with a priority on delivering low energy flows to downstream drainage lines, watercourses or land. The flow from the outlet must be directed onto a non-erodible surface or material and, for discharges to waters, sufficient energy must be dissipated before the flow enters the natural watercourse to ensure no erosion shall occur.

The pump inlet must be placed so that it will not disturb or take in any sediment or sediment laden water. The discharge must be monitored throughout to ensure that the water being syphoned or pumped:

- Complies with the discharge criteria.
- Does not come into contact with any soil or exposed surfaces before discharging.

- Does not mix with any sediment laden/untested water at either the inlet or outlet.

Water must never be discharged or reused onsite in a manner that exceeds the capacity of sediment controls and/or generates runoff with the potential to discharge from site.

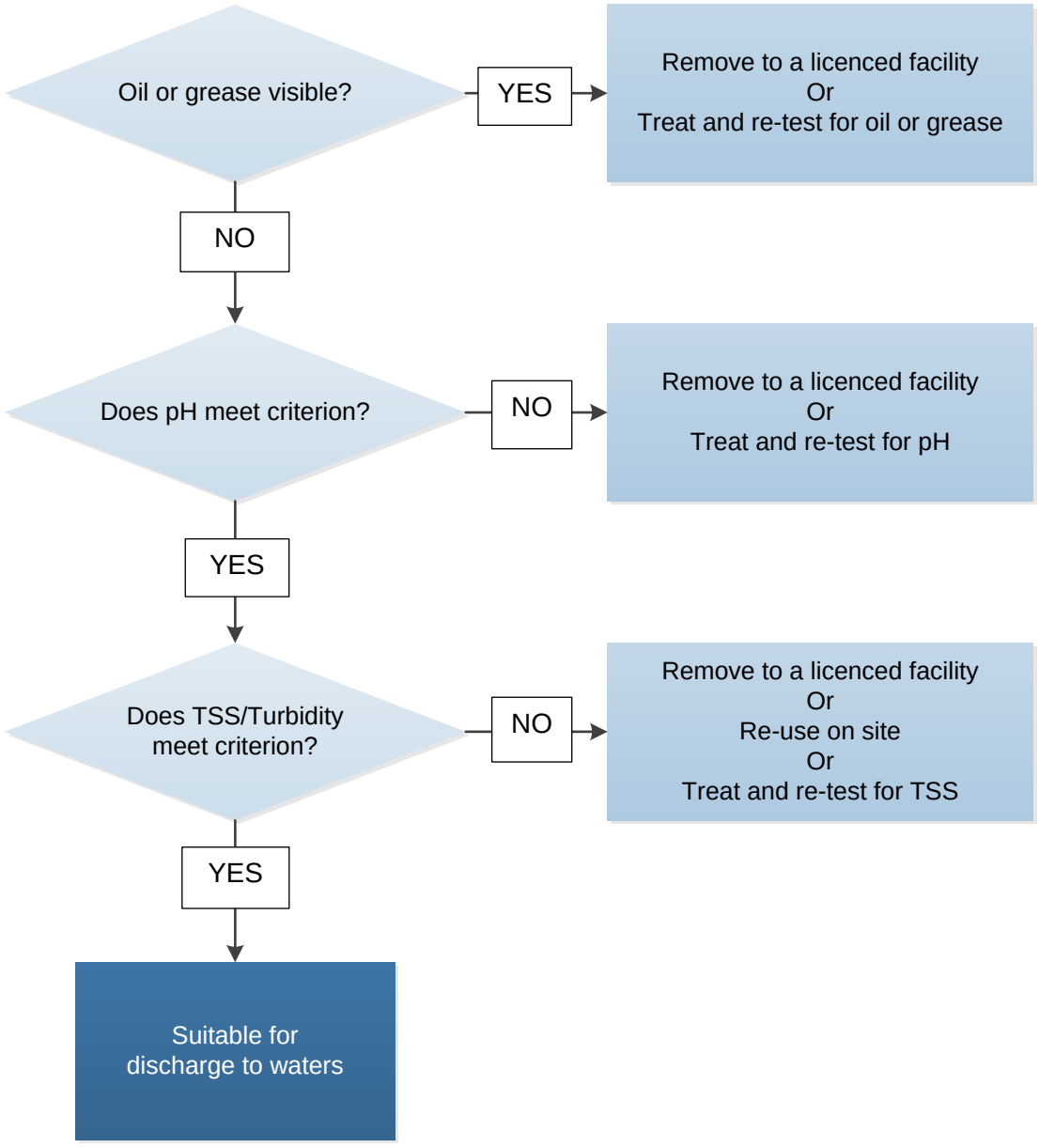

Figure 1: Process for testing water to determine options for removal, reuse, treatment or discharge

4.8.1. Monitoring and Maintenance

All sediment controls or areas that store water must be inspected to assess their integrity and capacity, as a minimum at the following times:

- Weekly during dry weather;
- Prior to forecast rainfall events; and
- During rainfall events (as often as possible), within 24 hours or as soon as possible following a rainfall event when the site is unattended (e.g. on weekends).

During any offsite or onsite discharge, regular monitoring must occur to ensure compliance with the requirements specified in this Procedure.

All rain event data shall be recorded for the site, including rainfall quantities from each rain event. Rainfall data should be gathered from the nearest monitoring station to the project.

4.8.2. Record Keeping

Records of all water discharges must be documented using the Water Discharge or Reuse Approval Form or site-specific equivalent. Records of all monitoring and maintenance measures must also be kept, on the site-specific environmental inspection checklist and other relevant document(s) (e.g. Site Foreman's diary).

5. Related documents and references

Related Documents and References
• Sydney Metro Environment and Sustainability Policy • Construction Environmental Management Framework • Water Discharge or Reuse Approval Form • Due Diligence Standard (TBC)

6. Superseded documents

Superseded Documents
There are no documents superseded as a result of this document.

7. Document history

Version	Date of approval	Notes
1.0	31 March 2015	New document.
2.0	7 July 2016	IMS Review.
3.0	27 March 2019	IMS Review.