PROJECT MANAGEMENT PLAN

Groundwater Management Plan

Sydney Metro West – Western Tunnelling Package

ISSUE DATE: MAY 2025

Document Details

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Signature	Signature	Signature
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DOCUMENT CONTROL

The current document version number and date of revision are shown in the document footer. All changes made to the Management Plan during its implementation on a live project are to be recorded in the amendment tables below.

Revision History

Revision	Date	Description of changes	Prepared by	Approved by
A	24/03/2022	Early Works Submission		
B	16/05/2022	Update following Stakeholder consultation		
C	2/11/2023	Inclusion of S.O.P and Annual Review		
D	25/11/23	Update in response to SM/ER Comments on Rev C		
E	14/11/24	Annual review of GWMP		
F	12/05/2025	Update in response to ER/SM Comments		

Terms and Definitions

Term	Definition
AFJV	Acciona Ferrovial Joint Venture
AHD	Australian Height Datum
ASS	Acid Sulfate Soil
BTEXN	Benzene, toluene, ethylbenzene, xylene, naphthalene
CBD	Central Business District
CCMS	Construction Complaints Management System
CEMF	Construction Environmental Management Framework
CEMP	Construction Environmental Management Plan
Clyde MSF	Clyde Maintenance and Stabling Facility
CoPC	Contaminants of potential concern
CSSI	Critical State Significant Infrastructure
CTP	Central Tunnelling Package
DCCEEW	Department of Climate Change, Energy, the Environment and Water (NSW) (Formerly DPE Water)
DPHI	Department of Planning Housing and Infrastructure (formerly DPE)
DSI	Detailed Site Investigation
EIS	Environmental Impact Statement
EMS	Environmental Management System
EPA	Environmental Protection Authority
EP&A	*Environmental Planning and Assessment Act* 1979
EPL	Environmental Protection License
ER	Environmental Representative
ESCP	Erosion and Sediment Control Plan
GLC	Gamuda Engineering – Laing O'Rourke Consortium
GDE	Groundwater Dependent Ecosystem
GWMP	Groundwater Management Plan
GWMoP	Groundwater Monitoring Program
HIR	Hydrogeological Interpretive Report
ISC	Infrastructure Sustainability Council
IS	Infrastructure Sustainability
MCoA	Ministers' Condition of Approval
PAH	Polycyclic Aromatic Hydrocarbons
PASS	Potential Acid Sulfate Soil
PCT	Plant Community Type
PFAS	Per- and Poly-fluoroalkyl Substances
POEO	Protection of the Environment Operations Act 1997 (NSW)

Term	Definition
(the) Project	Sydney Metro West - Western Tunnelling Package
REMM	Revised Environmental Management Measures
SMW	Sydney Metro West
SOP	Sydney Olympic Park
SOPA	Sydney Olympic Park Authority
SSI	State Significant Infrastructure
SVOC	Semi-Volatile Organic Compounds
SWMP	Soil and Water Management Plan
SWQMP	Surface Water Quality Monitoring Program
TBM	Tunnel Boring Machine
TSS	Total Suspended Solids
VOC	Volatile Organic Compounds
VoC	Verification of Competency
WTP	Western Tunnelling Package

1 INTRODUCTION

1.1 Project Description

The scope of the work being undertaken under the Sydney Metro West Western Tunnelling Package works (WTP) (the Project) includes but is not limited to, the following:

- Westmead Station box excavation, including temporary support, stub tunnels, partially mined station cavern and crossover cavern including permanent lining and support
- Parramatta Station, including excavation of station box and associated support
- Clyde Maintenance and Stabling Facility (MSF), including permanent dive structure, portal, spur running tunnels, spur tunnel junction cavern, bulk earthworks, civil structures, utilities corridor, road crossing and creek diversion
- Rosehill Services Facility, including shaft excavation, permanent lining and lateral support
- A precast segment manufacturing facility at Eastern Creek
- Demolition and site clearance works
- Tunnelling between Sydney Olympic Park (SOP) and Westmead. Tunnelling will be undertaken by placing the tunnel boring machines (TBMs) at the Rosehill Services Facility box and retrieved out at the SOP Station Box and then placed back at the Rosehill Services Facility and retrieved at the Westmead Station Box. Some surface works will be required for site establishment and to facilitate TBM retrieval and relaunching, such as crane set up and plant and material deliveries. Station box works such as spoil removal and concreting would also be required to facilitate TBM retrieval and re-launching.

Refer to Figure 1 for the location of the WTP project.

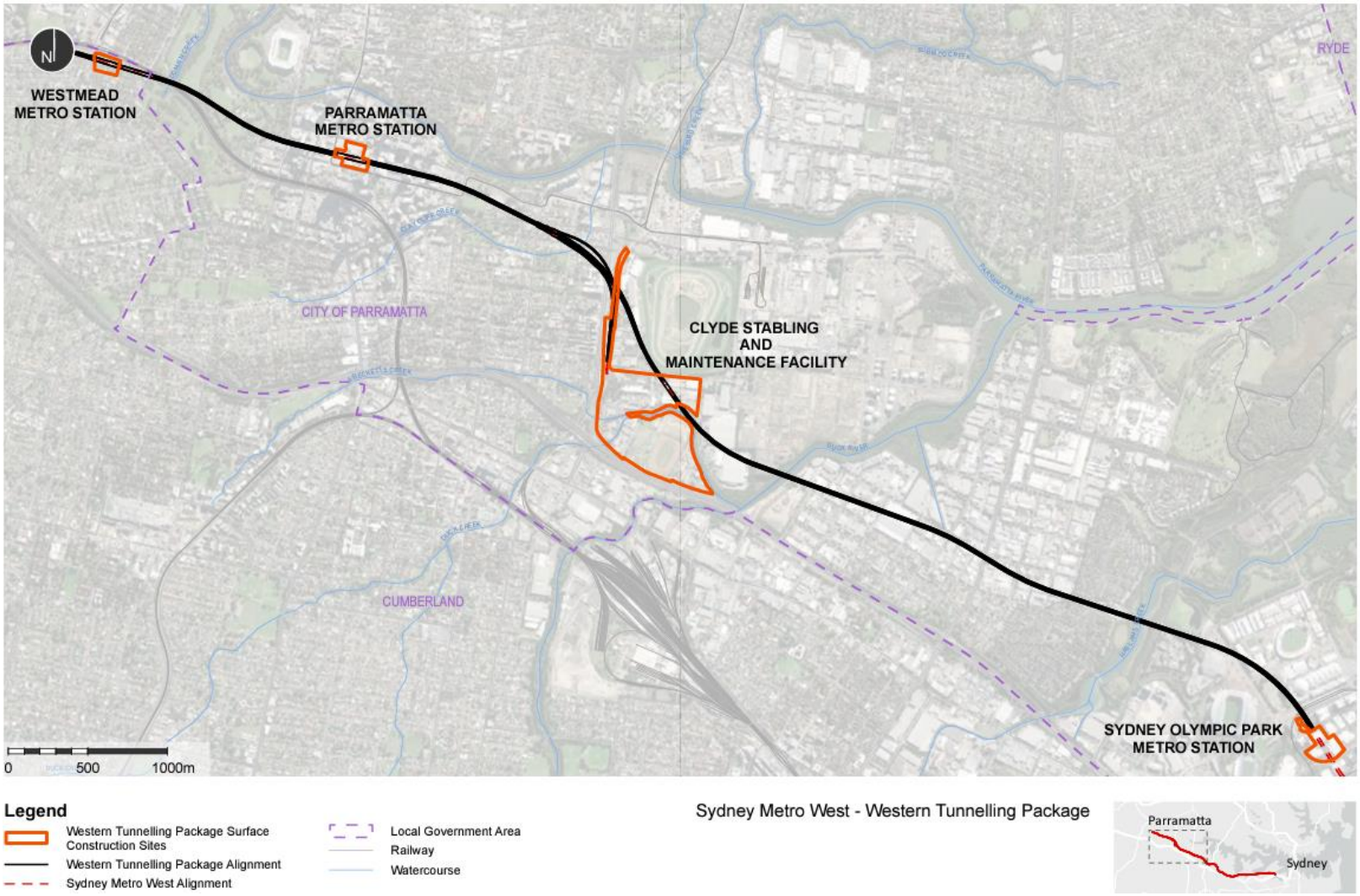

Figure 1: WTP Project Location

1.2 Context

The Construction Environmental Management Plan (CEMP) and sub-plans have been developed for the delivery of the WTP. It will be delivered by Gamuda Engineering Laing O'Rourke Consortium (GLC). This Groundwater Management Plan (GWMP) forms part of the CEMP (SMWSTWTP-GLO-1NL-EV-PLN-000001).

Sydney Metro West – Westmead to The Bays Concept and Stage 1 received planning approval on 11 March 2021 (SSI 10038). The Project comprises the WTP, which is the western portion of Stage 1 of SSI 10038, from Sydney Olympic Park to Westmead. This GWMP has been prepared to address requirements of the Minister's Conditions of Approval (MCoA), Revised Environmental Management Measures (REMMs) listed in the Sydney Metro West – Submissions Report, dated 20 November 2020, the Construction Environmental Management Framework (CEMF) requirements and all applicable legislation as they relate to the Project.

1.3 Environmental Management System Overview

An overview of the Environmental Management System (EMS) is provided in the CEMP Section 3.

Key interactions for this sub-plan with other management plans and monitoring programs in the EMS include:

- Site Establishment Management Plan
- Soil and Water Management Sub-plan
- Groundwater Monitoring Program
- Waste Management Sub-plan
- Spoil Management Sub-plan
- Flora and Fauna Management Sub-plan.

1.4 Community Feedback

Community feedback and complaints management will be dealt with in accordance with community communication strategy and complaints management system. Refer to the CEMP and the Community Communications Strategy for more information regarding ongoing consultation during the delivery of the Project.

1.5 Certification and Approval

Sydney Metro West – Westmead to The Bays Concept and Stage 1 was subject to environmental impact assessment under the NSW Environmental Planning and Assessment Act 1979 (EP&A Act). It was also declared a Critical State Significant Infrastructure (CSSI) by the Minister for Planning & Public Spaces (the Minister).

An Environmental Impact Statement (EIS) has been prepared under Division 5.2 of the EP&A Act and in accordance with Part 3 of Schedule 2 of the Environmental Planning and Assessment Regulation 2000. Following exhibition of the EIS, an Amendment Report and Submissions Report were also prepared. After an assessment was carried out, the Minister determined that the Sydney Metro West – Stage 1 would be approved subject to conditions.

The planning approval (Infrastructure Approval SSI 10038) and related environmental assessment documents are located at: https://www.planningportal.nsw.gov.au/major-projects/project/25631.

Section 6.1 of the EIS, Technical paper 7 - Hydrogeology refers to Section 5.23 of the EP&A Act, which states that a water use approval under Section 89, a water management work approval under Section 90 or an activity approval (other than an aquifer interference approval) under Section 91 of the *Water Management Act* 2000, is not required for approved State Significant Infrastructure (SSI). As such, water supply works approvals and water use approvals would not be required for Stage 1. However, an aquifer interference approval may still be required. GLC will continue to assess and if required, consult with the Department of Climate Change, Energy, the Environment and Water (DCCEEW)(NSW) on the need for an aquifer interference approval. The Revised Groundwater Modelling Reports (Section 7.11) as required by MCoA D122 will confirm the anticipated extent of the aquifer interference that may occur as a result of the Project.

Revision B of the CGWMP was endorsed by the ER on 20 May 2022, before being submitted to the Planning Secretary for information no later than one (1) month before the commencement of construction, which did not commence until 19 July 2022.

This GWMP, including any minor amendments approved by the ER, will be implemented for the duration of construction.

2 PURPOSE AND SCOPE

2.1 Purpose

The GWMP describes the groundwater management approach that will be employed by GLC employees and its subcontractors during construction of the Project. This sub-plan forms a part of the project CEMP and Gamuda Engineering's Environmental Management System.

This GWMP will address the following requirements with respect to groundwater:

- Sydney Metro Construction Environmental Management Framework (CEMF)
- Minister for Planning and Public Space's Conditions of Approval for the Project (MCoA)
- Revised Environmental Mitigation Measures (REMMs)
- SSI Modifications - Modification 1 Administrative Modification
- SSI Modifications - Modification 2 Clyde Stabling and Maintenance Facility
- SSI Modifications - Modification 3 Administrative Modification
- SSI Modifications – Modification 4 Administrative Modification
- SSI Modifications – Modification 5 Administrative Modification
- SSI Modifications – Modification 6 Administrative Modification
- Infrastructure Sustainability Council (ISC) Infrastructure Sustainability (IS) rating tool.

2.2 Scope

The GWMP outlines the mitigation and management measures that GLC will use to address potential groundwater impacts during the design and construction of the Project, while complying with relevant approval, statutory and contract requirements, which are outlined in **Attachment 1**.

Specifically, this sub plan addresses environmental aspects and impacts that relate to:

- Construction dewatering
- Potential ground movement due to induced tunnelling and construction activities below ground
- Water treatment plant (WTP) requirements and groundwater quality monitoring criteria
- Discharge requirements as per associated environmental licences
- Excavation works and the associated inflow and local flow regime concerning tanked and untanked construction areas
- Impact to groundwater recharge and aquifer structure and properties
- Groundwater drawdown and impacted third parties
- Groundwater dependant ecosystems (GDE)
- Surface water and groundwater interactions

The objectives, targets, performance criteria and implementation of the management plan are discussed in Section 3.

Note – this sub-plan does not address the environmental aspects and impacts associated with soil and surface water quality impacts during the construction of the Project. These are assessed and discussed within the Soil and Water Management Plan (SWMP). Groundwater monitoring requirements are detailed in the Groundwater Monitoring Program (GWMoP).

Groundwater management associated with construction activities at Sydney Olympic Park (SOP) was managed by the Central Tunnelling Package (CTP), which is currently being delivered by the Acciona Ferrovial Joint Venture (AFJV). Following TBM breakthrough at S.O.P in July 2024 and following completion of supporting works, all surface water and groundwater collected by GLC activities was redirected for treatment and discharge at the Rosehill WTP (Approximately August 2024).

The drawdown associated with the TBM and the cross-passage development is considered to be highly localised and temporary and as such the drawdown associated with these features has not been modelled at any stage of the project. Groundwater management for the connection between running tunnels and SOP has therefore not been assessed as a cumulative impact.

A key reference document that should be read in conjunction with this GWMP is the Rev C Hydrogeological Interpretative Report (HIR). This Report was finalised on 25th August 2022 (GLC, 2022) and submitted to DPE on 7 October 2022 for information in accordance with MCoA D122.

3 OBJECTIVES AND IMPLEMENTATION

3.1 Objectives, Targets and Performance Criteria

The key objective of this GWMP is to ensure that impacts to groundwater are minimised during construction of the WTP and that all works are undertaken in compliance with the Project requirements including the MCoA, REMMs and CEMF.

The GWMP will describe how GLC will manage and protect groundwater and associated receptors within the permitted criteria as far as practicable during the construction of the Project.

Table 1 outlines the GLC's groundwater objectives and targets for the Project. These objectives and targets for groundwater management have been developed with consideration of key performance outcomes within the Environmental Impact Statement (EIS).

Specific CEMF construction objectives in relation to groundwater management are outlined in Table 1. To achieve these objectives, the targets in Table 1 have been established for the management of groundwater impacts during the Project construction.

Table 1: Groundwater Management Objectives, Targets and Performance Criteria (CEMF)

Clause	Objective	Target	Performance Indicators
7.1 (a)	The following groundwater management objectives will apply to construction:		
i.	Reduce the potential for drawdown of surrounding groundwater resources	Minimise impacts to groundwater levels in active licensed groundwater supply bores during construction	• Monitoring and inspection records • Audit reports
ii.	Prevent the pollution of groundwater through appropriate controls	Prevent pollution of groundwater.	• Monitoring and inspection records • Audit reports
iii.	Reduce the potential impacts of groundwater dependent ecosystems	No decline of GDEs attributable to construction activities	• Monitoring and inspection records

The EIS (Chapter 27) identified specific performance outcomes for the Project; those relevant to the management of groundwater are included in Table 2.

Table 2: Performance Outcome Requirements

Performance Outcome Requirement	SMW Construction Performance Outcomes	Proposed method to achieve outcome
Long term impacts on surface water and groundwater hydrology (including drawdown, flow rates and volumes) are minimised	• Groundwater supply for licenced groundwater users is not significantly affected by groundwater drawdown • The groundwater accessible to groundwater	• Tanking of bulk excavations at Rosehill to avoid ongoing groundwater inflow • Stage 1 includes commitment to implement make good measures in

Performance Outcome Requirement	SMW Construction Performance Outcomes	Proposed method to achieve outcome
	dependent ecosystems is not significantly reduced • Structural damage to buildings from ground movement associated with excavation, tunnelling or groundwater drawdown is avoided	relation to any potential loss of yield for existing groundwater (bore supply) users due to construction • Stage 1 includes a commitment to further groundwater monitoring to better understand potential impacts on groundwater dependant ecosystems and inform mitigation as part of the design process • Where building damage risk is rated as moderate or higher (as per CIRIA 1996 risk-based criteria), a structural assessment of the affected buildings/structures would be carried out and specific measures implemented to address the risk of damage

3.2 Implementation

Specific CEMF implementation requirements of this groundwater management plan are outlined in Table 3 along with relevant sections document references.

Table 3: Management Implementation Requirements (CEMF)

Clause	Requirement	Relevant Section
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 7
ii.	The requirements of any applicable licence conditions	Attachment 1
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	GWMoP
iv.	Evidence of consultation with relevant government agencies	GWMoP
v.	The responsibilities of key project personnel with respect to the implementation of the plan	Section 8.1

Clause	Requirement	Relevant Section
vi.	Procedures for the treatment, testing and discharge of the groundwater from the site	Section 7,8,9 of the GWMoP
vii.	Compliance record generation and management	Section 8
viii.	Details of groundwater monitoring if required	Section 7 of the GWMoP
12.2		
ii.	Details of construction activities and their locations, which have the potential to impact on water courses, storage facilities, stormwater flows, and groundwater	Section 6
iii.	Surface water and ground water impact assessment criteria consistent with the principles of the Australian and New Zealand Environment Conservation Council (ANZECC) guidelines	Section 7.11 and SWMP
iv.	Management measures to be used to minimise surface and groundwater impacts, including identification of water treatment measures and discharge points, details of how spoil and fill material required by the project will be sourced, handled, stockpiled, reused and managed; erosion and sediment control measures; salinity control measures and the consideration of flood events	Section 7 and SWMP

4 ENVIRONMENTAL REQUIREMENTS

4.1 Legislation and Standards

GLC obligations include satisfying the requirements and complying with the provisions of the relevant legislation, guidelines, and policies, as well as international and Sydney Metro's standards. Details are provided in Table 4.

Table 4: Relevant Legislation and Guidelines

Legislation	(NSW) *Protection of the Environment Operations Act 1997* (POEO Act) (NSW) *Contaminated Land Management Act 1997* (CLM Act) (NSW) *Water Management Act 2000* (WM Act) *Sydney Water Act 1994* *Environmental Planning and Assessment Act 1979* (EP&A Act)
Standards	AS/NZS ISO 14001:2016 Environmental management systems - Requirements with guidance for use AS 1940-2017: The Storage and Handling of Flammable and Combustible Liquids AS/NZS 4452-1997: The Storage and Handling of Toxic Substances
Guidelines and Specifications	Australian and New Zealand Guidelines for Fresh and Marine Water Quality (known as 'ANZG Guidelines' (ANZG 2018) Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC): National Water Quality Management Strategy, Paper No.4, Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1, The Guidelines (ANZECC 2000) Guidelines for the Assessment and Management of Groundwater Contamination (DEC 2007) Managing Urban Stormwater: Soils and Construction, Volume 1 and Volume 2 (the 'Blue Book') (Landcom 2004) Approved Methods for the Sampling and Analysis of Water Pollutants in (NSW 2004) NSW Water Extraction Monitoring Policy (DWE 2007) NSW Aquifer Interface Policy (NoW 2012) Water Sharing Plan, Greater Metropolitan Reginal Groundwater Sources Background Document, Sydney (NoW 2011) Road and Maritime: Dewatering guidelines (Roads and Maritime 2011) NSW Groundwater Quality Management Policy (DLWC 2007) NSW Groundwater Dependent Ecosystem Policy (DLWC 2002) NSW Groundwater Policy Framework Document (DLWC 2002) NSW Groundwater Quality Protection Policy (DLWC 1998) National Environment Protection Council (NEPC) 1999 (amended 2013), National Environment Protection (Assessment of Site Contamination) Measure (NEPM) Per- and Poly-fluoroalkyl Substances National Environmental Management Plan 2.0 (HEPA 2020) Requirements for publishing pollution monitoring data (Environmental Protection Authority (EPA) 2013)

4.2 Approvals, Licenses and Permits

This GWMP has been developed to satisfy the requirements of MCoA C1. A full list of applicable MCoAs, REMMs, CEMF requirements and Environmental Protection License (EPL) condition

requirements is provided in Attachment 1. Other legislation relevant to this GWMP is included in Attachment 2 of the CEMP.

4.3 IS Rating Tool Requirements

GLC has identified specific ISC rating credits for the Project. Those relevant to the management of groundwater are included in Table 5.

Table 5: ISC Rating Credits relevant to this GWMP

Credit	IS Rating Tool Requirement	Document Reference
Dis-1 L1	• Measures to minimise adverse impacts to receiving water environmental values during construction and operation have been identified and implemented • Monitoring of water discharges and receiving waters is undertaken at appropriate intervals and at times of discharge during construction	Section 7.6 GWMoP - Section 7
Dis-1 L2	• The requirements for L1 are achieved • Monitoring and modelling of water discharges and receiving waters demonstrates no adverse impact on local receiving water environmental values • The infrastructure does not increase peak stormwater flows for rainfall events of up to a 1.5 year ARI event discharge	GWMP – Sections 7, 8, 9 SWMP
Dis-1 L3	• The requirements for L2 are achieved • Opportunities to improve receiving water environmental values have been identified and implemented • Monitoring and modelling demonstrates improvement of receiving water environmental values	GWMoP – Sections 7, 8, 9

5 EXISTING ENVIRONMENT

Groundwater constraints within and adjacent to the project have been identified and documented in the following environmental assessment reports which included detailed desktop studies and field investigations:

- Sydney Metro West Stage 1 EIS Chapter 18 Groundwater
- Sydney Metro West Stage 1 EIS Technical Paper 7 - Hydrogeology
- Sydney Metro West Stage 1 EIS Technical Paper 8 - Contamination
- Golder | Douglas Partners (2018): Groundwater Level Monitoring Report, 1791865-003-R-GWMR3-RevA, October 2018.
- Gamuda Engineering – Laing O'Rourke Consortium (2021): Hydrogeological Interpretive Report, Rev C dated 25th August 2022.

The following chapters summarise the existing groundwater environment and the likely Project impacts as identified in the EIS.

5.1 Topography and Drainage

The Project falls within the catchment of the Parramatta River. The catchment lies to the west of the Sydney CBD within the relatively flat region of the Cumberland Plain. Elevations range from 140 metres Australian Height Datum (AHD) in the north-west of the catchment to sea level in the east. Most of the waterways are within urbanised coastal areas.

5.2 Geology

5.2.1 Local Geological Conditions

SMW EIS Chapter 18 indicates that a large portion of the Stage 1 construction footprint is dominated by the Wianamatta geological group. This comprises primarily of the Ashfield Shale which is comprised of black to dark grey shale and laminate.

Within the Project, the Ashfield shale and Hawkesbury sandstone are the prominent geological unit for Westmead and Paramatta Stations while Clyde MSF is underlain by Quaternary alluvium deposits made up of alluvial and marine sediments representative of gullies, valleys and former drainage channels.

Limited geophysical impact has been noted within the Project footprint and are not predicted to provide associated conduit or hydraulic barries for groundwater inflow. A representation of the Sydney 1:100,000 Geological Series Sheet 9130 (NSW Department of Mineral Resources, 1983) and the Parramatta 1:100,000 Geological Sheet 9030 (NSW Department of Mineral Resources, 1991) is displayed below in Figure 2.

The geological conditions at each construction site as defined in Technical Paper 7, are summarised in Table 6 below. The potential presence of dykes and faults has been summarised from the Hydrogeology TAN GT3. The intrusion of dykes can cause metamorphism of the host rock due to the high temperature of the intruding material. This can cause the host rock immediately adjacent the intrusion to increase in strength, or it can result in increased fracturing at the contact zone which in turn can provide a conduit for high groundwater inflows.

Table 6: Project Site Specific Geological Conditions

Construction Site	Geological Units	Indicative depths (mbgl)	Dykes or Faults
Westmead metro station	• Alluvial/residual clay • Ashfield shale • Hawkesbury sandstone	• 0 – 2 • 2 – 45 • 45+	Faults may be present
Paramatta metro station	• Alluvial/residual clay and fluvial sand • Ashfield shale • Hawkesbury sandstone	• 0 – 16 • 16 – 19 • 19+	Faults and dykes may be present
Clyde maintenance and stabling facility (incorporating Rosehill)	• Fill • Alluvial/fluvial sand, clay, peat • Ashfield shale • Hawkesbury sandstone	• 0 – 1 • 1 – 5 • 5 – 30 • 30+	Faults and a dyke may be present
Sydney Olympic Park metro station	• Fill/alluvial/residual clay • Ashfield Shale • Hawkesbury Sandstone • Inferred fault	• 0 – 2 • 2 – 45 • 45+	Inferred fault

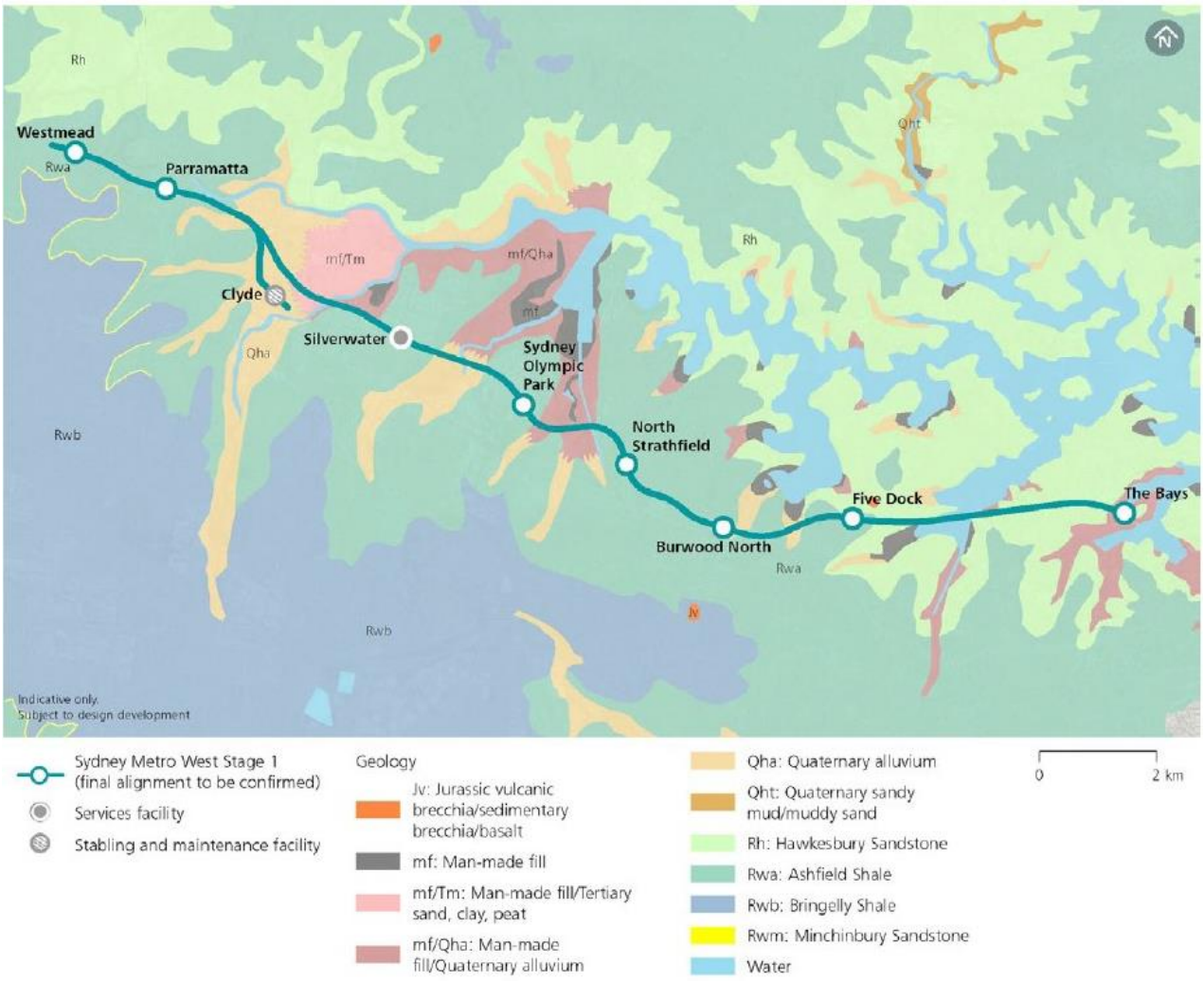

Figure 2: Geological units along the Sydney Metro West alignment (EIS, 2020)

5.3 Hydrogeological Setting

Based off an initial assessment in the SMW EIS Chapter 18 it is indicated that the aquifers located within stage 1 are situated within porous and fractured rock aquifers. Porous aquifers in alluvial soils are continuous (unconfined) throughout the region. Porous aquifers in residual soils are often ephemeral, localised and discontinuous. This is indicative of down-gradient hydraulic movement within the soil profile and building up on the underlying bedrock.

5.3.1 Groundwater Levels

The groundwater level across most of the Stage 1 construction site is generally shallow; within the Project footprint it is seen to be between 3m to 12m below ground surface. Construction site specific groundwater levels are presented in Table 7.

Table 7: Project Site Specific Groundwater Levels (Technical Paper 7)

Construction Site	Typical groundwater level near construction site	
	Metres below ground surface	Metres Australian Height Datum
Westmead metro station	3.0	33
Paramatta metro station	6.0	4
Clyde maintenance and stabling facility (incorporating Rosehill)	0.7 - 5.0	3 to 7
Sydney Olympic Park	12	12

5.3.2 Surface Water and Groundwater Interaction

Chapter 18 of the SMW EIS identified limited surface and groundwater interaction and is likely to be focused around infiltration through soils, discharge from groundwater to surface water in low lying areas at water courses and bodies and leakage from surface water to recharge the groundwater.

Watercourses within a proximity to the Project footprint are identified below in Table 8.

Table 8: Regional Watercourse within the Project footprint (<2km)

Construction site	Watercourse or waterbody	Approximate distance from Stage 1 (m)
Westmead metro station	Parramatta River	250
	Toongabbie Creek	1,250
	Domain Creek	250
	Finlayson Creek	1,000
Paramatta metro station	Paramatta River	250
	Clay Cliff Creek	1,500
Clyde maintenance and stabling facility (incorporating Rosehill)	Duck Creek	<100
	A'Becketts Creek	<500
Sydney Olympic Park	Haslams Creek	900
	Powells Creek	1000
	Saleyards Creek	350
	Associated water bodies (Lake Belvedere, Bennelong Pond)	350
	Bicentennial Park Wetlands	500
	Newington Wetlands	1500

5.4 Sensitive Receptors

5.4.1 Groundwater Dependent Ecosystems (GDE)

Chapter 18 of the SMW EIS references Technical Paper 10 to indicate that groundwater dependent ecosystems (GDE's) are present within a proximity of < 2km of the stage 1 construction package footprint (Figure 3).

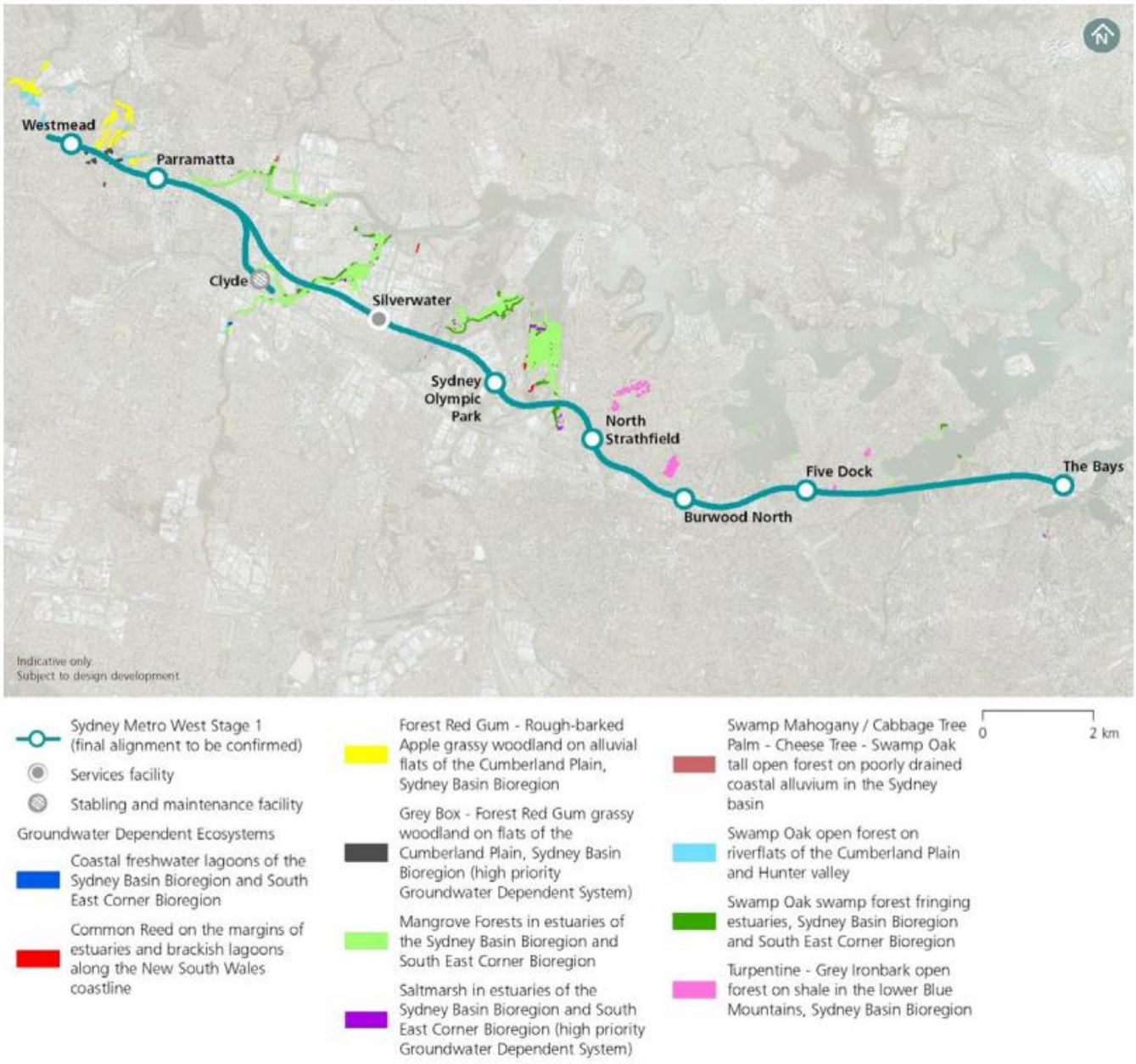

Figure 3: Groundwater Dependent Ecosystems (EIS, 2020)

It is indicated that there are no mapped aquatic GDE's within the Project footprint however Chapter 22 (Biodiversity-Stage 1) identifies areas of high potential groundwater dependent terrestrial vegetation including:

- Saltmarsh in estuaries of the Sydney Basin Bioregion and Southeast Corner Bioregion
- Grey Box- Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion Plant Community Type (849) (a vegetation community classified as Cumberland Plan Woodland in the Sydney Basin Bioregion)
- Forest Red Gum- Rough-barked Apple grassy woodland on flats of the Cumberland Plan, Sydney Basin Bioregion Plant Community Type (835) (a vegetation community classified as Cumberland Plain Woodland in the Sydney Basin Bioregion).

High priority GDE's are listed in Schedule 5 of the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources (Department of Industry, 2011). The plan lists Cumberland Plain Woodland and Coastal Saltmarsh in the Sydney Basin bioregion as high priority GDE's. Therefore, Grey Box- Red Gum woodland on the flats of the Cumberland plan in the vicinity of the Westmead metro station and Paramatta Metro station construction sites, as well as the Saltmarsh in the vicinity of Sydney Olympic Park construction site, are classified as high priority GDE's. '

5.4.2 Registered Groundwater Users

The EIS and Technical Paper 7 reviews the regional WaterNSW Groundwater Bore Database (WaterNSW,2019) and the Register of Water Approvals (WaterNSW, 2019) with the identification of 31 registered groundwater bores located within the predicted groundwater level drawdown zone of influence across the entire Project alignment. The locations and bore classification relevant to the Project can be seen in Figure 4 and includes the following:

- Fourteen (14) bores which are installed for monitoring purposes
- One (1) bore which is installed for industrial purposes
- One (1) bore which is registered as a water supply bore (GW024667)

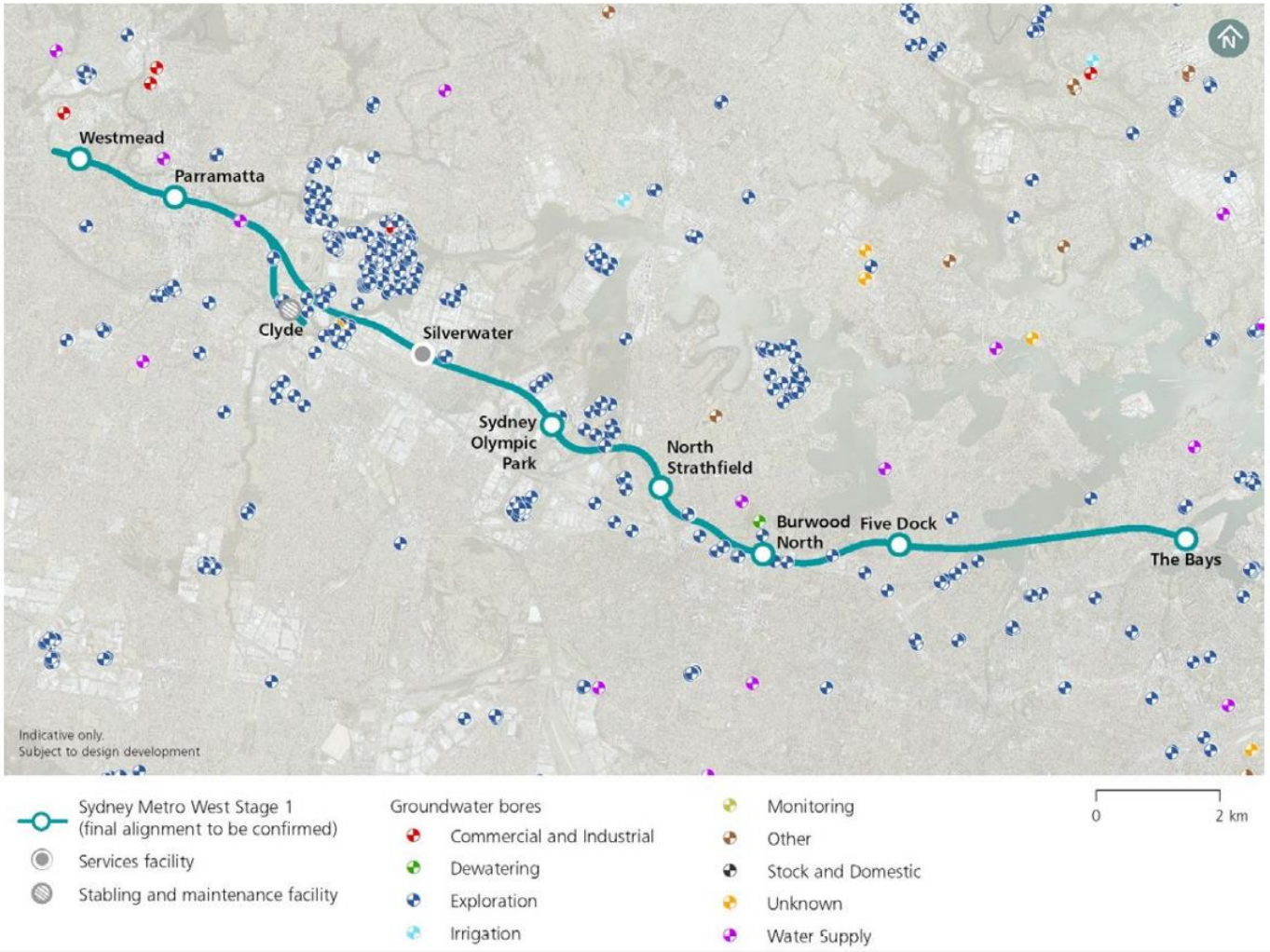

Figure 4: Existing groundwater bores (1km radius) - Stage 1

5.5 Groundwater Quality

Table 9 as referenced from Chapter 18 of the EIS shows a summary of the regional geology and anticipated general groundwater quality expected within the Project.

Table 9: Geological Summary and Associated Water Quality Parameters

Geological unit	Expected salinity (as total dissolved solids)	Expected pH	Other Expected Characteristics
Quaternary deposits (residual and alluvial soils)	Fresh to saline	Neutral to slightly acidic	Nil
Ashfield Shale	Brackish to saline 2,000 milligrams per litre to 10,000 milligrams per litre	Neutral to slightly acidic (4-8)	Nil

Information referenced from table 18-5 of the EIS (Chapter 18)

Groundwater samples collected along the proposed alignment during baseline investigations found conditions that were consistent with the typical ranges listed in Table 8.

Technical Paper 7 notes the overall salinity hazard is reported as high between Westmead and Parramatta and very high between Parramatta and SOP.

5.6 Potential Contamination in Groundwater

The EIS has identified potential to encounter contaminated land and associated risk to groundwater throughout the alignment of the Project. There is the potential to encounter land impacted by historical contaminating activities of varying nature at all station boxes and along the tunnel alignment. The construction sites all lie within historic and/or current commercial/industrial activities.

Key sites with the potential for contamination to exist, and require assessment include the following:

- Westmead metro station construction site
- Parramatta metro station construction site
- Clyde maintenance and stabling facility construction site
- Rosehill services facility
- Sydney Olympic Park construction site

A review of Chapter 18 and Chapter 20 of the EIS along with Technical Paper 7 has indicated that a range of contaminants in the baseline groundwater monitoring bores exceeded the ANZG (2018) toxicant default guideline values for 95% species protection of freshwater aquatic ecosystems for the following substances:

- Ammonia
- Heavy metals (arsenic, cobalt, cadmium, copper, lead, manganese, nickel and zinc).

Groundwater samples also commonly exceeded the ANZECC (2000) default guideline value for physical and chemical stressors, comprising:

- Total nitrogen
- Oxides of nitrogen
- Total phosphorous
- Reactive phosphorous

While not identified in surrounding groundwater at concentrations above the adopted criteria the following additional contaminants may be identified at low levels in groundwater seepage.

- Total recoverable hydrocarbons
- Aromatic hydrocarbons: Benzene, toluene, ethylbenzene, xylene, naphthalene (BTEXN)
- Volatile organic compounds (VOCs)
- Semi-volatile organic compounds (SVOCs)

It is noted that ANZG (2018) does not provide a 95 percent trigger value for iron, however iron concentrations in measured groundwater is relatively high for the Stage 1 construction footprint when compared against Canadian freshwater aquatic ecosystem guideline (0.3 mg/L).

Table 10 provides a summary of potential sources of groundwater contamination that are deemed to potentially pose a risk to the Project footprint through groundwater migration and the associated exposure pathways. Further detail on these potential contaminants of concern refer to SMW EIS Chapter 20.

The SWMP (SMWSTWTP-GLO-1NL-EN-PLN-000001) includes details for the delivery of the contaminated land management program in accordance with the MCoA. The program includes assessment of groundwater and potential sources of groundwater contamination. Groundwater will be assessed through Detailed Site Investigations (DSI) across each of the construction sites and, if necessary, the delivery of a Remediation Action Plan (RAP), both of which will be reviewed by a NSW EPA accredited Site Auditor. Results from these actions may require consideration within this plan.

Table 10: Summary of potential groundwater contamination sources and associated contaminants of potential concern

Potential Source	Associated Contaminants	Westmead Station	Parramatta Station	Rosehilll Shaft	Clyde	Tunnels	Sydney Olympic Park
Leaks and spills from fuel storage infrastructure (such as service stations, mechanic workshops)	Petroleum hydrocarbons, volatile organic compounds (VOCs) and heavy metals	✓		✓	✓	✓	
Firefighting activities associated with surrounding facilities (such as sub stations or aerodromes)	Per- and polyfluoroalkyl substances (PFAS)		✓	✓	✓	✓	✓
Land reclamation, landfilling and other uncontrolled fill material.	Heavy metals, petroleum hydrocarbons, pesticides, polychlorinated biphenyls (PCBs)			✓	✓	✓	✓
Acid sulfate soils (ASS)	Acidic conditions, sulphides		✓	✓	✓		
Former and current industrial land uses	Hydrocarbons, heavy metals and metalloids, chlorinated hydrocarbons (solvents), phenolics, pesticides, heavy metals, PFAS, polycyclic aromatic hydrocarbons (PAH)		✓	✓	✓	✓	
Existing railways and associated activities (including fill material)	Metals, petroleum hydrocarbons, PAH, nutrients, phenols, carbamates, pesticides, herbicides	✓					
Dry cleaners and solvent use (former printing facility)	Chlorinated hydrocarbons		✓	✓		✓	
Application of fertilizers and pesticides	Pesticides, herbicides, nutrients					✓	
Former abattoir – inappropriate storage, use, disposals and burials.	Pathogens, nutrients, and pesticides						✓

6 ENVIRONMENTAL ASPECTS AND POTENTIAL IMPACTS

6.1 Construction Activities

The Project will involve a range of construction activities incorporating various heavy machinery, plant and equipment that will operate in several locations. The broad categories of construction activity likely to have an impact on the regional groundwater are identified below:

- Bulk earthworks
- Drainage works
- Station box excavation
- Operations at site compounds including fuel and chemical storage, refuelling and chemical handling
- Site tunnelling and cut and cover construction
- Dewatering of groundwater inflows into tunnels and operation of water treatment plants.

A summary of the excavation type and groundwater management approach for the Project is summarised in Table 11 below.

Table 11: Excavation type and proposed construction (Technical Paper 7)

Location	Excavation Type	Construction
Westmead metro station	• Station Box Excavation • Crossover cavern to east of box	• Drained box • Drained crossover cavern during construction (cavern would be lined (undrained) following excavation but are assumed to be drained throughout the excavation period)
Parramatta metro station	• Station Box Excavation	• Undrained (soil) • Drained (rock)
Clyde MSF (incorporating Rosehill)	• Tunnel portal and dive structure	• Undrained (soil) • Drained (rock)
Sydney Olympic Park	• Station Box Excavation with northern entry adit*	• Drained (rock)

**Note – station box excavation will be completed by the CTP Contractor prior to WTP's presence on site to undertake the TBM retrieval and re-launching process.*

Aspects and the potential for impacts have been considered during a high-level Project wide risk assessment which is included as Attachment 4 of the CEMP. The Project wide risk assessment has been undertaken to identify and assess the potential requirement for establishment of control measures and identify if the need for site specific mitigation measures/controls should be applied (i.e., environmental work method statement).

Activities that have been identified to have a 'high' level of residual environmental risk will be discussed with all attendees before the risk level is accepted. There were no high-risk activities identified for the management of groundwater during civil works for Stage 1 of the Project.

6.2 Summary of Potential Groundwater Impacts Arising from Construction Activities

The potential for impacts on groundwater will depend on several factors. Primarily impacts will be dependent on the nature, extent and magnitude of construction activities and their interaction with the natural environment. The Project EIS (Chapter 27) and Technical Paper 7 identify the key potential impacts that require mitigation. The specific potential groundwater impacts at each construction site relevant to the EIS and identified in the Groundwater Technical Paper are summarized in Table 12.

Table 12: Summary of potential impacts due to Stage 1 (Jacobs, 2020)

Location	Potential Impacts
Westmead metro station	• GW2 & GW3: Potential reduced baseflow to Creeks • GW4: Migration of contaminants in groundwater and reduction in beneficial uses of aquifers • GW5 & GW6: Ground movement and settlement
Parramatta metro station	• GW2 & GW3: Potential reduced baseflow to Creeks • GW4: Migration of contaminants in groundwater and reduction in beneficial uses of aquifers • GW5 & GW6: Ground movement and settlement
Clyde MSF (incorporating Rosehill)	• GW1: Loss of groundwater available to existing groundwater (bore supply) users • GW2 & GW3: Potential reduced baseflow to Creeks • GW4: Migration of contaminants in groundwater and reduction in beneficial uses of aquifers • GW5 & GW6: Ground movement and settlement
Sydney Olympic Park	• GW2 & GW3: Potential reduced baseflow to Creeks • GW4: Migration of contaminants in groundwater and reduction in beneficial uses of aquifers • GW5 & GW6: Ground movement and settlement

In addition to the impacts identified within the EIS, the potential impacts associated with the construction of the Project include:

- Contamination of groundwater by site activities
- Exposure of acid sulfate soils
- Changes in groundwater recharge
- Impacts to groundwater dependent ecosystems
- Saltwater intrusion into aquifers

The potential impacts identified above are discussed in further detail in the following sections.

6.3 Groundwater Drawdown and Inflows

With regard to drawdown Section 4.1.5.1 Watertightness – General (h) states that the tunnelling contractor must design the Project Works to limit the effect on the groundwater management

regime during construction, maintenance and operation, such that there is minimal adverse effect on the built environment.

Underground excavation taking place within the Project will generally be within low permeability material and therefore limited drawdown will be taking place during these works.

Rock in the vicinity of the water-bearing geological features including dykes, joint swarms and faults have the potential to have hold a high hydraulic conductivity (i.e. ability of groundwater to pass through pores and fractures within the rock unit). Identification of such features would be carried out, with significant water bearing features grouted prior to excavation, to reduce the potential for groundwater inflows to the excavations.

Groundwater lowering is however likely to occur both during construction and throughout the design life of the stations as most station boxes and shafts have been designed to be drained structures in the permanent case, except for the services facility shafts (e.g., Rosehill), and Parramatta Station which are designed as tanked structures. Cut-off walls (using either secant piles or diaphragm walls) will be installed around these station boxes prior to their excavation to limit inflows and propagation of groundwater drawdown.

As all mined structures are designed to be undrained, their excavation is expected to not cause long term groundwater drawdown. However, some drawdown may occur in the short term, where underground metro structures will lie below the water table and there is a hydraulic connection.

Groundwater inflow during construction will be controlled through a range of measures, which may involve the implementation of a grouting program; ground improvement in areas of high inflow (such as where adverse fractures, joints, shearing, and bedding planes are present); and potentially the installation of secant piles or diaphragm panels at surface to form cut-off walls.

Potential inflow rates that will meet requirements outlined in the NSW Aquifer Interference Policy and the Water Sharing Plan (as defined in the project EIS) are presented in Table 11.

Table 13 presents the estimates of groundwater inflow rates which have been included in the project Hydrogeological Interpretive Report (HIR) The estimated inflows do not satisfy the minimum impact considerations of the NSW Aquifer Inference Policy and therefore the policy is not expected to be triggered. The need for an Aquifer Interference Policy will continue to be monitored over the course of the project in consultation with DPE - Water, as required.

A detailed assessment of groundwater drawdown and inflows is provided in the Hydrogeological Interpretive Report (HIR), including drawdown contours.

Table 13: Estimated Groundwater Inflow (EIS Report) – WTP

Location	EIS assumed design	Estimated inflow (L/s)		Estimated inflow (Mega litres per year)	
		One year after excavation	Two years after excavation	One year after excavation	Two years after excavation
Westmead metro station construction site	Untanked excavation with tanked crossover cavern	1.5	1.5	54	46
Parramatta metro station construction	Tanked (soil) Untanked (rock)	2.7	2.7	89	85

Location	EIS assumed design	Estimated inflow (L/s)		Estimated inflow (Mega litres per year)	
		One year after excavation	Two years after excavation	One year after excavation	Two years after excavation
Clyde MSF construction site (incorporating Rosehill)	Tanked (soil) Untanked (rock)	0.5	0.8	38	40
Sydney Olympic Park	Untanked (rock)	0.4	0.4	13	12

Table 14: Estimated Groundwater Inflow - WTP

Location	Infrastructure	Scenario	End 1 year (m^3/day)	End 2 year (m^3/day)
Westmead	Station Box	Likely flow	94	46.6
	Eastern cross-over cavern	Likely flow	-	104
	Nozzles and western Cavern	Likely flow	-	11
Parramatta	Station box	Likely flow	142	126
	Nozzles	Likely flow	-	90
Sydney Olympic Park	Station Excavation	Likely flow	22	20
Rosehill	Service facility	Likely flow	6	6

Location	Infrastructure	Scenario	End 1.25 years (m^3/day)	End 2.5 years (m^3/day)
Clyde	Portal and Clyde Dive	Likely flow	42	32
	Access shaft	Likely flow	12	13
	Spur tunnels	Likely flow	238	0
	Junction	Likely flow	29	136

Note:

- *Westmead, Parramatta and Clyde Inflow values were obtained from the GLC Hydrogeological Interpretive Report Aug 2022*
- *Sydney Olympic Park values were obtained from the CTP Hydrogeological Assessment Report Aug 2022*
- *Rosehill Inflow values were obtained from the GLC Rosehill Hydrogeological Interpretive Report July 2022*

6.4 Ground Movement and Settlement

Ground movement relates to an occurrence of released or redistributed stress within the underlying rock formations or from ground consolidation following the drawdown of groundwater. Excavation

and intrusive groundworks often is the main cause for stress redistribution while consolidation settlement from groundwater drawdown is generally a prolonged process.

Settlement may occur as a result of groundwater drawdown within open excavations with the greatest potential for this to happen remaining within soft superficial surface deposits as a result of a lowered perched water table. Due to the short-term construction periods for the cross-passages and the migrating nature of the TBM, the expected drawdowns associated with tunnelling and cross-passage installation would be small and as such drawdown associated with these items of infrastructure were considered unlikely to generate ground settlement or environmental impacts.

Construction of certain underground sections may create an increased potential for induced ground movement at the surface and below ground which may include ground settlement and lateral movement. If not adequately managed, ground movement has the potential to damage infrastructure, nearby buildings and surrounding structures in a close vicinity.

The estimated drawdown and potential settlement risks associated with construction excavations are addressed for each site in the Hydrogeological Interpretive Report (GLC, 2022). A detailed discussion on ground movement and potential settlement impacts is provided in the initial concept design report on Ground Movement and Existing Infrastructure (AECOM | WSP, 2019) and is being further refined as part of detailed design by GLC.

A GWMoP will be implemented to provide ongoing assessment of drawdown impacts and potential settlement risks.

6.5 Exposure of Acid Sulfate Soils

Acid sulfate soils (ASS) are naturally occurring soils, commonly associated with low lying areas of fine-grained sediments and typically occurring in lacustrine, estuarine, or swamp environments. Sediment accumulations within the harbours would also have an elevated risk of ASS. For acid sulfate soils to exist, the soils need to be saturated (anoxic) and contain sulfide minerals, the most common of which is pyrite. Potential acid sulfate soils (PASS) are water-saturated soils, rich in iron sulphide minerals, that have not yet been oxidised.

Groundwater level drawdown associated with construction excavation has the potential to desaturate acid sulfate soils. Disturbance of PASS and exposure of the sulphide minerals to oxygen through de-saturation of the soils, results in sulfide oxidation and subsequent acidification of the soil and potentially groundwater. Acidification of groundwater can result in the mobilisation of heavy metals previously bound in the formation, leading to environmental impacts.

Potential impacts of acidification and mobilisation of heavy metals include:

- Increased toxicity and loss of biodiversity in wetlands and waterways for ecosystems receiving the groundwater discharge
- Groundwater contamination for down-gradient groundwater users
- Reduced agricultural productivity
- Corrosion of concrete and steel infrastructure
- Discoloration of soil and groundwater seepage.

6.6 Groundwater Recharge

Changing the natural land surface from being pervious (that is, water can infiltrate through), to an impervious area, has the potential to reduce infiltration of rainfall or surface water to the aquifer below. This will change the amount of recharge in the groundwater system. The potential effects on groundwater recharge at each Project site is summarised below.

Table 15: Potential Impacts to Groundwater Recharge (Jacobs, 2020)

Location	Potential Impacts to Groundwater Recharge
Westmead metro station	• The works at Westmead station would increase the proportion of impervious areas through the site establishment and excavation works, which could reduce recharge rates. However, the net increase in impervious areas owing to the project is small relative to the local catchment areas, and the net impact on regional recharge due to the Westmead station construction is not likely to be significant.
Parramatta metro station	• Almost all ground over the proposed Parramatta construction site is currently impervious. Therefore, the works in this area will likely not reduce recharge rates.
Clyde MSF (incorporating Rosehill)	• The footprint of the Clyde MSF includes part of the Sydney Speedway. This ground accounts for approximately 30% of the site footprint which is currently pervious. Therefore, the construction works are likely to reduce the groundwater recharge rate in the vicinity of the construction site. This would potentially reduce the groundwater baseflow to Duck Creek and A'Becketts Creek.
Sydney Olympic Park	• Most works at the proposed construction site currently occurs on impervious surfaces. Therefore, works are not anticipated to reduce recharge rates.

6.7 Groundwater Dependent Ecosystems

As detailed in Section 5.4, Grey Box-Forest Red Gum woodland on the flats of the Cumberland Plain within the vicinity of the Westmead and Parramatta stations, as well as the Saltmarshes in the vicinity of the Sydney Olympic Park station, are identified as high priority terrestrial vegetation GDE. The associated Plant Community Type (PCT) with the terrestrial GDE identified in proximity to the Parramatta and Westmead stations is not obligate (i.e. they are not entirely dependent on groundwater) and are not likely to be dependent on the sporadic subsurface groundwater presence.

Tunnel excavation would typically pass within 500m of GDE's in the suburbs of Westmead, Parramatta, Clyde, and Sydney Olympic Park. Given the sealed nature of the tunnel, groundwater drawdown is likely to be insignificant and impacts to GDE's are not expected.

For GDE's associated with the Cumberland Plain Wood near Westmead and Parramatta, the likelihood of these ecosystems being impacted by the groundwater level drawdown associated with Stage 1 Station Excavation is also low. The groundwater level drawdown in the sandstone induced by station excavation is not likely to cause direct groundwater level drawdown within these geological units, however this impact would be associated with works during shaft excavation. Similarly, negligible impacts are expected at the saltmarsh estuaries near Sydney Olympic Park metro station as this site is located outside of the impacted groundwater zone.

Soils within the Westmead and Parramatta Stations are predominantly from the Blacktown soil unit- refer to EIS Chapter 19 (Soils and surface water quality-Stage 1); which is summarised to be strong setting acidic soils with localised salinity and sodicity found within gently undulating rises.

The Clyde Maintenance and Stabling Facility (MSF) footprint resides within disturbed terrain that has been extensively impacted by human activity including landfill and reworking of natural materials. Within regions of historical landfilling, it is likely that rock, reworked soil, building waste and materials will be encountered causing limited fertility, low wet strength and provides limited low water availability. This indicates that plant roots will be in a highly variable soil profile across the WTP footprint with a risk of limited water availability becoming prevalent especially in the disturbed terrain profiles.

In accordance with MCoA D122, a revised Groundwater Modelling Report was prepared and submitted to the Secretary before the commencement of bulk excavations to identify the groundwater drawdown effects (refer Section 6.3). The Rosehill and Wider Construction Site HIR was submitted to DPE on 14 July 2022 and 7 October 2022 respectively. The model identifies if additional monitoring or mitigation is required to reduce/prevent adverse impact on groundwater dependent ecosystems.

6.8 Groundwater Users

Details about groundwater users sourced from the EIS Technical Paper 7 are summarized in Table 16.

Table 16: Potential Impacts to Groundwater Users (Jacobs, 2020)

Location	Potential Impacts to Groundwater Users
Westmead metro station	• One WaterNSW-registered bore (GW108378) was identified within the predicted extent of groundwater level drawdown. WaterNSW reports the purpose of this bore as commercial/industrial, and its depth is around 280 metres below ground surface. • The estimated groundwater level drawdown at this bore during excavation is four metres, two years after excavation. This does not satisfy the minimal impact considerations of the NSW Aquifer Interference Policy. However, due to the depth of the bore and an assumed standing water level of 20m bgl, the available water column in the bore would be reduced by approximately 2%. Based on this, groundwater supply is not likely to be affected at this bore due to excavation works.
Parramatta metro station	• WaterNSW-registered bores were not identified within the predicted extent of groundwater drawdown
Clyde MSF (incorporating Rosehill)	• Eleven WaterNSW-registered bores were identified within the predicted extent of groundwater drawdown. WaterNSW reports the purpose of these bores are monitoring.
Sydney Olympic Park	• Three WaterNSW-registered bores were identified within the predicted extent of groundwater level drawdown. WaterNSW reports the purpose of these bores are monitoring.

6.9 Groundwater Contamination

Contaminated groundwater may be encountered during the construction activities, namely during excavation dewatering and tunnelling in the vicinity of sites with contamination potential. If

groundwater contamination is not assessed and appropriately managed, construction activities may expose workers, the public and environmental receptors to contaminated groundwater via direct contact or discharge to surface waters. Potential impacts as a result of contact with or discharge of contaminated groundwater may include:

- Contaminant exposure risk to project personnel and the general public
- Contaminant exposure to environmental receptors
- Degradation of aquatic ecosystems.

Excavations that significantly alter groundwater flow regimes have a large potential to increase the likelihood of contaminant transport towards excavation sites throughout the Project. Any potentially contaminated groundwater within the extent of groundwater drawdown would migrate towards the excavation posing a potential exposure risk to site users/workers and adjacent site users and could reduce the beneficial use of the aquifer. As the shaft and dive excavations are undrained across the soil horizon, there is potential for contaminated groundwater within the soils to be drawn downwards into the rock.

A number of contaminants have been identified in groundwater (Section 5.6) that present risks to site users/workers and adjacent site users and could reduce the beneficial use of the aquifer if migration and infiltration to excavations occurs.

There is potential to contaminate groundwater through incidents such as spills associated with refuelling and hazardous materials storage. The risks to groundwater because of an incident will be managed in accordance with the CEMP. Surface runoff will be managed in accordance with the Soil and Water Management Plan and associated Erosion and Sediment Control Plans (ESCP).

The identification of areas with potentially contaminated soil and the associated key aspects, impacts, mitigation, and management measures are detailed in the Soil and Water Management Plan.

Section 5.6 details areas of potential groundwater contamination sources and contaminants specific to each construction site associated with the project between Westmead and Sydney Olympic Park. All three sites within the Project were considered moderate risk of groundwater contamination. This was identified as contamination through migration from off-site sources.

The construction activities associated with Stage 1 are unlikely to result in any significant contamination of groundwaters with appropriate on-site management. Potential sources of contamination during construction activities include:

- Use and storage of chemicals associated with construction activities (e.g., fuels and oils associated with the operation of plant and equipment).
- Leaks and spills on site from heavy machinery, plant, and equipment
- Stockpiling of potentially contaminated soils, including acid sulfate soils

Measures to mitigate groundwater contamination from site activities are discussed in Section 7.8.

Impacts due to vapour and gases to potential groundwater contamination will be shown in Detailed Site Investigations (DSI) and any resulting site-specific contamination management plans or Remediation Action Plans (RAPs).

6.10 Saltwater Intrusion

Groundwater level drawdown in the vicinity of saltwater bodies has the potential to cause saltwater to intrude into freshwater groundwater systems. Saline water can reduce the beneficial uses of the

groundwater system, impact in-ground structures (durability), and potentially impact existing groundwater users and groundwater dependent ecosystems (Jacobs, 2020).

Potential risks of saltwater intrusion during construction stage activities have been assessed as part of EIS assessment stages (Jacobs, 2020), and as part of the project HIR (GLC, 2021). The findings of the EIS assessment are summarized in Table 17.

Table 17: Saltwater Intrusion Risk Assessment (Jacobs, 2020)

Location	Saltwater Intrusion Risks
Westmead metro station	The Westmead metro station construction site lies upgradient of the Charles Street and Marsden Street weirs on the Parramatta River. Therefore the waters of Parramatta River in the vicinity of the station are not expected to be saline, and groundwater in the vicinity of the Westmead metro station construction site is therefore not likely to be impacted by saline water intrusion.
Parramatta metro station	It is possible that saline water within the Parramatta River east of the Charles Street weir could be drawn into the fresher groundwater adjacent to the river. Groundwater supply for primary industries/ industrial/drinking water and sites with groundwater-dependent cultural or spiritual values were not identified in the area where this potential impact could occur. The groundwater dependent ecosystems (terrestrial vegetation) identified in the area where this potential impact could occur comprise Estuarine Mangrove Forest, which are tolerant of saline groundwater. Based on this, potential saline water intrusion in this area is not likely to impact the environmental value of the aquifer.
Clyde MSF (incorporating Rosehill)	It is possible that saline water within the Duck Creek could be drawn into fresh groundwater adjacent to the river. Groundwater supply for primary industries/drinking water and sites with groundwater-dependent cultural or spiritual values were not identified in the area where this potential impact could occur. The groundwater dependent ecosystems (terrestrial vegetation) identified in the area where this potential impact could occur comprise Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion, Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion, and Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion, which are tolerant of saline groundwater. Furthermore, groundwater supply bores and in-ground structures (such as deep foundations) were not identified in this area. Based on this, increased salinity in the groundwater in this area is not likely to impact these groundwater dependent ecosystems or the environmental value of the aquifer.
Sydney Olympic Park	It is possible that saline water within Powells Creek and the Bicentennial Park Wetlands could be drawn into the fresh groundwater between the station excavation and these waterways/water bodies. Groundwater supply for primary industries/drinking water and sites with groundwater dependent cultural or spiritual values were not identified in the area where this potential impact could occur. The groundwater dependent ecosystems (terrestrial vegetation) identified in the area where this potential impact could occur comprise Common reed, Mangrove Forests and Swamp Oak forests of the Sydney Basin Bioregion and South East Corner Bioregion. All of which are tolerant of saline groundwater,

Location	Saltwater Intrusion Risks
	which suggests impacts from saline intrusion are unlikely to impact the value of these aquifers.

6.11 Surface Water Impacts

The four construction sites for the Project lie entirely within the upper estuary of the Parramatta River Catchment, a tributary of Sydney Harbour. The catchment is highly urbanised and altered from its natural state. There are some areas of open space and parkland which influence the water quality and quantity, recharge rates, and speed of surface flow within the catchment.

The catchment is dominantly estuarine for waterways downstream of the Charles Street Weir and below the limit of tidal influence. Freshwater (aquatic) environmental conditions are prevalent above the Charles Street Weir.

Details about surface water impacts are sourced from the EIS Technical Paper 7 and are presented as per each Project site below. Further details about surface water within the Project is summarised in the Surface Water Quality Management Plan (SWQMP) (Ref: GA-PLN-SWQ-001).

Table 18 provides a summary of the potential surface water impacts from construction activities.

Table 18: Potential Surface Water Impacts

Location	Potential Surface Water Impacts
Westmead metro station	Groundwater level drawdown due to station excavation is expected in the vicinity of Domain Creek and Toongabbie Creek, and some 150 metres to 200 metres from Finlaysons Creek and the Parramatta River. Finlaysons Creek is a concrete lined channel and is not likely to receive groundwater baseflow. Groundwater baseflow contribution to Parramatta River would likely be negligible relative to the river water flows/volumes. It is not known whether groundwater contributes baseflow to Domain Creek or Toongabbie Creek. Groundwater level drawdown at distance from that creek could result in reduced groundwater flow towards the creek, and if so, ultimately reduced baseflow to the creek. These stream flows are likely to support the Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain and Swamp Oak open forest on river-flats of the Cumberland Plain and Hunter Valley groundwater dependent ecosystems, which would have roots within the clay alluvium, and the water available within this alluvium would be impacted if baseflows are reduced due to groundwater drawdown. Other aquatic ecosystems could also be impacted if baseflows are reduced. However, as baseflows are likely to be a minor component of streamflow, the significance of this impact is likely to be low. Construction stage inflows to excavations including groundwater and incident rainfall to excavations will be pumped to and treated at a dedicated construction water treatment plant located at the Westmead construction site. Pollutant limits on discharges from the construction water treatment plant will be identified in the EPL for discharges from the site. The construction water treatment plants have been designed with the objective of maintaining or improving water quality in waterways receiving discharge from the site.

Location	Potential Surface Water Impacts
Parramatta metro station	Groundwater drawdown due to station excavation dewatering is expected around Clay Cliff Creek, and at distance from the Parramatta River. Clay Cliff Creek is a concrete lined channel and is not likely to receive groundwater baseflow contributions at surface through the impervious sections. Groundwater baseflow contribution to Parramatta River around the Parramatta Construction Site are likely to be limited in magnitude relative to the river water flows/volumes, and magnitude of groundwater contributions from the wider catchment. Excavation works at Parramatta metro station construction site are therefore not likely to result in a significant reduction in baseflow contributions to streams or environmental flows / low-flows through the Parramatta River. Construction stage inflows to excavations including groundwater and incident rainfall to excavations will be pumped to and treated at a dedicated construction water treatment plant located at the Parramatta construction site. Pollutant limits on discharges from the construction water treatment plant will be identified in the EPL for discharges from the site. The construction water treatment plants have been designed with the objective of maintaining or improving water quality in the Parramatta River, which is the principal waterway receiving discharge from the site.
Clyde MSF (incorporating Rosehill)	Groundwater level drawdown resulting from the dewatering of excavations associated with the shaft and dive is predicted in the vicinity of A'Becketts Creek and Duck Creek. It is not known whether groundwater contributes baseflow to these surface water features, but it is considered likely given the low-lying position of the creeks within the catchment. Excavation works could potentially cause reduced baseflow to A'Becketts Creek and Duck Creek as a result of groundwater level drawdown from excavation dewatering activities, and as a result of reduced groundwater recharge caused by the emplacement of impervious surfaces replacing pervious ground at the Sydney Speedway. The Technical Paper 10 notes that estuarine and near-shore marine systems, such as coastal mangroves are known to somewhat rely on the submarine discharge of groundwater, but that the extent of groundwater dependence is not well known. The groundwater baseflow to Duck Creek is likely to support the Mangrove Forests in estuaries of the Sydney Basin Bioregion and Southeast Corner Bioregion, Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion, and Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion along Duck Creek, which could be impacted if baseflows are reduced. Other aquatic ecosystems are also likely to be impacted if baseflows are reduced. However, as baseflows are likely to be a minor component of streamflow, the significance of this impact is likely to be low. Construction stage inflows to excavations including groundwater and incident rainfall to excavations will be pumped to and treated at dedicated construction water treatment plants located at the both the Clyde and Rosehill portions of the

Location	Potential Surface Water Impacts
	Clyde MSF construction site. Pollutant limits on discharges from the construction water treatment plants will be identified in the EPL for discharges from the site. The construction water treatment plants have been designed with the objective of maintaining or improving water quality in the A'Becketts Creek and Duck Creek, which are the principal waterways receiving discharge from the site.
Sydney Olympic Park	Groundwater level drawdown due to station excavation is predicted at distance from Haslams Creek, the Mason Park wetlands, Bicentennial Park wetlands, and the Brickpit at Sydney Olympic Park. However, it is not known whether groundwater contributes baseflow to these surface water features. It should be noted that GLC will not be undertaking any further excavation works at SOP. Therefore, any observed deviations to the expected groundwater parameters (including groundwater dependant surface systems) at the time of site handover, would be attributed to excavation works completed by the Central Tunnelling Package. If existing groundwater baseflow contributes to the surface waters, the completion of Station Box excavation could see a reduction in the baseflow contribution to these surface waters and the groundwater dependent ecosystems they support along Haslams Creek and within the Bicentennial Park and Mason Park wetlands. These communities include Common Reed, Swamp Oak Forests, Mangrove Forests and Saltmarsh of the Sydney Basin Bioregion and South East Corner Bioregion. Other aquatic ecosystems could also be impacted if baseflows are reduced, however given baseflows are a minor component of creek streamflow, and the groundwater modelling undertaken as part of the EIS is conservative, the significance of this impact on Haslams Creek is likely to be low – particularly for works delivered by GLC. For the Bicentennial and Mason Park wetlands, rainfall and tidal flows from the Parramatta River are likely to be the dominant source of water for the wetland systems. As groundwater baseflows are likely to be a minor component of water contributing to the wetland systems, the significance of this impact is likely to be low. Upon GLC's takeover of the upper most portion of SOP, groundwater and surface water (i.e rainfall) inflows within the station box will be pumped to and treated at dedicated construction water treatment plants located at the both the Clyde and Rosehill portions of the Clyde MSF construction site. Pollutant limits on discharges from the construction water treatment plants will be identified in the EPL for discharges from the site.

7 ENVIRONMENTAL MITIGATION AND MANAGEMENT MEASURES

Measures to manage groundwater impacts will be implemented throughout construction of the Project.

7.1 Summary Groundwater Management and Mitigation Measures

A summary of the specific groundwater management and mitigation measures that will be adopted to meet the requirements of the MCoA and REMMs are outlined in Table 19 along with relative timing and persons responsible.

A detailed discussion on environmental mitigation and management measures that will be adopted to address the MCoA, REMM, and CEMF are provided in Sections 7.1 – 7.12.

The MCoA, REMMs, CEMF requirements and EPL requirements that relate to this GWMP are detailed in Attachment 1.

Table 19: Groundwater Management and Mitigation Measures – MCoA and REMMs

Item	Impact / Issue	Reference	Mitigation and Management Measure and Project site requirements	Timing	Responsibility
1	Potential non-compliance with the implementation or achievement of performance outcomes, commitments and mitigation measures specified in the Groundwater Management Plan	MCoA C1	• Compliance Tracking, adequate resourcing, project induction, staff training, auditing.	Prior to and during construction	Environment and Sustainability Lead (or delegate)
2	Make good provisions for groundwater users must be provided in the event of a material decline in water supply levels, quality or quantity from registered existing bores associated with groundwater changes from construction.	MCoA D121	• Site inspection would be carried out on supply bores GW024667 and GW108378 to confirm the status and viability of the bores. • If the bores are found to be viable, and observed to be significantly impacted by the project, make good measures would be implemented if a loss of yield were to occur. If required, make good options will be determined and agreed to by the registered user prior to implementation.	Prior to and during construction	Design Manager Environment and Sustainability Lead (or delegate)
3	Potential reduced baseflow to Creeks	REMM GW2 and GW3	• A review of additional geotechnical and hydrogeological data at Westmead metro station and Clyde MSF construction sites will be undertaken to refine baseline information on geotechnical and hydrogeological conditions. This information will be used to further refine, whether predicted groundwater drawdown from WTP is likely to occur in the vicinity of watercourses. • This information has been documented as part of the Revised Groundwater Modelling Report. • A Hydrogeological Model *for* SOP was obtained from CTP given excavation works would be completed by them prior to WTP's presence on site. AFJV will continue to monitor their groundwater wells while GLC undertake works in the northern half of the S.O.P site. WTP will monitor groundwater impacts in accordance with their Monitoring Program.	Prior to construction	Design Manager
4	Potential reduced baseflow to Creeks	REMM GW2 and GW3	• Additional site investigations would be carried out at creeks or surface water bodies associated with Westmead metro station and Clyde MSF, where the additional data review in (3) above shows there is a likely surface water/groundwater interaction. • Where a significant reduction in baseflow is predicted due to Stage 1, design responses would be implemented at station and shaft excavations to reduce potential baseflow loss. This has been addressed in the form of the GLC Hydrogeological Interpretive Report (August 2022). • A Hydrogeological Model for SOP was obtained from CTP given excavation works would be completed by them prior to WTP's presence on site. AFJV will continue to monitor their groundwater wells while GLC undertake works in the northern half of the S.O.P site. WTP will monitor groundwater impacts in accordance with their Monitoring Program.	Prior to tunnelling	Environment and Sustainability Lead (or delegate) Design Manager
5	Migration of contaminants in groundwater and reduction in beneficial uses of aquifers	REMM GW4 MCoA C14 MCoA D121 MCoA D117	• Monitoring of groundwater levels and quality at the site during construction. This is inclusive of monitoring of contamination. Monitoring and reporting of groundwater levels and groundwater quality will be carried out in accordance with the GWMoP.	During the construction phase	Environment and Sustainability Lead (or delegate)
6	Ground movement and settlement	REMM GW5 MCoA D122	• Detailed geotechnical and hydrological models for Stage 1 were developed in 2022 and will be progressively updated during design and construction. The detailed geotechnical and hydrological model would include elements as described in REMM GW5.	Prior to the construction of Excavations	Design Manager

Item	Impact / Issue	Reference	Mitigation and Management Measure and Project site requirements	Timing	Responsibility
			• This Information will be document as part of the Revised Groundwater Modelling Report. • A Hydrogeological Model for SOP was obtained from CTP given excavation works would be completed by them prior to WTP's presence on site. AFJV will continue to monitor their groundwater wells while GLC undertake works in the northern half of the S.O.P site. WTP will monitor groundwater impacts in accordance with their Monitoring Program.	that impact groundwater.	
7	Ground movement and settlement	MCoA D60 MCoA D61 REMM GW5 REMM GW6	• Where building damage risk is rated as moderate or higher (as per the CIRIA 1996 risk-based criteria), a structural assessment of the affected buildings/structures would be carried out and specific measures implemented to address the risk of damage from settlement created by groundwater drawdown. • A suitably qualified and experienced person must undertake condition surveys of all buildings, structures, utilities and the like identified as being at risk of damage before commencement of any worth that could impact on the subject surface/subsurface structure. • The results of the surveys must be document in a Pre-construction Condition Survey Report for each item surveyed. Copies of Pre-construction Condition Survey Reports must be provided to the relevant owners of the items and no later than one (1) month before the commencement of the work that could impact on the subject surface/subsurface structure. • The results of the surveys must be documented in a Post-construction Condition Survey Report for each item surveyed. Copies of Post-construction Condition Survey Reports must be provided to the landowners of the items surveyed, and no later than three (3) months following the completion of the work that could impact on the subject surface/subsurface structure unless otherwise agreed by the planning secretary	Prior to work that could potentially impact the surface or sub-surface structure	Construction Manager Project Engineer Community and Stakeholder Manager
8	Loss of groundwater available to existing groundwater (bore supply) users	MCoA C15, C17	• Where a significant exceedance of target changes to groundwater levels are predicted at surrounding land uses and nearby water supply works, an appropriate groundwater monitoring program would be developed and implemented. The program would aim to confirm no adverse impacts on the groundwater levels or to appropriately manage any impacts. • Monitoring at any specific location would be subject to the status of the water supply work and agreement with the landowner	During construction of excavations that impact groundwater.	Design Manager Environment and Sustainability Lead (or delegate)
9	Water Reuse Strategy must be prepared, which sets out options for the reuse of collected stormwater and groundwater during Stage 1 of the CSSI.	MCoA D79	• Preparation of a construction Site Water Reuse and Dewatering procedure	Prior to Construction	Environment and Sustainability Lead (or delegate)

7.2 Groundwater Drawdown and Inflow Control

Groundwater inflow during construction will be controlled through a range of measures, which may involve the implementation of a grouting program; ground improvement in areas of high inflow (such as where adverse fractures, joints, shearing and bedding planes are present); and potentially the installation of secant piles or diaphragm panels at surface to form cut-off walls.

Observations of inflows during construction will be undertaken to support a targeted pre-grouting program to maintain inflows to within the specified localised and station box inflow criteria, to characterise contributions from surface water and groundwater in the excavation and to meet MCoA C17 (e) and (j). Assessment of relative inputs from surface water and groundwater may be supported by the installation of a site-specific rain gauge.

7.3 Ground Movement and Settlement

A detailed geotechnical and hydrogeological model for Stage 1 was developed and submitted to the Secretary 14 July and 7 October 2022 respectively. This document will be progressively updated during design and construction. The detailed Geotechnical and Hydrogeological Report includes:

- Condition surveys of buildings and structures in the vicinity of the tunnel and excavations prior to the commencement of excavation at each site.
- Assessment of the potential for damage to structures, services, basements and other sub-surface elements through settlement or strain
- Predicted groundwater inflows, groundwater take and changes to groundwater levels including at nearby water supply works.

The mitigation and management measures that will be adopted for the management of potential settlement impacts are as follows:

- Where building damage risk is rated as moderate or higher (as per the CIRIA 1996 risk-based criteria), a structural assessment of the affected buildings/structures would be carried out and specific measures implemented to address the risk of damage from settlement created by groundwater drawdown.
- A suitably qualified and experienced person will undertake condition surveys of all buildings, structures, utilities and the like identified as being at risk of damage before commencement of any worth that could impact on the subject surface/subsurface structure.
- The results of the surveys will be document in a Pre-construction Condition Survey Report for each item surveyed. Copies of Pre-construction Condition Survey Reports will be provided to the relevant owners of the items and no later than one (1) month before the commencement of the work that could impact on the subject surface/subsurface structure.
- The results of the surveys will be documented in a Post-construction Condition Survey Report for each item surveyed. Copies of Post-construction Condition Survey Reports will be provided to the landowners of the items surveyed, and no later than three (3) months following the completion of the work that could impact on the subject surface/subsurface structure unless otherwise agreed by the planning secretary.

The HIR includes modelling of groundwater drawdown and inflows associated with key WTP infrastructure, which can be used by the geotechnical discipline to assess settlement impacts. The assessment of settlement is being undertaken by the GLC settlement discipline.

7.4 Acid Sulfate Soils

Management of ASS and PASS involves preventing the minerals from oxidising, or neutralising the acid released from oxidised soils by mixing those soils with a neutralising agent (generally lime).

Acid drainage can also occur from rock formations that contain sulfide minerals, such as are likely to be present in the black shale units of the Ashfield Shale, and possibly in some finer grained units of the Hawkesbury Sandstone.

For the WTP alignment the characterisation and management of ASS and PASS is being considered by the GLC contamination team.

7.5 Groundwater Recharge

No significant impacts to groundwater recharge have been identified through the EIS or HIR for the project. As such, no specific management measures are required for the management of changes in groundwater recharge.

7.6 Groundwater Dependent Ecosystems

A risk-based assessment approach will be adopted for the assessment of project impacts to GDEs. Therefore, the assessment has been limited to the areas of predicted groundwater level drawdown around dewatered excavations such as station boxes, portals, and other major infrastructure. The following mitigation measures are presented in Table 20.

Table 20: Groundwater Management Measures- terrestrial GDEs

Measures	Description	Proposed Management Measure
Assessment	Groundwater drawdown assessment	• Refinement of the potential zone of native vegetation impact based on detailed design phase groundwater drawdown assessment
	Groundwater level assessment	• Additional groundwater monitoring wells would be installed in the vicinity of suspected GDEs within the zone of drawdown, if required. • These additional wells will provide an improved assessment of likely groundwater dependence and will be used for groundwater level monitoring during construction.
Monitoring	Groundwater level monitoring	• A program of groundwater level monitoring should be implemented before and during construction, and for an agreed period of operation while groundwater levels recover
	Tree health monitoring	• GDE vegetation monitoring would be conducted as per the FFMP for GDE Monitoring.

Measures	Description	Proposed Management Measure
Mitigation System	Manual vegetation maintenance	• Where the health of vegetation associated with GDE's is observed to decline as a result of construction and confirmed through the groundwater monitoring indicating a lowered water table, manual vegetation maintenance would commence until vegetation health recovers, or until groundwater levels recover post-construction

7.7 Groundwater Users

Site inspections and desktop reviews of WaterNSW were undertaken on supply bores GW024667 and GW108378 to confirm their current viability. Bore GW024667 was deemed to no longer exist on account its registered location is now located within recent housing development. Borehole GW108378 has also been identified to be an unlicensed borehole, rendering the borehole unusable for extracting groundwater. It should also be noted, GW108738 was a test bore only, and was not developed further than that. On this basis, the bore is concluded to not exist.

Make good measures would be implemented if a loss of yield were to occur recorded for drawdown impact over 2 m. This would include provision of alternative water supplies, replacement with a deeper bore, or compensation for additional pumping costs.

The Groundwater Monitoring Program developed by GLC would provide opportunities to monitor groundwater level changes that may occur as a result of the proposed works. As part of this Monitoring Program, GLC would first aim to confirm no adverse impacts on groundwater levels or appropriately manage any impacts. Monitoring at any specific location would be subject to the status of the water supply work and agreement with the landowner.

7.8 Groundwater Contamination

The SWMP details specifics for the mitigation and management measures relating to the management of soil and water contamination including the contaminated land management strategy to mitigate groundwater contamination.

Groundwater contamination is identified from various industrial, commercial and historical operations within the greater WTP Stage 1 footprint. Groundwater assessment indicates that these activities will provide low to moderate risk of impact to the construction activities proposed. During Stage 1 works it is suggested that monitoring of water quality continues as per Section 5.6 of the GWMP.

All groundwater, including contaminated groundwater that is intercepted within excavations and tunnels will be treated by the water treatments plants described in Section 7.12. The migration of potentially contaminated groundwater will be limited using inflow control measures in excavations, as described in Section 7.2.

For the running tunnels, the tunnel boring machines would construct a pre-cast segmental tunnel lining as excavation progresses. The tunnels would therefore be undrained almost immediately following their excavation.

The suite of water quality parameters and contaminants of potential concern (CoPC) identified in Table 9, and the groundwater monitoring plan will be reviewed following the pre-construction

baseline monitoring and after the DSIs for each Project site has been completed. This review may result in additional CoPC being added or if these contaminants have not been identified, they will be removed from the parameters that are being monitored.

As discussed in Section 6.9 the construction activities associated with Stage 1 are unlikely to result in any significant contamination of groundwaters with appropriate on-site management.

Potential sources of contamination from site activities and proposed management measures are summarised in Table 21.

Table 21: Groundwater Management Measures- Groundwater Contamination by Site Activities

Activity	Proposed Management Measure
Use and storage of chemicals associated with construction activities (e.g., fuels and oils associated with the operation of plant and equipment).	• Ensuring all staff and contractors receive a site-specific induction including contamination procedures. • All liquid dangerous goods and hazardous chemicals will be stored within a bunded (secondary containment) storage container or spill tray within the delineated construction compounds. • Implement contamination management activities during construction works. • Accidental spillages will be managed through emergency spill procedures. • Emergency spill kits will be kept on site during construction and staff will be trained in their use
Leaks, spills and tracking of contamination on site from heavy machinery, plant, and equipment	• Ensuring all staff and contractors receive a site-specific induction including contamination procedures. • Ensure all vehicles, plant and other machinery that have been in contact with contaminated soil are decontaminated prior to leaving site. • Implement contamination management activities during construction works. • Accidental spillages will be managed through emergency spill procedures. • Emergency spill kits will be kept on site during construction and staff will be trained in their use

Activity	Proposed Management Measure
Stockpiling of potentially contaminated soils, including acid sulfate soils	• Ensuring all staff and contractors receive a site-specific induction including contamination procedures • Ensure testing of contaminated soil is conducted by a trained and competent person • Ensure all movement of contaminated materials is tracked and managed in accordance with appropriate waste management protocols. • Ensure contaminated soil is handled, stockpiled, reused and/or disposed of as per the project's contamination management strategy. • Ensure water runoff from contaminated land and stockpiles is contained, treated or disposed to ensure there is no pollution of land or waterways. • Monitor and report on contamination management during construction. • Implement contamination management activities during construction works. • Notify the Supervisor and/or Environment and Sustainability Lead (or delegate) immediately if unexpected, contaminated material is suspected or discovered.

A GWMoP is being implemented throughout the construction period to monitor the concentrations and distributions of contaminants in groundwater. Information derived through the monitoring program will be used to assess potential migration of groundwater contamination towards excavations and plan management measures where necessary. The GWMoP has also been used to ensure that site activities do not result in direct contamination of groundwater and if found, plan appropriate remedial actions.

7.9 Saltwater Intrusion

No significant saltwater intrusion risks have been identified through the EIS or HIR for the project. As such, no specific management measures are required for the management of saltwater intrusion.

7.10 Surface Water Impacts

Potential surface water impacts during construction are discussed in Section 6.11 and generally include:

- Drawdown of groundwater adjacent to creeks resulting in decreased baseflow to watercourses
- Discharge of treated effluent to receiving watercourses, sourced from groundwater inflows / incident rainfall into excavations and tunnels.

The drawdown of groundwater adjacent to creeks has been assessed as part of the EIS stage investigations, with outcomes indicating drawdown is unlikely to result in significant adverse impacts due to the limited importance of groundwater as a source for streamflow.

Discharge of treated effluent to receiving waterways has been assessed as part of the project Water Pollution Impact Assessment (WPIA), which is assessed by the NSW EPA to inform pollutant concentration limits on discharges from the construction water treatment plants.

The construction water treatment plants have been designed with appropriate treatment processes to meet the water quality objectives of the receiving watercourses, incorporating the ANZG (2018) and ANZECC (2000) default guideline values for toxicants and stressors. The construction water treatment plants will be managed throughout the construction process to monitor performance against the pollution concentration limits, which will be agreed through consultation with the NSW EPA.

Further information on the construction water treatment plants is provided in Section 7.12.

7.11 Groundwater Modelling Report

In accordance with MCoA D122, revised Groundwater Modelling Report(‘s) were prepared for the Project to inform current and potential future groundwater impacts associated with the project works. The modelling output has and will be used to provide guidance on inflow rates and management practices associated with the Project groundwater. The Groundwater Modelling report (GMR) will also provide information on the predicted drawdown at each site. The GMR will be compared to the EIS predictions trigger values established for drawdown, inflow rates and potential salinity or contamination migration issues.

The GWMP has been updated using the results obtained from the Revised Groundwater Modelling Report (‘s) and will continue to be updated as and when needed, and where there are updates made to the Groundwater Modelling Report. Revision and update of this Plan and the GWMoP will be undertaken in accordance with the continual improvement process outline in the CEMP.

Revisions to the GMR will be completed over the construction period in a progressive manner. A Revised GMR was developed for the Rosehill Service Facility Site (July 2022), with another developed for the entire project (including tunnelling) (August 2022). Each Revised Modelling Report was prepared before the commencement of bulk excavation, and was submitted to the Secretary for information on 14th July 2022 and 7th October 2022 for the Rosehill GMR and Project Wide GMR respectively.

7.12 Construction Water Treatment Plants

Groundwater inflow would be collected and treated during construction of the Project via temporary Water Treatment Plants when required at each Project construction site. Water treatment plants are currently proposed at Westmead, Parramatta, the Clyde MSF and Rosehill. There is also a Water Treatment Plant currently in operation at Sydney Olympic Park, however, this is owned by AFJV.

Inflow to water treatment plants will comprise a mixture of groundwater, TBM process water, stormwater runoff falling in excavation areas, and washdown water. Clean stormwater runoff will be diverted around the site where possible. Although groundwater intrusion at S.O.P will be negligible given the lined nature of the station box, initial site water will be managed by AFJV using their WTP until TBM breakthrough by GLC, after which water management will be by GLC. Following TBM breakthrough at S.O.P in July 2024 and following completion of supporting works, all surface water and groundwater collected by GLC activities was redirected for treatment and discharge at the Rosehill WTP (Approximately August 2024).

Groundwater inflow rates to water treatment plants will vary according to the scale of open excavations and bulk rock mass permeability of geological units exposed below the water table. All flows associated with operation of the TBM will be diverted for treatment at the Rosehill construction water treatment plant located in the Clyde MSF.

Inflows to water treatment plants related to incident rainfall into exposed excavation areas will be highly variable over time in response to the frequency, intensity, and duration of storm events. During dry conditions there will be negligible contributions from stormwater to water treatment plants. All Incident rainfall into excavations will be pumped to the construction water treatment plants to remove contaminants prior to discharge into receiving waterways. Water treatment plants will be designed with sufficient capacity to process groundwater flows and rainfall events, with storage in balance tanks providing buffering of flows. Further information on stormwater conditions and stormwater management is provided in the SWMP for the Project.

Further design development will confirm the local stormwater system capacity to receive construction water treatment plant inflows. In the event there is a stormwater infrastructure capacity issue with existing infrastructure, mitigation measures such as storage detention to control water outflow during wet weather events will be implemented.

During commissioning of each of the water treatment plant/s, a minimum of two rounds of commissioning sampling will be undertaken to confirm efficacy of treatment measures in achieving the required outcomes. All the parameters listed in the GWMoP will be tested during this commissioning phase. The main targets of the testing are:

1. If the Water Treatment Plant/s perform to meet the relevant discharge criteria and what design or operational modifications may be required in order for it to meet the required discharge criteria.
2. The relationship between turbidity and Total Suspended Solids (TSS) will be measured as a proxy for TSS and may require more sampling well into the post-commissioning phase.

The water treatment plant will not be deemed “commissioned” until two subsequent rounds of testing confirm compliance with discharge criteria. If water treatment plants are unable to meet the EPL discharge criteria, a review of the treatment methods will be assessed, and the methods revised.

The construction water treatment plants will be designed to ensure discharged water quality is compliant with relevant discharge criteria prescribed in the Projects EPL (No. 21676). GLC worked collaboratively with the EPA during the EPL application process to develop site specific discharge criteria for both surface water and groundwater, of which are detailed below in Table 22 as well as in the CSWMP and GWMoP.

Locations for discharge points have been confirmed with the EPA, following relevant reviews for water flow capacity. Calibrated flow meters, calibrated pH and turbidity sensors will help to monitor discharge volumes as well as inform management of any variation in the water treatment plant/s performance. Several discharge locations (referred to as Points in the EPL) are specified in the license, of which have specific discharge criteria. The points listed in this plan however, will be subject to change, following consultation with the EPA and amendment to the EPL. As of April 2025, these ‘Points’ are as follows:

- Point 1: Eastern Creek Pre-Cast Yard stormwater discharge point.
- Point 3: Discharge from the Westmead permanent Water Treatment Plant to Domain Creek
- Point 4: Discharge from the Rosehill permanent Water Treatment Plant to Duck River
- Point 5: Discharge from the Parramatta construction Water Treatment Plant to Parramatta River

In accordance with MCoA D117 and D118, discharge criteria from Water Treatment Plants, as specified in the Project EPL No.21676 would take precedence and include the following parameters:

Table 22 Water Treatment Plant - discharge to stormwater parameters

		Discharge/Monitoring point			
Parameter	Unit	Point 1	Point 3	Point 4	Point 5
Oil and grease	Visible?	No	No	No	No
pH	pH	6.5 – 8.5	6.5 – 8.5		6.5 – 8.5
Total suspended solids	mg/L	50 mg/L			
Turbidity	NTU		20		10
Ammonia	µg/L		200	910	790
Arsenic	µg/L		13		13
Cadmium	µg/L		0.2		0.7
Chromium (hexavalent)	µg/L		1.0	30	4.4
Chromium (trivalent)	µg/L		27		4.4
Cobalt	µg/L		1.4	5	1
Copper	µg/L		1.4	1.3	1.3
Electrical Conductivity	µS/cm		2200		
Iron	µg/L		300		300
Lead	µg/L		3.4		1
Manganese	µg/L		1900		1900
Mercury	µg/L		0.06		0.4
Nickel	µg/L		11		35
Nitrate + nitrite (oxidised nitrogen)	µg/L		200	1200	300
Nitrogen (total)	µg/L		1000	1800	1200
Perfluoro octane sulphonate (PFOS)	µg/L		0.13	0.13	0.0091
Perfluoro octanoic acid (PFOA)	µg/L				0.062
Phosphorus (total)	µg/L		25	90	90
TPH C10-C36 Fraction	µg/L		100		100
TPH C6-C9 Fraction	µg/L		100		100
Zinc	µg/L		8	12	12

7.13 Groundwater Reuse

The reuse of groundwater will be assessed as part of the Water Reuse Strategy developed as part of the sustainability scope of work for the project. The Water Reuse Strategy is based on best practice and advice sought from relevant agencies. Water reuse continues to be a viable option on the Project. However, where reuse is determined to not be feasible, then the Planning Secretary would be notified.

GLC do not intend to reuse groundwater prior to treatment. Any reuse options will be assessed following treatment through the systems described.

8 COMPLIANCE MANAGEMENT

8.1 Roles and Responsibilities

The GLC Project Team's organisational structure and overall roles and responsibilities are outlined in Section 7 of the WTP CEMP. Specific responsibilities for the implementation of environmental controls relevant to groundwater are detailed in Table 23.

Table 23: Responsibility Matrix

Role	Authority and Responsibility
Environment and Sustainability Lead (or delegate)	• Develop and implement the Groundwater Management Sub-plan • Engage suitably qualified consultants to support implementation of this sub-plan • Regularly engage with key stakeholders and other interface contractors to achieve environmental alignment (e.g., discharge points and premises areas) in according with the interface management plan • Consult with the Project Director and Construction Director, oversee the investigation and reporting of environmental incidents arising from groundwater impacts
Design Manager	• Manage specific geotechnical, hydrological and hydrogeological reviews and ensure these are considered within the Groundwater Modelling Report • Manage review of private domestic bores and potential make good requirements • Engage with the Environment and Sustainability Lead (or delegate) on the development and implementation of the Groundwater Monitoring Program
Senior Approvals/ Environmental Advisor	• Prepare Environmental Control Maps (ECMs) to outline the controls in this Sub-plan relevant to each work activity • Oversee compliance reporting and tracking • Oversee the keeping of all environment records • Oversee water quality and groundwater monitoring in accordance with this sub-plan • Delivery of toolbox/prestart presentation (or other specific training) to inform work crews of the controls documented in the ECMs • Respond to environmental incidents and non-compliances
Environmental Advisor	• Prepare site-specific action management plans for Groundwater inflow, groundwater recharge, surface water impacts, GDE impact and groundwater quality • Investigate the extent (horizontal and vertical) of the impacts identified in Section 6.2
Construction Manager	• Review and provide resources to implement the controls identified in the ECMs
Project Hydrogeologist	• Prepare and update groundwater management control plans in accordance with this GWMP including calculations for groundwater inflow, drawdown and quality

Role	Authority and Responsibility
Site Supervisor	• Install and maintain environmental control in accordance with ESCPs and ECMs • Attend inspections with the Environmental Coordinator, Sydney Metro/ER or other stakeholders • Implement corrective actions raised during Environmental inspections in agreed timeframes • Obtain and comply with Water Discharge Permits prior to any groundwater discharge from the site • Work in conjunction with the Soil and Water Quality Management Plan within the CEMP to notify the environmental coordinator of any observations in water quality or any signs of potential groundwater contaminants
All personnel	• Notify Site Supervisor of any observations of visual difference in groundwater quality in conjunction with the Soil and Water Quality Management Plan

8.2 Training

The project inductions would include groundwater management measures as deemed necessary based on site specific risks, to ensure that personnel understand the potential impacts from construction and the proposed mitigation measures.

The site induction training would address elements related to groundwater management. For example:

- Relevant details of the CEMP
- Relevant legislation and guidance
- Water Quality management and procedures – including discharge processes.
- Conditions of environmental licences, permits and approvals.

Targeted training in the form of toolbox talks or tailored training sessions will also be provided to personnel with a key role in groundwater management. Specific training may include:

- Water treatment plant management, which may include a verification of competency (VoC) or similar process for water treatment plant operators to maintain compliant operations.

Further details regarding inductions and training are outlined in Section 9 of the CEMP.

8.3 Monitoring, Inspections and Reporting

Review and confirmation of the implementation of groundwater management measures identified throughout this document will be undertaken as part of the reporting and auditing regimes described within the CEMP. Site environmental inspections will include a review on the relevant mitigation measures and the groundwater level monitoring/bore obligations.

Refer to the GWMoP for details relating to groundwater monitoring and the inspection criteria. Refer to the CEMP for full details on reporting and record keeping requirements and processes.

In addition to any records listed in the CEMP, the following compliance records will be kept (either by GLC or the consultants which undertake monitoring or other works):

- Laboratory records
- EPL Annual Reports
- Groundwater monitoring sheets
- Water treatment plant operational performance data
- Records of groundwater levels and water quality testing
- Six-monthly Construction Monitoring Report as outlined in the GWMoP.
- Records of all groundwater monitoring bores and wells in the immediate vicinity of the Project
    - If any bores or monitoring locations need to change (i.e due to damage), then the replacement bore(s) will need to be added to the monitoring locations in the GWMoP. This update would occur annually as a minimum as determined by the GWMoP or as needed.

In accordance with SM requirements, GLC will retain and protect existing groundwater wells where practicable, noting that some will require decommissioning due to their location within excavation footprints. Where the groundwater wells cannot be retained or protected GLC will notify SM as soon as possible.

8.4 Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this sub-plan, MCoA and other relevant approvals, licenses, and guidelines. These audits will be undertaken at planned intervals to provide information on whether the Project:

- Is meeting its compliance obligations
- Conforms to this sub-plan
- Determines if this sub-plan is effectively implemented and maintained.

The approach to internal and independent audits, including auditing schedule, is outlined further in Section 11.3 of the CEMP.

8.5 Environmental Incidents

Management of environmental incidents is detailed in Section 12.2 of the CEMP. Examples of incidents as they relate to groundwater may typically include:

- Leaks or spills from vehicles or equipment
- Uncontrolled release of contaminated groundwater
- Contaminated find with potential to be released to groundwater
- Excessive drawdown with impactful settlement of ground

8.6 Complaints Register

All complaints made by the community and stakeholders will be managed in accordance with Sydney Metro's requirements, the Overarching Community Communication Strategy, including the Sydney Metro Construction Complaints Management System (CCMS) (2021), as well as relevant MCoAs (B1 – B6). Further details on the complaints register can be found in the Project CEMP (SMWSTWTP-GLO-1NL-EV-PLN-000001), Section 10.

9 REVIEW AND IMPROVEMENT

9.1 Continuous Improvement

The Project Management Team will review the status and adequacy of the EMS including the CEMP and CEMP Sub-plans. The objective of the review will be to ensure that it meets current Sydney Metro and GLC requirements as well as relevant environmental standards.

Continuous improvement of this GWMP will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives, and targets for the purpose of identifying opportunities for improvement.

The continuous improvement process will be designed to:

- Identify areas of opportunity for improvement of environmental management and performance
- Determine the cause or causes of non-conformances and deficiencies
- Develop and implement a plan of corrective and preventative action to address any nonconformances and deficiencies
- Verify the effectiveness of the corrective and preventative actions
- Document any changes in procedures resulting from process improvement
- Make comparisons with objectives and targets.

In order to ensure continual improvement and prevent recurring issues, this sub-plan will be reviewed in response to:

- Corrective actions arising from non-conformance, incidents, or audits.
- Opportunity for improvement in environmental management performance which may be identified by the project team, ER or Sydney Metro
- Changes to the Gamuda Engineering EMS

Review of this sub-plan will occur annually as a minimum, or as needed in consultation with Sydney Metro and the ER. A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure as outlined in the CEMP. At a minimum, and in accordance with the CEMF CI 3.17b, management systems will be reviewed by the Senior Management Team annually.

9.2 Document Updates

The processes described above may result in the need to update or revise this sub-plan. This will occur annually as a minimum, or as required and may only be approved by the Environment and Sustainability Lead or delegate.

Where minor amendments are made to this GWMP, the revised GWMP will be issued to the ER for review and endorsement in accordance with MCoA A30(j).

9.3 Distribution

All GLC personnel and contractors will have access to this GWMP via the project document control management system. The approved GWMP will be published on the GLC website within one week of being approved in accordance with MCoA B11.

The document is uncontrolled when printed.

ATTACHMENTS

Attachment 1 – Compliance Matrix

The MCoA, REMMs, CEMF requirements and EPL requirements that relate to this GWMP and the GWMoP are detailed in the following tables.

MCoAs

ID	Conditions of Approval	Document Reference
C1	Construction Environmental Management Plans (CEMPs) and CEMP Sub-plans must be prepared in accordance with the Construction Environmental Management Framework (CEMF) included in the documents listed in Condition A1 of this schedule to detail how the performance outcomes, commitments and mitigation measures specified in the documents listed in Condition A1 of this schedule will be implemented and achieved during construction.	• Section 3
C3	The **CEMP(s)** not requiring the Planning Secretary's approval must be submitted to the **ER** for endorsement no later than one (1) month before the commencement of construction or where construction is phased no later than one (1) month before the commencement of that phase. That **CEMP** must obtain the endorsement of the **ER** as being consistent with the conditions of this approval and all undertakings made in the documents listed in **Condition A1** of this schedule.	• Section 1.5
C6	The **CEMP Sub-plans** must state how: a) the environmental performance outcomes identified in the documents listed in **Condition A1** of this schedule will be achieved, b) the mitigation measures identified in the documents listed in **Condition A1** of this schedule will be implemented, c) the relevant conditions of this approval will be complied with; and d) issues requiring management during construction (including cumulative impacts), as identified through ongoing environmental risk analysis, will be managed through SMART principles.	• Section 3.1, Section 7 and CEMP
C8	The **CEMP Sub-plans** not requiring the Planning Secretary's approval must obtain the endorsement of the **ER** as being in accordance with the conditions of approval and all relevant undertakings made in the documents listed in **Condition A1** of this schedule. Any of these **CEMP Sub-plans** must be	• Section 1.5

ID	Conditions of Approval	Document Reference
	submitted to the **ER** with, or subsequent to, the submission of the **CEMP** but in any event, no later than one (1) month before construction or where construction is phased no later than one (1) month before the commencement of that phase.	
C10	Construction must not commence until the **CEMP** and all **CEMP Sub-plans** have been approved by the Planning Secretary or endorsed by the **ER** (whichever is applicable), unless otherwise agreed by the Planning Secretary. The **CEMP** and **CEMP Sub-plans**, as approved by the Planning Secretary or endorsed by the **ER** (whichever is applicable), including any minor amendments approved by the **ER,** must be implemented for the duration of construction. Where construction of Stage 1 of the CSSI is phased, construction of a phase must not commence until the **CEMP** and **CEMP Sub-plans** for that phase have been approved by the Planning Secretary or endorsed by the **ER** upon nomination by the Planning Secretary (whichever is applicable).	• Section 1.5
C14 (d)	C14 The following Construction Monitoring Programs must be prepared in consultation with the relevant government agencies identified for each to compare actual performance of construction of Stage 1 of the CSSI against the performance predicted in the documents listed in Condition A1 of this schedule or in the CEMP: d) Groundwater – In consultation with: DPE Water and SOPA (in respect of Sydney Olympic Park)	• GWMoP
C15	Each Construction Monitoring Program must provide: (a) details of baseline data available including the period of baseline monitoring (b) details of baseline data to be obtained and when (c) details of all monitoring of the project to be undertaken (d) the parameters of the project to be monitored (e) the frequency of monitoring to be undertaken (f) the location of monitoring (g) the reporting of monitoring results and analysis results against relevant criteria (h) details of the methods that will be used to analyse the monitoring data (i) procedures to identify and implement additional mitigation measures where the results of the monitoring indicated unacceptable project impacts (j) a consideration of SMART principles	• GWMoP

ID	Conditions of Approval	Document Reference
	(k) any consultation to be undertaken in relation to the monitoring programs; and (l) any specific requirements as required by Conditions C16 to C17 of this schedule.	
C17	Groundwater Construction Monitoring Program must include: (a) groundwater monitoring networks at each construction excavation site (b) detail of the location of all monitoring bores with nested sites to monitor both shallow and deep groundwater levels and quality (c) define the location of saltwater interception monitoring where sentinel groundwater monitoring bores will be installed between the saline sources of the estuary or river and that of the stations or shafts (d) results from existing monitoring bores (e) monitoring and gauging of groundwater inflow to the excavations, appropriate trigger action response plan for all predicted groundwater impacts upon each noted neighbouring groundwater system component for each excavation construction site (f) trigger levels for groundwater quality, salinity and groundwater drawdown in monitoring bores and / or other groundwater users (g) daily measurement of the amount of water discharged from the water treatment plants (h) water quality testing of the water discharged from treatment plants (i) management and mitigation measures and criteria (j) groundwater inflow to the excavations to enable a full accounting of the groundwater take from the Sydney Basin Central Groundwater Source (k) reporting of groundwater gauging at excavations, groundwater monitoring, groundwater trigger events and action responses; and (l) methods for providing the data collected to Sydney Water where discharges are directed to their assets.	• GWMoP
C18	With the exception of any Construction Monitoring Programs expressly nominated by the Planning Secretary to be endorsed by the ER, all Construction Monitoring Programs must be submitted to the Planning Secretary for approval.	• Section 1.5 of the GWMP • Refer to ER endorsement
C19	The Construction Monitoring Programs not requiring the Planning Secretary's approval must obtain the endorsement of the ER as being in accordance with the conditions of approval and all undertakings made in the documents listed in Condition A1 of this schedule. Any of these Construction Monitoring Programs must be submitted to the ER for endorsement at least one (1) month before the	• N/A

ID	Conditions of Approval	Document Reference
	commencement of construction or where construction is phased no later than one (1) month before the commencement of that phase.	
C20	Any of the Construction Monitoring Programs which require Planning Secretary approval must be endorsed by the ER and then submitted to the Planning Secretary for approval at least one (1) month before the commencement of construction or where construction is phased no later than one (1) month before the commencement of that phase.	• Section 1.5 of the GWMP • Refer to ER endorsement and construction commencement timing
C21	Unless otherwise agreed with the Planning Secretary, construction must not commence until the Planning Secretary has approved, or the ER has endorsed (whichever is applicable), all of the required Construction Monitoring Programs and all relevant baseline data for the specific construction activity has been collected.	• Refer to Planning Secretary approval
C22	The Construction Monitoring Programs, as approved by the Planning Secretary or the ER has endorsed (whichever is applicable), including any minor amendments approved by the ER, must be implemented for the duration of construction and for any longer period set out in the monitoring program or specified by the Planning Secretary or the ER (whichever is applicable), whichever is the greater.	• See each applicable monitoring program
C23	The results of the Construction Monitoring Programs must be submitted to the Planning Secretary, ER and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program.	• GWMoP
D60	A suitably qualified and experienced person must undertake condition surveys of all buildings, structures, utilities and the like identified in the documents listed in Condition A1 of this schedule as being at risk of damage before commencement of any work that could impact on the subject surface / subsurface structure. The results of the surveys must be documented in a Preconstruction Condition Survey Report for each item surveyed. Copies of Pre-construction Condition Survey Reports must be provided to the relevant owners of the items surveyed in the vicinity of the proposed work, and no later than one (1) month before the commencement of the work that could impact on the subject surface / subsurface structure.	• Section 7.1, 7.3
D61	Condition surveys of all items for which condition surveys were undertaken in accordance with Condition D60 of this schedule must be undertaken by a suitably qualified and experienced person after completion of the work identified in Condition D60 of this schedule. The results of the surveys must be documented in a Post-construction Condition Survey Report for each	• Section 7.1, 7.3

ID	Conditions of Approval	Document Reference
	item surveyed. Copies of Post-construction Condition Survey Reports must be provided to the landowners of the items surveyed, and no later than three (3) months following the completion of the work that could impact on the subject surface / subsurface structure unless otherwise agreed by the Planning Secretary.	
D79	Water Reuse Strategy must be prepared, which sets out options for the reuse of collected stormwater and groundwater during Stage 1 of the CSSI. The Water Reuse Strategy must include, but not be limited to: (a) Evaluation of reuse options (b) details of the preferred reuse option(s), including volumes of water to be reused, proposed reuse locations and/or activities, proposed treatment (if required), and any additional licences or approvals that may be required (c) measures to avoid misuse of recycled water as potable water (d) consideration of the public health risks from water recycling (e) timeframe for the implementation of the preferred reuse option(s)	• Section 7.13
D117	Stage 1 of the CSSI must be designed and constructed so as to maintain the NSW Water Quality Objectives (NSW WQO) where they are being achieved as at the date of this approval and contribute towards achievement of the NSW WQO 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 WQO.	• GWMoP
D118	Unless an EPL is in force in respect to Stage 1 of the CSSI and that licence specifies alternative criteria, discharges from wastewater treatment plants to surface waters must not exceed (a) the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018 (ANZG (2018)) default guideline values for toxicants at the 95 per cent species protection level (b) for physical and chemical stressors, the guideline values set out in Tables 3.3.2 and 3.3.3 of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 (ANZECC/ARMCANZ) (c) for bioaccumulative and persistent toxicants, the ANZG (2018) guidelines values at a minimum of 99 per cent species protection level. Where the ANZG (2018) does not provide a default guideline value for a particular pollutant, the	• Section 7.12

ID	Conditions of Approval	Document Reference
	approaches set out in the ANZG (2018) for deriving guideline values, using interim guideline values and/or using other lines of evidence such as international scientific literature or water quality guidelines from other countries, must be used.	
D119	If construction stage stormwater discharges are proposed, a Water Pollution Impact Assessment will be required to inform licensing consistent with section 45 of the POEO Act. Any such assessment must be prepared in consultation with the EPA and be consistent with the National Water Quality Guidelines, with a level of detail commensurate with the potential water pollution risk.	• SWMP
D121	Make good provisions for groundwater users must be provided in the event of a material decline in water supply levels, quality or quantity from registered existing bores associated with groundwater changes from construction.	• GWMoP
D122	The Proponent must submit a revised Groundwater Modelling Report in association with Stage 1 of the CSSI to the Planning Secretary for information before bulk excavation at the relevant construction location. The Groundwater Modelling Report must include: (a) for each construction site where excavation will be undertaken, cumulative (additive) impacts from nearby developments, parallel transport projects and nearby excavation associated with the CSSI (b) predicted incidental groundwater take (dewatering) including cumulative project effects (c) potential impacts for all latter stages of the CSSI or detail and demonstrate why these later stages of the CSSI will not have lasting impacts to the groundwater system, ongoing groundwater incidental take and groundwater level drawdown effects (d) actions required after Stage 1 to minimise the risk of inflows (including in the event latter stages of the CSSI are delayed or do not progress) and a strategy for accounting for any water taken beyond the life of the operation of the CSSI (e) saltwater intrusion modelling analysis, from estuarine and saline groundwater in shale, into The Bays metro station site and other relevant metro station sties; and (f) a schematic of the conceptual hydrogeological model.	• Section 7.1 and 7.11 of GWMP

REMMs

ID	Revised Environmental Management Measure	Document Reference
SSQW5	The water treatment plants would be designed so that wastewater is treated to a level that is compliant with the ANZECC/ARMCANZ (2000) and ANZG (2018) and draft ANZG (2020) default guidelines for 95% species protection and 99% species protection and 99% species protection for toxicants that bioaccumulate unless other discharge criteria are agreed with relevant authorities.	GWMoP
SSWQ7	Further design development would confirm the local stormwater system capacity to receive construction water treatment plant inflows. In the event there is a stormwater infrastructure capacity issue with existing infrastructure, mitigation measures such as storage detention to control water outflow during wet weather events would be implemented.	Section 7.12
GW2	A review of additional geotechnical and hydrogeology data would be undertaken to confirm the geological and groundwater conditions and determine, based on these local conditions, whether predicted groundwater drawdown from Stage 1 is likely to occur in the vicinity of these creeks. Where the additional data review \ shows local conditions and predicted groundwater drawdown are likely to cause surface water-groundwater interaction, then additional site investigations (in accordance with GW3) would be undertaken for those creeks or surface water bodies.	Section 7.1
GW3	Additional site investigations would be carried out at creeks or surface water bodies where the additional data review in GW2 shows there is a likely surface water / groundwater interaction. This would involve baseline monitoring of creek flows (streamflow gauging) prior to construction, and baseflow streamflow analysis to confirm the existing groundwater baseflow contribution to streamflow for each creek. Where a significant reduction in baseflow is predicted due to Stage 1, design responses would be implemented at station and shaft excavations to reduce potential baseflow loss.	Section 7.1
GW4	Monitoring of groundwater levels and quality at the site area would occur before, during and after construction. This would also include monitoring of potential contaminants of concern. Groundwater level data would be regularly reviewed during and after construction by a qualified hydrogeologist. Groundwater monitoring data would be provided to the NSW Environment Protection Authority and Department of Planning, Environment, Water and the Natural Resources Access Regulator for information prior to commencement of construction.	Section 7.1 GWMoP
GW5	A detailed geotechnical model for Stage 1 would be developed and progressively updated during design and construction. The detailed geotechnical model would include:	Section 7.1

ID	Revised Environmental Management Measure	Document Reference
	• Assessment of the potential for damage to structures, services, basements and other subsurface elements through settlement or strain • Predicted changes to groundwater levels, including at nearby water supply works Where building damage risk is rated as moderate or higher (as per the CIRIA 1996 risk-based criteria), a structural assessment of the affected buildings/ structures would be carried out and specific measures implemented to address the risk of damage. Where a significant exceedance of target changes to groundwater levels are predicted at surrounding land uses and nearby water supply works, an appropriate groundwater monitoring program would be developed and implemented. The program would aim to confirm no adverse impacts on groundwater levels or to appropriately manage any impacts. Monitoring at any specific location would be subject to the status of the water supply work and agreement with the landowner	
GW6	Condition surveys of buildings and structures in the vicinity of the tunnel and excavations would be carried out prior to the commencement of excavation at each site.	Section 7.1

CEMF Requirements

Clause	Requirement	Document Reference
7.1 (a)	The following groundwater management objectives will apply to construction:	
i.	Reduce the potential for drawdown of surrounding groundwater resources	Section 7.2
ii.	Prevent the pollution of groundwater through appropriate controls	Section 7.8
iii.	Reduce the potential impacts of groundwater dependent ecosystems	Section 7.6
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:	Specific references below
i.	The groundwater mitigation measures as detailed in the environmental approval documentation	Section 7
ii.	The requirements of any applicable licence conditions	Attachment 1

Clause	Requirement	Document Reference
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	GWMoP
iv.	Evidence of consultation with relevant government agencies	GWMP
v.	The responsibilities of key project personnel with respect to the implementation of the plan	Section 8.1
vi.	Procedures for the treatment, testing and discharge of the groundwater from the site	Section 7,8,9 of the GWMoP
vii.	Compliance record generation and management	Section 8
viii.	Details of groundwater monitoring if required	Section 7 of the GWMoP
12.2		
ii.	Details of construction activities and their locations, which have the potential to impact on water courses, storage facilities, stormwater flows, and groundwater	Section 6
iii.	Surface water and ground water impact assessment criteria consistent with the principles of the Australian and New Zealand Environment Conservation Council (ANZECC) guidelines	Section 7.10 and SWMP
iv.	Management measures to be used to minimise surface and groundwater impacts, including identification of water treatment measures and discharge points, details of how spoil and fill material required by the project will be sourced, handled, stockpiled, reused and managed; erosion and sediment control measures; salinity control measures and the consideration of flood events	Section 7 and SWMP

Environment Protection Licence

Environmental Protection License (EPL) No. 21676 will apply to the Project. The EPL prescribes water quality parameters to be measured and associated discharge criteria from licensed discharge points as presented in Section 7.12 of this plan. It also detail the monitoring and analytical requirements by reference to authority publications (e.g., Methods for sampling and analysis of water pollutants in NSW (EPA 2004).

In some cases, a trade waste agreement may be sought from Sydney Water for disposal of wastewater into the sewer system, however this is currently not the preferred method of groundwater management, and no agreement has been sought at this time.

The Project construction activities are designated as '***Railway activities—railway infrastructure construction'*** under Schedule 1 of the POEO Act. Scheduled activities under clause 48 of the POEO Act, require an Environmental Protection Licence (EPL) for the premise at which a scheduled activity is carried on.

The EPL for the project is EPL 21676. A copy can be found on the public register.