SYDNEY METRO CITY & SOUTHWEST
VICTORIA CROSS INTEGRATED STATION DEVELOPMENT
CONSTRUCTION GROUNDWATER MANAGEMENT PLAN

REVISION STATUS

Rev	Date	Details / Description
A	10/03/20	Initial copy for consultation
B	05/05/20	Addressing stakeholder comments
C	12/05/20	Addressing ER comments

D	19/05/20	Addressing ER and Sydney Metro comments
E	29/05/20	Addressing ER comments
F	09/07/20	Addressing DPIE comments

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DOCUMENT CONTROL/ APPROVALS

Title:	**Sustainability Management Plan**			
Document No.:	TBC			
Document Path:	TBC			
Disciplines	Environment			
	Name	**Position**	**Date**	**Signed/ Approved**
Originator(s)	Jason Ambler	Environment Manager	10/03/20	
Review				
Approval				

GENERAL INFORMATION

Acronyms

Table 1: Acronyms

Term	Description
AS	Australian Standard
CEMF	Sydney Metro Construction Environmental Management Framework
CEMP	Construction Environmental Management Plan
CGMP	Construction Groundwater Management Plan
CoA	Conditions of Approval
Council	North Sydney Council
CSSI	Critical State Significant Infrastructure
DECC	Department of Energy and Climate Change
DPIE	Department of Planning, Industry and Environment
EIS	The Sydney Metro City and Southwest Chatswood to Sydenham Environmental Impact Statement dated 3 May 2016 submitted to the Secretary seeking approval to carry out the CSSI and as revised if required by the Secretary under the EP&A Act
EP&A Act	*Environmental Planning and Assessment Act 1979 (NSW)*
EPA	NSW Environment Protection Authority
ER	Environmental Representative (independent of design and construction personnel)
ISD	Integrated Station Development
MCoA	Minister's Condition(s) of Approval
Minister, the	The Minister of New South Wales (NSW) Planning
NRAR	Natural Resources Access Regulator
NSW	New South Wales
PIR	Preferred Infrastructure Report The Sydney Metro City and Southwest Chatswood to Sydenham Submissions and Preferred Infrastructure Report dated October 2016 submitted to the Secretary under the EP&A Act
POEO Act	*Protection of Environment Operations Act 1997* (NSW)
Proponent	The person or organisation identified as the proponent in Schedule 1 of the planning approval
REMM	Revised Environmental Mitigation Measure
Secretary	The Secretary of the Department of Planning and Environment

Term	Description
SMC&SW	Sydney Metro City & Southwest
SMP	Sustainability Management Plan
SPIR	Submissions and Preferred Infrastructure Report
SSI	State Significant Infrastructure
TSE	Tunnelling and Station Excavations
VCISD	Victoria Cross Integrated Station Development

1 PROJECT REQUIREMENTS

1.1 CSSI Planning Approval Conditions

Critical State Significant Infrastructure, Sydney Metro City and South West, Chatswood to Sydenham, Conditions of Approval SSI 15_7400

Clause	Condition Details	Ref
C3	The following CEMP sub-plans must be prepared in consultation with the relevant government agencies identified for each CEMP sub-plan and be consistent with the CEMF and CEMP referred to in Condition C1. Groundwater – DPI Water	This CGMP, Section 3.2, Appendix A
C4	The CEMP sub-plans must state how: a) the environmental performance outcomes identified in the EIS as amended by the documents listed in A1 will be achieved;	Sections 1.4, 3.1, 5.7, 6, 7.5
	b) the mitigation measures identified in the EIS as amended by documents listed in A1 will be implemented;	Sections 1.2, 6, 7, 8
	c) the relevant terms of this approval will be complied with; and	Section 1.1, This Plan
	d) issues requiring management during construction, as identified through ongoing environmental risk analysis, will be managed.	Sections 6, 7.1, 8.7
C5	The CEMP sub-plans must be developed in consultation with relevant government agencies. Where an agency(ies) request(s) is not included, the Proponent must provide the Secretary justification as to why. Details of all information requested by an agency to be included in a CEMP sub-plan as a result of consultation and copies of all correspondence from those agencies, must be provided with the relevant CEMP sub-plan.	Appendix A
C6	Any of the CEMP sub-plans may be submitted to the Secretary along with, or subsequent to, the submission of the CEMP but in any event, no later than one (1) month before commencement of construction.	Section 3.2
C7	The CEMP must be endorsed by the ER and then submitted to the Secretary for approval no later than one (1) month before the commencement of construction or within another timeframe agreed with the Secretary.	Section 3.2
C8	Construction must not commence until the CEMP and all CEMP sub-plans have been approved by the Secretary. The CEMP and CEMP sub-plans, as approved by the Secretary, including any minor amendments approved by the ER, must be implemented for the duration of construction. Where the CSSI is being staged, construction of that stage is not to commence until the relevant CEMP and sub-plans have been approved by the Secretary.	Section 3.2
C9	The following Construction Monitoring Programs must be prepared in consultation with the relevant government agencies identified for each Construction Monitoring Program to compare actual performance of construction of the CSSI against predicted performance. Required Construction Monitoring Programs Relevant government agencies to be consulted for each Construction Monitoring Program d) Groundwater - DPI Water	Section 8 Appendix A
C10	Each Construction Monitoring Program must provide: a) details of baseline data available; 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;	Section 8

	h) procedures to identify and implement additional mitigation measures where results of monitoring are unsatisfactory; and i) any consultation to be undertaken in relation to the monitoring programs.	
C12	The Construction Monitoring Programs must be developed in consultation with relevant government agencies as identified in Condition C9 of this approval and must include, to the written satisfaction of the Secretary, information requested by an agency to be included in a Construction Monitoring Programs during such consultation. Details of all information requested by an agency including copies of all correspondence from those agencies, must be provided with the relevant Construction Monitoring Program.	Appendix A
C13	The Construction Monitoring Programs must be endorsed by the ER and then submitted to the Secretary for approval at least one (1) month before commencement of construction or within another timeframe agreed with the Secretary.	Section 3.2
C14	Construction must not commence until the Secretary has approved all of the required Construction Monitoring Programs, and all relevant baseline data for the specific construction activity has been collected.	Sections 3.2, 5, 8.2
C15	The Construction Monitoring Programs, as approved by the Secretary 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 Secretary, whichever is the greater.	Section 8 (introductory paragraph)
C16	The results of the Construction Monitoring Programs must be submitted to the Secretary for information, and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program.	Section 8.4
C17	Where a relevant CEMP sub-plan exists, the relevant Construction Monitoring Program may be incorporated into that CEMP sub-plan.	Section 8
E107	The CSSI must be constructed and operated so as to maintain the NSW Water Quality Objectives where they are being achieved as at the date of this approval, and contribute towards achievement of the NSW Water Quality Objectives over time where they are not being achieved as at the date of this approval, unless an EPL in force in respect of the CSSI contains different requirements in relation to the NSW Water Quality Objectives, in which case those requirements must be complied with.	Sections 7.2, 7.3

1.2 REVISED ENVIRONMENTAL MITIGATION MEASURES

REMM	Mitigation Measure	Reference
SCW4	Discharges from the construction water treatment plants would be monitored to ensure compliance with the discharge criteria in an environment protection licence issued to the project.	No EPL issued or required for the VCISD project.

1.3 CONSTRUCTION ENVIRONMENTAL MANAGEMENT FRAMEWORK (CEMF)

Section	Details	Ref
3.4	Construction Environmental Management Sub-Plans a) Subject to Section 3.3(c) and Section 3.2(c) the Principal Contractor will prepare issue-specific environmental sub-plans to the CEMP and SMP which address each of the relevant environmental impacts at a particular site or stage of the project. Issue specific sub-plans will include: • Groundwater management.	This CGMP Section 6

<table>
<tr><th>Section</th><th>Details</th><th>Ref</th></tr>
<tr><td>3.8</td><td>Register of Hold Points
a) Principal Contractors will identify hold points, beyond which approval is required to proceed with a certain activity. Example activities include vegetation removal and water discharge. Hold points will be documented in relevant CEMPs.
b) Table 1.4 provides the structure for the register of hold points as well as a preliminary list of hold points which will be implemented.
Table 1.4 Preliminary Register of Hold Points
<table>
<tr><th>Hold Point</th><th>Release of Hold Point</th><th>By Wo</th></tr>
<tr><td>Discharge of water</td><td>Water tested to verify compliance and approval to discharge</td><td>Contractor’s Environment Manager (or delegate)</td></tr>
</table></td><td>Sections 7.2, 7.3, 7.4</td></tr>
<tr><td>7.1</td><td>Groundwater Management Objectives
a) The following groundwater management objectives will apply to construction:
i. Reduce the potential for drawdown of surrounding groundwater resources.
ii. Prevent the pollution of groundwater through appropriate controls.
iii. Reduce the potential impacts of groundwater dependent ecosystems.</td><td>Sections 3.1, 8.1</td></tr>
<tr><td>7.2</td><td>Groundwater Management Implementation
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.
ii. The requirements of any applicable license conditions.
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.
iv. Evidence of consultation with the NSW Office of Water.
v. The responsibilities of key project personnel with respect to the implementation of the plan.
vi. Procedures for the treatment, testing and discharge of groundwater from the site.
vii. Compliance record generation and management.
viii. Details of groundwater monitoring if required.</td><td>This CGMP</td></tr>
<tr><td>7.3</td><td>Groundwater Mitigation
a) Examples of groundwater mitigation measures include:
i. Implementing all feasible and reasonable measures to limit groundwater inflows to stations and crossovers.
ii. Undertaking groundwater monitoring during construction (levels and quality) in areas identified as ‘likely’ and ‘potential’ groundwater dependent ecosystems.</td><td>Sections 6, 7</td></tr>
</table>

1.4 EIS Environmental Performance Outcomes

Aspect	Details	Ref
Groundwater and geology	The project would make good any impacts on groundwater users. The project would avoid any damage to buildings from settlement.	Sections 3.1, 5.7, 6, 7.5

It is also noted that EIS Technical Paper 7 Groundwater Assessment, Table E.2 confirms the project does not exceed the Groundwater Related Minimum Harm Criteria Assessment (NSW Office of Water, 2012).

It is noted that the City and Southwest Chatswood to Sydenham Staging Report (Staging Report) details extent of applicability of the various aspects of the planning approval, Construction Environmental Management Framework (CEMF) and Revised Environmental Mitigation Measures. The Staging Report also outlines how these aspects will be covered in the project documentation (aspect specific sub plan or addressed within the Construction Environmental Management Plan). This is summarised in Figure 1 below, including for each environmental management category:

- Whether a stand-alone 'Construction Environmental Management Plan sub-plan', 'Construction Traffic Management Plan', 'Sustainability Management Plan sub-plan' or 'Workforce Development and Industry Participation Plan' will be prepared.
- Whether the category risks will be addressed in the main CEMP/SMP document in the form of a procedure ('CEMP-P' or 'SMP-P'),
- Whether the category risks will be addressed in the main CEMP/SMP document only ('CEMP' or 'SMP'), or
- Whether the category risks are not applicable to the stage ('N/A').

CEMF Environmental Management Category	SYAB	NCW-P7	Demolition A & B	TSE	CSM	SSJ	MP ISD – Demolition	ISD	BS	LW	TSOM
Spoil	N/A	N/A	N/A	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	N/A	CEMP sub-plan	CEMP	CEMP sub-plan	CEMP
Groundwater	N/A	N/A	N/A	CEMP sub-plan	CEMP sub-plan	CEMP -P	N/A	CEMP sub-plan	CEMP	CEMP	CEMP
Traffic	CoA E82 CTMP	CoA E82 CTMP	CoA E82 CTMP	CoA E82 CTMP	CoA E82 CTMP	CoA E82 CTMP	CoA E82 CTMP	CoA E82 CTMP	CoA E82 CTMP	CoA E82 CTMP	CoA E82 CTMP
Noise & Vibration	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan
Heritage	CEMP sub-plan	CEMP -P	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP -P
Flora & Fauna / Biodiversity	CEMP -P	CEMP -P	CEMP -P	CEMP sub-plan	CEMP sub-plan	CEMP -P	CEMP -P	CEMP -P	CEMP -P	CEMP -P	CEMP -P
Visual Amenity	CEMP -P	CEMP -P	CEMP -P	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP -P	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan
Carbon & Energy	N/A	N/A	N/A	SMP sub-plan	SMP sub-plan	SMP sub-plan	N/A	SMP sub-plan	SMP sub-plan	SMP sub-plan	SMP sub-plan
Materials	N/A	N/A	N/A	SMP sub-plan	SMP sub-plan	SMP sub-plan	N/A	SMP sub-plan	SMP sub-plan	SMP sub-plan	SMP sub-plan
Soil & Water	CEMP -P	CEMP -P	CEMP -P	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP -P	CEMP -P	CEMP -P	CEMP sub-plan	CEMP -P
Air Quality	CEMP -P	CEMP -P	CEMP -P	CEMP sub-plan	CEMP sub-plan	CEMP sub-plan	CEMP -P	CEMP -P	CEMP -P	CEMP sub-plan	CEMP -P
Waste (and Recycling)	CEMP -P*	SMP-P	SMP sub-plan	SMP sub-plan	SMP sub-plan	SMP sub-plan	SMP-P	SMP sub-plan	SMP sub-plan	SMP sub-plan	SMP
Workforce Development	WFDIP Plan	N/A	WFDIP Plan	WFDIP Plan	WFDIP Plan	WFDIP Plan	WFDIP Plan	WFDIP Plan	WFDIP Plan	WFDIP Plan	WFDIP Plan

Figure 1 - Staging Report applicability, VCISD – outlined in red is relevant to this plan

2 INTRODUCTION

2.1 Sydney Metro Description

Sydney Metro is Australia's biggest public transport project. In 2024, Sydney will have 31 metro railway stations and a 66km standalone metro railway system – the biggest urban rail project in Australian history. The Sydney Metro Project is illustrated in the Figure below.

Services started in 2019 in the city's north west with a train every four minutes in the peak. Sydney Metro will be extended into the CBD and beyond to Bankstown in 2024. There will be new metro railway stations underground at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street, Waterloo and new metro platforms under Central.

On 9 January 2017, the Minister for Planning approved the Sydney Metro City & Southwest - Chatswood to Sydenham project as a Critical State Significant Infrastructure project (reference SSI 15_7400) (CSSI Approval). The terms of the CSSI Approval includes all works required to construct the Sydney Metro Victoria Cross Station, including the demolition of existing buildings and structures on both sites. The CSSI Approval also includes construction of below and above ground improvements with the metro station structure for appropriate integration with the Over Station Development (OSD).

With regards to CSSI related works, any component of the detailed design that is contained within the "metro box envelope" and public domain will be pursued in satisfaction of the CSSI conditions of approval and do not form part of the scope of the State Significant Development Approval (SSDA) for the OSD, unless otherwise specified in the SSDA.

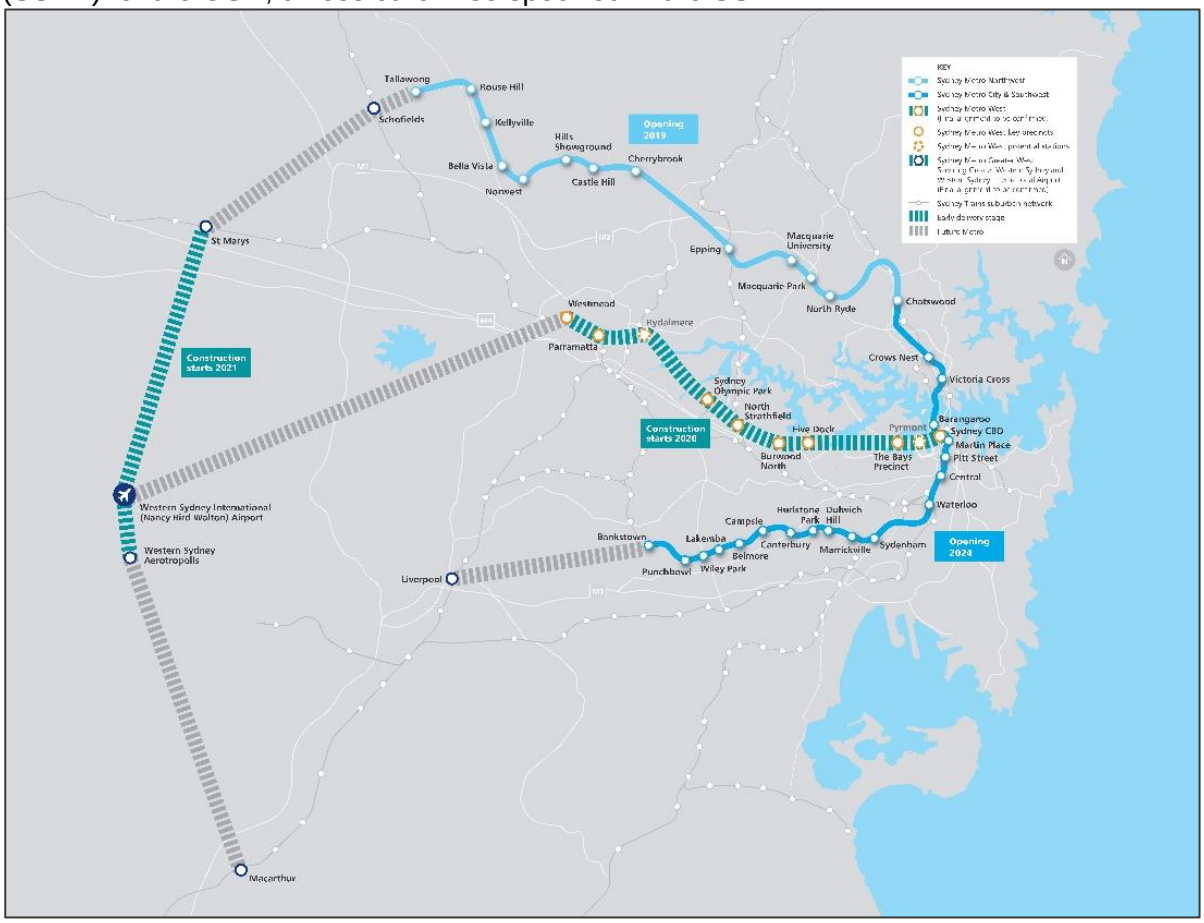


Figure 2 - Sydney Metro Alignment Map. Source: Sydney Metro

2.2 Project Background

Situated at the corner of Miller and Berry Streets, and corner of McLaren and Miller Streets North Sydney, the new Victoria Cross Integrated Station Development (VCISD) represents a unique opportunity to create a new precinct in the heart of North Sydney that has seamless access to retail, commercial offices and transport infrastructure. The new station supports the continued growth of North Sydney, adding to the vibrancy of the area through new employment and retail opportunities, improved pedestrian connections and high quality outdoor spaces.

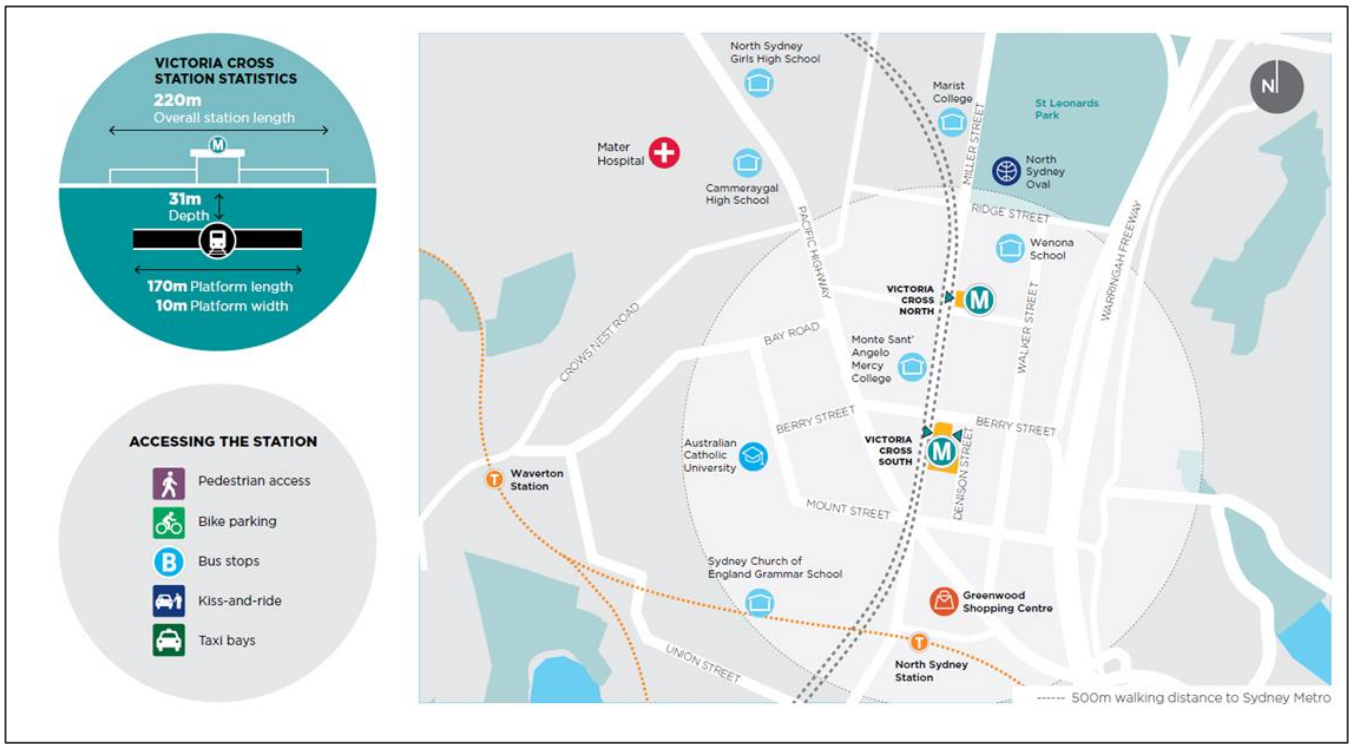


Figure 3: Victoria Cross Site Location

VCISD will integrate retail opportunities and enhance North Sydney as a thriving commercial, residential, retail and entertainment hub. The new Victoria Cross Station will be a cavern station located beneath Miller Street between Berry and McLaren Streets in North Sydney. Sydney Metro have engaged the Tunnel and Station Excavation (TSE) contractor separately to complete the tunnels, platform cavern, adits and station box excavation. The station will have two separate entrances (refer to Figure 4):

- the southern station entrance, bound by Miller, Berry and Denison Streets; and
- the smaller northern station entrance being located on Miller Street at the corner of McLaren Street.

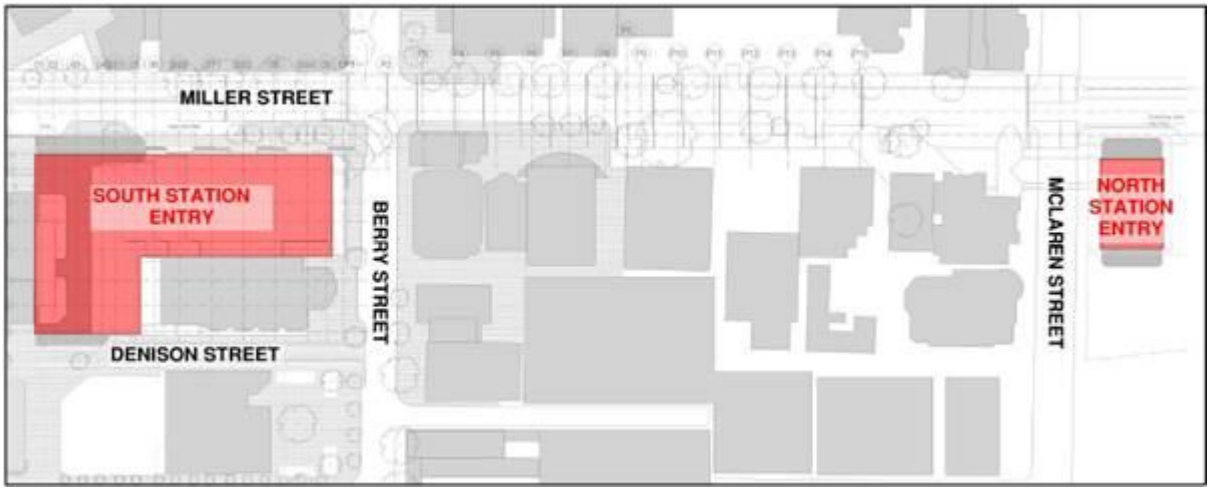


Figure 4: Location of the Victoria Cross Station entrances

2.3 The Site

The Victoria Cross station is to be located beneath Miller Street in North Sydney from McLaren Street and extending approximately 40 metres beyond Berry Street. The main cavern is 265 metres long, elliptical shaped and will house the rail tracks and platforms. The cavern permanent lining has a span of 23.8 m and a height of 15.7m and will be approximately 20 metres below ground surface. In addition, there will be a northern and southern station shaft providing access from street level to the platforms below. The surrounding vicinity of the site contains predominately medium and high-rise commercial buildings, mixed with low rise public, educational, commercial and retail buildings. Immediate neighbouring buildings have deep basements with between two and six levels below ground level. Deep basements have been identified at 50 and 65-69 Berry Street and 105-153 and 199 Miller Street.

The northern shaft will be constructed over a footprint of approximately 28 m x 35 m or 980 m^2. It will provide a link for commuters from the northern end of the cavern with McLaren Street via an eastern and western station adit.

The southern shaft covers a larger footprint and will provide a link for commuters from the southern end of the cavern with Berry and Denison Streets via an eastern and western station adit. The southern shaft footprint is configured in an 'L' shape extending 100 m parallel to Miller Street and also parallel to Berry Street covering an area of 5050 m^2.

It is noted that the VCISD project does not involve the bulk excavation of the shafts or tunnels associated with the Sydney Metro project, which will be completed by the TSE contractor. The VCISD scope if for construction of the new metro station only. As the station shafts are designed as drained structures, and tunnels are lined structures, drawdown of groundwater levels close to the project is anticipated to be to the base of the shaft and generally stable when the site is handed over to VCISD from the TSE Contractor. With bulk excavation completed by TSE, and as the VCISD scope includes detailed excavation for footings and other similar structural requirements, and the construction of the Victoria Cross Station, VCISD activities will not impact groundwater levels. Groundwater level and drawdown is not anticipated to represent a risk to the VCISD project or be the result of any VCISD works as no bulk excavation is being completed.

2.4 Key Dates and Timeframes

Key dates for preparation and submission of sustainability reports and deliverables are outlined below.

Table 2 - Project Phases

Activity	Dates
Design of Station	
Stage 2	Submit Nov 2019
Stage 3	Submit May 2020
Construction of Station	November 2020 to August 2023

3 PURPOSE

This Construction Groundwater Management Plan (CGMP) has been developed for the Victoria Cross Integrated Station Development project (VCISD) works approved under Sydney Metro City & Southwest Chatswood to Sydenham project and the Critical State Significant Infrastructure Approval (CSSI) CSSI 15_7400. This approval is for the station works, and a separate State Significant Development application has been made for the over station development (OSD) component. OSD works are not considered within this CGMP.

This CGMP is a sub-plan of the Construction Environmental Management Plan prepared by Lendlease as per Ministers Conditions of Approval (MCoA) C3. This CGMP has been prepared to outline the measures to mitigate potential groundwater impacts associated with the VCISD works. The scope of this work is approved as part of the Critical State Significant Infrastructure Approval (CSSI) CSSI 15_7400.

The CGMP has been prepared by Lendlease to address the relevant requirements of the MCoA, Revised Environmental Mitigation Measures (REMMs) outlined in Chapter 11 of the Submissions and Preferred Infrastructure Report (SPIR), and Sydney Metro Construction Environmental Management Framework (CEMF).

3.1 Objectives and Targets

In accordance with the CEMF the objectives of the CGMP are:

- Reduce the potential for drawdown of surrounding groundwater resources, as appropriate to the VCISD works
- Prevent the pollution of groundwater through appropriate controls
- Reduce the potential impacts of groundwater dependant ecosystems

In accordance with the Environmental Performance Outcomes as stated within the Sydney Metro City & Southwest Chatswood to Sydenham Submissions and Preferred Infrastructure Report, the performance targets include:

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

As the VCISD project does not involve the bulk excavation of the shafts, caverns or tunnels associated with the Sydney Metro project (to be completed by the TSE contractor prior to VCISD construction commencing) and with the VCISD scope including construction of the new metro station only, VCISD groundwater management will be focussed on monitoring of the groundwater quality of any groundwater required to be discharge offsite, and site management to prevent pollution.

3.2 Preparation and Consultation of this CGMP

This CGMP has been designed to address client expectations and requirements, and adequately address risks and stakeholder concerns. The MCoA requires the project to consult with specific authorities and stakeholders in the preparation of this CGMP. The table below indicates approval required (A), endorsement required (E) and consultation (C) required by the MCoA for this CGMP.

Table 3 - Consultation Required for the CGMP and Related Documents

Document	Primarily required by	Sydney Metro	DPI Water (Now NRAR)	ER[1]	DPIE
Groundwater Management Plan	MCoA C3(e)	C	C	E	A
Groundwater Monitoring Program	MCoA C9(d)	C	C	E	A

Note 1 – As per MCoA A24(d), the ER is required to review and endorse this CGMP, including the corresponding groundwater monitoring program, to ensure it is consistent with the requirements of the CSSI approval. For documents requiring specialist review and/or endorsement, the ER is not required to endorse the specialist content.

This CGMP, as a sub-plan of the CEMP (or equivalent document), may be submitted to The Secretary of the Department and Environment along with, or subsequent to, the submission of the CEMP but in any event, no later than one (1) month before commencement of construction. Construction must not commence until the CEMP (or equivalent document) and all required sub-plans and monitoring programs have been approved by the Secretary.

Appendix A further outlines the consultation undertaken with NRAR, the outcomes of the reviews and any follow up actions required.

4 KEY LEGISLATIVE REQUIREMENTS

Key legislation is represented in the table below.

Table 4 - Key Legislation

Legislation	Summary of Obligations	Relevance to this CGMP
Environmental Planning and Assessment Act 1979	This Act establishes a system of environmental planning and assessment of development proposals for the State.	The approval conditions and obligations are incorporated into this CGMP.
Protection of the Environment Operations Act 1997	This Act all the controls necessary to regulate pollution and reduce degradation of the environment, provides for licensing of scheduled development work, scheduled activities and for offences and prosecution under this Act.	Section 148 of the Act requires a pollution incident causing or threatening material harm to the environment to be notified to the EPA and other authorities immediately. The Act provides for the issuing of environmental protection notices to control work and activities not covered by licences. The VCISD does not constitute a scheduled activity under the Act and will not be completed under an Environmental Protection License.
Contaminated Land Management Act 1997	This Act provides for a process to investigate and remediate land that has been contaminated and presents a significant risk of harm to human health. Section 60 of the Act is a “Duty to Report Contamination”. This duty applies to owners of land and persons who become aware their activities have contaminated the land.	This plan defines how Lendlease will manage works to comply with this Act
Water Management Act 2000 *Water Management (General) Regulation 2018*	This Act and Regulation provide for the protection, conservation and ecologically sustainable development of water sources of the State and in particular to protect, enhance and restore water sources and their associated ecosystems.	The objective of this Act is to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations. Separate project approval under this Act is not required. There is no plan to actively dewater the excavation as part of the works. Groundwater will be withdrawn from sumps within the excavation where it has naturally seeped in. With reference to Clause 21(1) and Clause 3 of Schedule 4 of the Regulation, the Sydney Metro project is exempt from obtaining a Water Access Licence as the works constitute construction of rail infrastructure by a transport authority, with associated environmental impacts considered in the project Environmental Impact Statement.
Sydney Water Act 1994	This Act establishes the Sydney Water Corporation as a statutory State-owned corporation. The functions of the Sydney Water Corporation are to supply and store water, provide sewerage services, provide stormwater drainage and dispose of waste water within its area of operations.	Coordination may be required with Sydney Water during the works for a Permit to discharge treated groundwater to a Sydney Water stormwater drain

Waste Avoidance and Resource Recovery Act 2001	This Act repeals the Waste Minimisation and Management Act, 1995.The purpose of the Act is to encourage the most efficient use of resources and to reduce environmental harm in accordance with the principles of ecological sustainable development. The Act provides for the making of policies and strategies to achieve these ends. It is an offence under the Protection of the Environment Operations Act to wilfully or negligently dispose of waste in a manner that harms or is likely to harm the environment.	The relevance of the Act to this project is to implement the strategies by adopting the hierarchy of avoidance; avoidance of unnecessary resource consumption; resource recovery (including reuse, reprocessing, recycling and energy recovery), disposal (as a last resort).

4.1 Standards and Guidelines

Compliance standards, policies and guidelines relevant to Groundwater management are detailed below.

- Landcom (2004). Managing Urban Stormwater: Soils and Construction. (Volume 1 of the 'Blue Book').
- DECC (2008). Managing Urban Stormwater: Soils and Construction. Volume 2D: Main Road Construction. (Volume 2D of the 'Blue Book').
- EPA (2014) Waste Classification Guidelines
- ANZECC (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality (collectively known as the 'ANZECC Guidelines').
- ANZECC (2000). Australian and New Zealand Guidelines for Water Quality Monitoring and Reporting (collectively known as the 'ANZECC Guidelines').
- Australian and New Zealand guidelines for fresh and marine water quality (2018)
- Transport for NSW's Water Discharge and Re-use Guideline.
- NSW Office of Water (2012). NSW Aquifer Interference Policy.
- Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources (2011).

5 EXISTING ENVIRONMENT

5.1 Geology

Regionally the Victoria Cross Station is located within the Permo-Triassic Sydney Basin that is characterised by sub-horizontal lying sedimentary sequence of mainly sandstone and sandstone interbedded with siltstone and shale. The published 1:100,000 series geological map 9130 (Herbert, 1983) for Sydney, Sheet 9130 indicates that the project area is underlain by the Ashfield Shale and Hawkesbury Sandstone. The shale forms a thin veneer across the northern part of the station footprint, however drilling indicates the shale is shallow and will not be intersected by the cavern. The project footprint is located within the central part of the Sydney Basin commonly known as the Fairfield Basin where the greatest thickness of sediments are encountered. Regionally the sediments dip to the west at typically less than five degrees.

Large scale penetrative faulting is rare in the Sydney Basin (Och et al, 2009). Structurally there are major faults oriented north-north-east to south-south-west that cross cut the basement rocks. These fault zones represent zones of increased joint frequency that are referred to as joint swarms. At Victoria Cross Station no major regional geological structures intersect the cavern excavations. Low angle localised faulting has been inferred from geotechnical boreholes drilled as part of this investigation from concentrated jointing, crushed seams, shear seams and core loss. Intrusive dykes of Jurassic age intrude and cross-cut the sandstone within the Sydney Basin, although none have been mapped in the vicinity of the Victoria Cross Station.

The geology intersected at Victoria Cross Station based on geotechnical drilling and previous works is fill, residual soil and Hawkesbury Sandstone as summarised below. Fill materials are variable and range from imported soils for landscaping to locally excavated materials for the construction of buildings. Residual soils are derived from the Hawkesbury Sandstone that have been weathered in-situ to soil and still retain some of the rock fabric structure. The residual soils are typically low to high plasticity and are composed of a combination of silty clay, clay, sand and gravel. The Hawkesbury Sandstone is a medium to coarse grained, siliceous sandstone. The sandstone is interbedded with siltstone (or laminate) and shales lenses and consists of three facies including massive, cross bedded and sheet facies. Geotechnically the upper 4 to 6 metres beneath the residual soil has been classified as lower strength Class iii, iv and v sandstone in accordance with the classification system for the Sydney Basin (Pells, et al, 1998). A laminate layer (Sandstone Class iv) is present at approximately RL 57m and is approximately 1 to 2 m thick but the lateral extent of the laminate layer is unknown. Below this sandstone is good quality high strength Class i and ii sandstone.

Table 5 - Summary of subsurface conditions

Unit	RL (top of unit)(m AHD)	Thickness (m)	Description
Fill	63 to 83	0.0-1.5	Clay and silt with brick fragments
Residual Soil	62 to 70	0.0-1.0	Sandy clay sand and sand
Hawkesbury Sandstone	61 to 81	>50	Sandstone Class iv and v (up to 1.5m thick) overlying Class iii (2m to 3m thick), improving to Class ii and then Class I with depth.

Note; the VCISD project does not involve bulk excavation of the station shafts or tunnels associated with the Sydney Metro project. Bulk excavation is to be completed by the Sydney Metro Tunnel and Station Excavation (TSE) contractor prior to VCISD construction commencing. The VCISD scope is for construction of the new metro station only, which will include detailed excavation only.

5.2 Hydrogeology

The caverns and the majority of the station shafts are to be constructed beneath the existing water table level. Groundwater at Victoria Cross Station is present within the heterogeneous fractured rock aquifer of the Hawkesbury Sandstone. Previous groundwater monitoring completed by the Sydney Metro TSE contractor indicates the water table is located within the Class i and ii sandstone below the fill and residual soil at depths around 14 to 15 metres below ground level. There may be some perched groundwater within the fill or residual soil pooled over laminate lenses and recharged by rainfall. The water table is dependent upon the landscape position and the impact of neighbouring buried structures, such as deep basements and tunnels.

Regional groundwater flow within the sandstone is eastward towards the Tasman Sea. Locally, groundwater flow is influenced by natural drainage features and drained in-ground structures such as basements, tunnels or groundwater pumping.

The Hawkesbury Sandstone is characterised as a dual porosity aquifer whereby groundwater is transmitted by both the primary porosity or interconnected void space between grains of the rock matrix and the secondary porosity which is due to secondary structural features such as joints, fractures, faults, shear zones and bedding planes. The Hawkesbury Sandstone is not one aquifer but several ‘stacked aquifers’ due to the heterogeneous and layered nature of the unit. Interbedded shale lenses can provide local or extensive confining layers creating separate aquifers with different hydraulic properties including differing hydraulic heads.

Increased groundwater flow to excavations is typically associated with the intersection of major water bearing fractures. Individual joints in sandstone are typically not vertically continuous for more than 15 to 30 metres but can be horizontally persistent for up to 100 metres or more. High angle defects and joints in the Hawkesbury Sandstone are frequently open to depths of 30 metres. Groundwater discharge is primarily through baseflow to surface drainage lines and Sydney Harbour with additional discharge via evapotranspiration associated with shallow aquifer, drainage to in-ground drained structures and pumping. Recharge is predominately via rainfall infiltration. The magnitude of groundwater recharge is dependent upon land use with the highest recharge areas being parkland and bushland with urbanised areas restricting recharge due to the high proportion of hardstand areas.

Additional groundwater level monitoring data has also been received from the TSE contractor (see Appendix B), showing that the monitored groundwater levels have been stable from September 2019 to March 2020. This demonstrates groundwater levels have equalised, following the recent tunnel and station shaft excavation activities completed by the TSE contractor. No further impacts to groundwater levels are anticipated from the VCISD works as no bulk excavation, tunnelling or other activities that will impact or augment the groundwater table are to be completed.

5.3 Groundwater Monitoring Network

Four piezometers were constructed at Victoria Cross Station between 2015 and 2017. The location of these piezometers is shown in Figure 5.

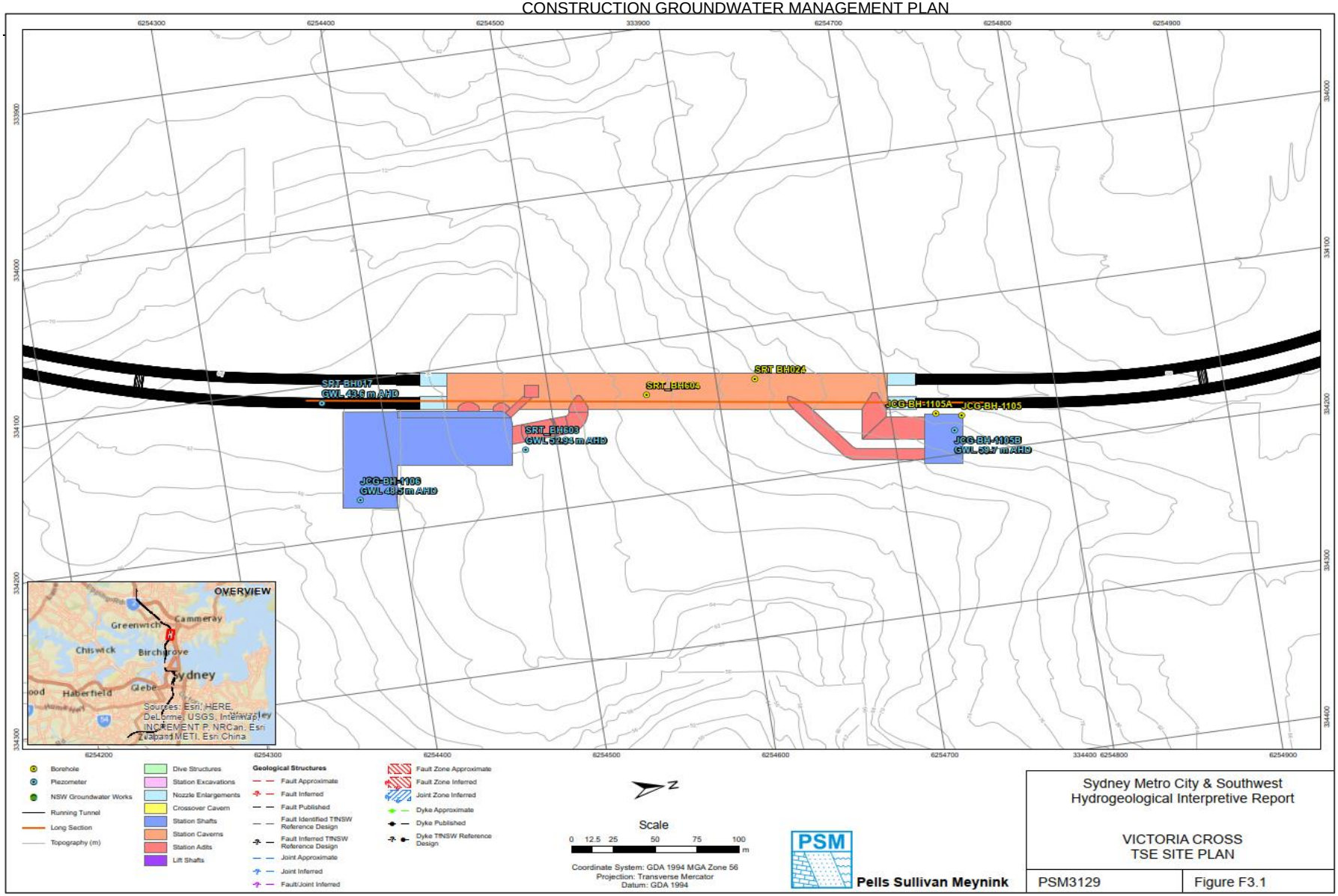


Figure 5 - Existing Piezometer Locations taken from the TSE Hydrogeological Interpretive Report

Three of the monitoring wells have been located in the southern part of the station and one located north of the station within the station shaft footprint. It is anticipated that all these piezometers will be destroyed before station construction commences. The piezometers are screened in Class i and ii Hawkesbury Sandstone with the piezometer construction details summarised below.

Table 6 - Summary of Piezometer Details, taken from TSE Hydrogeological Interpretive Report, 2018

Piezometer	Screen interval	Collar	Average SWL*	Depth mbgl**	Construction date
SRT-BH017	36.6 – 38.8	62.9	43.6	19.3	12 May 2015
SRT-BH603	1.9 – 40.1	66.9	52.9	14.0	23 Nov 2016
JCG-BH1105B	20.6 – 35.6	79.1	59.7	19.4	16 Sep 2017
JCG-BH1106	9.8 – 19.4	59.9	48.5	11.4	18 Oct 2017

*SWL - Standing water levels
**mbgl - metres below ground level

5.4 Groundwater Level Monitoring

Monitored groundwater levels in the four on-site monitoring wells as presented above have been averaged over several monitoring events. The groundwater is relatively deep ranging from 11.4 metres in the south east to 19.4m depth in the north east. It is likely that the groundwater levels are not static but are drawn down by adjacent deep basements that are dewatered. The reduced groundwater levels are shown in Figure 6 below.

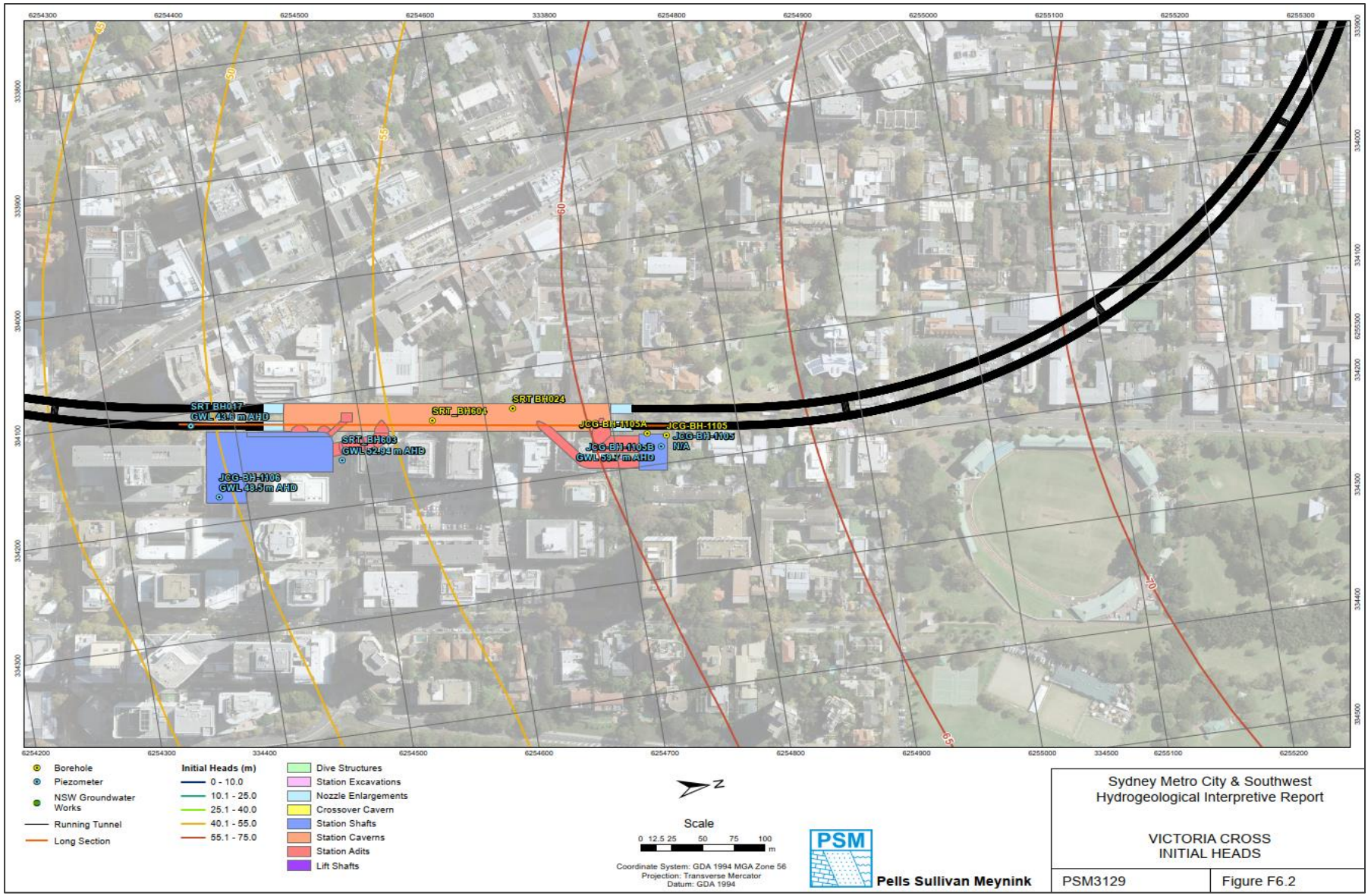


Figure 6 - Inferred baseline groundwater levels taken from the TSE Hydrogeological Interpretive Report

The groundwater contours indicate that groundwater flows to the west towards Sydney Harbour along a relatively consistent hydraulic gradient of 0.033. The relatively steep hydraulic gradient across the station footprint is reflective of the steep topographic gradient between the station and Sydney Harbour. Groundwater levels have been monitored automatically by dataloggers in selected piezometers at Victoria Cross Station by the TSE contractor as follows:

- SRT-BH017 – September 2015 to May 2016
- SRT-BH603 – November 2016 to June 2017

The existing groundwater levels are between 3m below and 12m above the crown level of the cavern excavation. Prior to January 2018 JCB-BH1105B was destroyed and JCB-BH1106 is subject to flooding and could not be accessed in March 2018. In June 2017 the data logger was in SRT_BH603 was reported to have been removed.

It is noted that the contribution of groundwater drawdown to subsidence in hard rock, as is the case at Victoria Cross, is minor to negligible. There is a comprehensive risk-based management process for the VCISD project with respect to subsidence in the project Instrumentation and Monitoring Plan outlined in section 7.5. Additional groundwater level monitoring data has also been received from the TSE contractor (see Appendix B), showing that the monitored groundwater levels have been stable from September 2019 to March 2020. The VCISD project designers have assessed the current data and confirmed that there is no design requirement to provide monitoring of external groundwater levels for the purpose of verifying structural design at any stage of the construction.

VCISD will utilise data from the TSE contractor's Hydrogeological Interpretive Report as the most appropriate baseline data. No further baseline data is proposed to be obtained.

5.5 Groundwater Quality

Groundwater within the Hawkesbury Sandstone is generally acidic but of low salinity. Elevated concentrations of dissolved iron and manganese naturally occur within the Hawkesbury Sandstone which can cause staining when discharged and oxidised. In caverns and adits groundwater ingress becomes oxidised causing the dissolved iron and manganese to precipitate forming sludge in drainage lines. Sulphate reducing bacteria (SRB) commonly occurs in the Hawkesbury Sandstone due to elevated dissolved concentrations of iron and manganese present. SRB are anaerobic but can cause severe corrosion of iron material in the groundwater as enzymes are produced which can accelerate the reduction of sulphate compounds to corrosive hydrogen sulphide.

Groundwater quality monitoring was undertaken in monitoring wells SRT-BH603 in December 2016 and SRT-BH017 in April; 2016. These results are presented below. The groundwater quality from these samples indicates the groundwater is of low salinity with minor hydrocarbon contamination detected. It is noted that during groundwater sampling pH values were initially in excess of 10, however during purging the pH declined and stabilised to around 5. The initial high pH values are attributed to grout entering the monitoring well during construction. The adopted guidelines for metals were exceeded for copper and zinc. The dissolved iron concentration is elevated which is consistent with groundwater quality monitored elsewhere within the Hawkesbury Sandstone. Minor hydrocarbon contamination (0.016 µg/L) was detected for the volatile Total Recoverable Hydrocarbon (TRH) for the chain length (C6 – C10).

Table 7 - Groundwater quality measured in SRT-BH603 and SRT-BH017, taken from TSE Hydrogeological Interpretive Report, 2018

Analyte	Unit	ANZECC 95% Marine	SRT-BH603	SRT-BH017
TDS	mg/L	-	260	^
Electrical Conductivity	µS/cm	2200	^	240
Alkalinity (as $CaCO_3$)	mg/L	-	<5	10

pH	pH units	6.5-8.0*	^	5.2
TOC^^^	mg/L	-	66	24
Total Nitrogen	mg/L	0.5*	1.5	2.1
TKN^^	mg/L	-	^	1.6
NOx as N	mg/L	0.4*	^	0.53
Ammonia as N	mg/L	0.2*	0.24	0.12
Total Phosphorous	mg/L	0.05*	^	0.3
Na	mg/L	-	46	30
Cl	mg/L	-	52	20
SO_4	mg/L	-	86	11
SRB	CFU/ml	-	<20	^
Mn	µg/L	-	200	<5
Fe	µg/L	-	4400	12
Cr	µg/L	27.4	2	<1
Cu	µg/L	1.3	16	2
Pb	µg/L	4.4	2	<1
Ni	µg/L	70	12	1
Zn	µg/L	15	190	3
TRH (C_6-C_{10})	µg/L	-	0.016	^
TRH (C_{10}-C_{40})	µg/L	-	^	Nd
PAH	µg/L	-	nd	1.1***
BTEX	µg/L	700**	nd	^

Notes:
* Lowland Rivers in south-east Australia (ANZECC, 2000)
(-) no guideline value, (^) not analysed, (nd) non detect
** guideline is for benzene only
***naphthalene detected
^^Total Kjeldahl Nitrogen
^^^ Total Organic Carbon

Additional groundwater quality monitoring will be undertaken should groundwater seepage to the VCISD site be identified, to further characterise groundwater quality and assist in assessing the level of water treatment required prior to discharge from site.

5.6 Groundwater Inflow Quantity

Groundwater inflows have been predicted for the south shaft, north shaft and cavern for a base case of hydraulic parameters. Peak seepage rates are typically expected to occur when the excavation reached its maximum depth and then declined as steady state conditions are achieved. Predicted groundwater inflows are summarised below.

Table 8 - Predicted base-case groundwater inflow rates, taken from TSE Hydrogeological Interpretive Report, 2018.

Victoria Cross	Seepage Rate (kL/day)		
	Peak	12 months post construction	Steady-state
Cavern	42	0	0
South Shaft	19	14	11
North Shaft	28	19	18

It is noted that anecdotal evidence supplied from the TSE contractor indicates that groundwater inflows have been observed to be much lower than those listed in the table above, during the bulk excavation and tunnelling activities at the Victoria Cross station location.

5.7 Predicted Groundwater Drawdown and Impacts

Groundwater inflows to the excavations will cause the water table within the Hawkesbury Sandstone to decline. As tunnel excavation and station shaft excavation undertaken by the TSE contractor continues, the inflows are predicted to peak and then decline but the depressurisation caused by the tunnel inflows would propagate to the surface causing the water table to decline and the cone of depression would extend outwards to progressively greater distances until steady state conditions are reached. Predicted steady state drawdown contours are presented graphically on Figure 7.

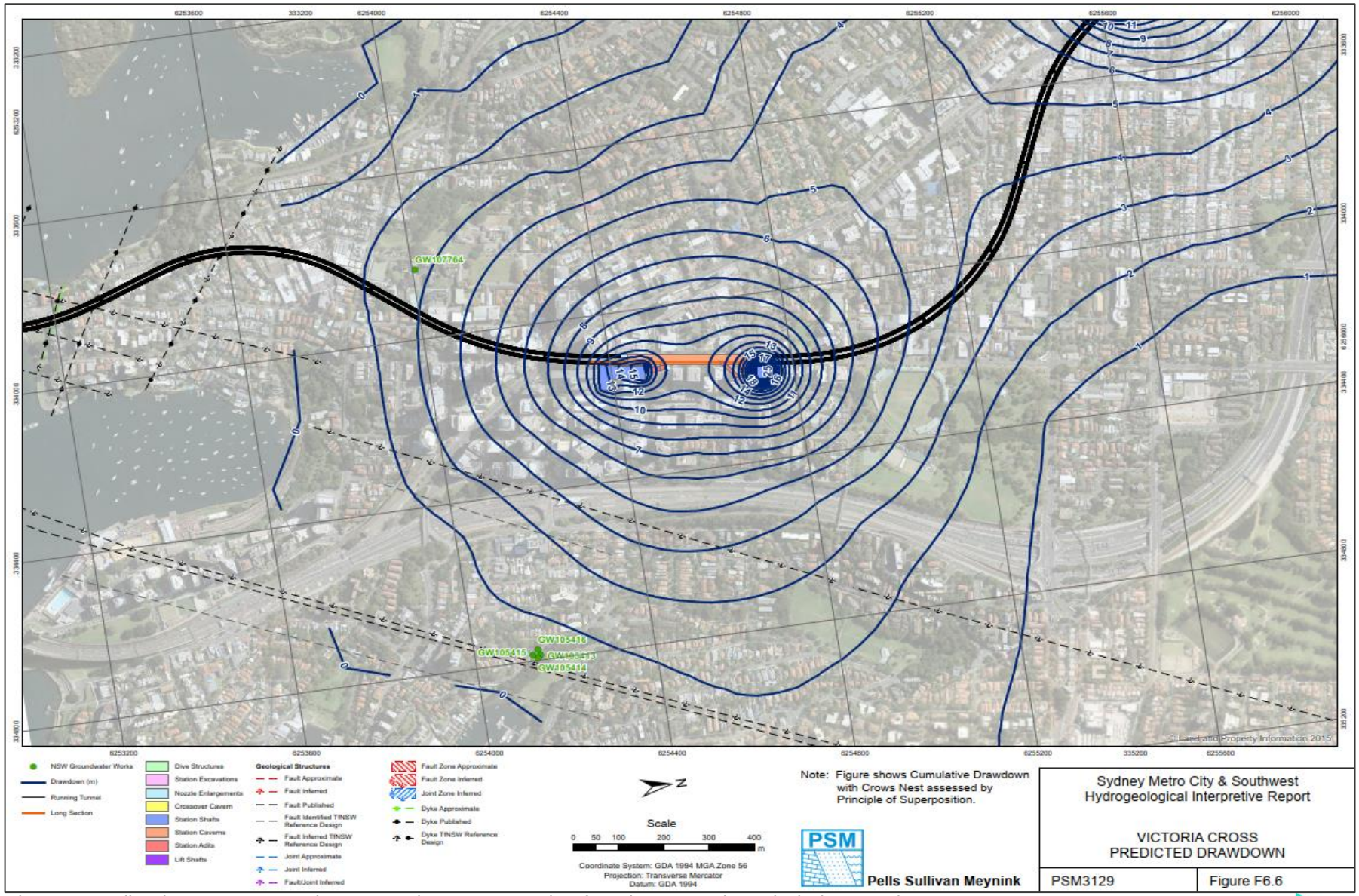


Figure 7 - Predicted Long-term Groundwater Drawdown contours taken from the TSE Hydrogeological Interpretive Report

Note; The VCISD project does not involve the bulk excavation of the station shafts or tunnels associated with the Sydney Metro project. The VCISD scope is for construction of the new metro station only. Any drawdown impacts will be due to TSE contractor bulk excavation works, prior to commencement of VCISD construction. As the station shafts are designed as drained structures, and tunnels are lined structures, drawdown of groundwater levels close to the project is anticipated to be to the base of the shaft and generally stable when handed over to VCISD from the TSE Contractor. Groundwater level and drawdown is not anticipated to represent a risk to the VCISD project or be the result of any VCISD works as no bulk excavation is being completed. No groundwater users have been identified in vicinity of the VCISD project.

5.8 Construction and Operation

Victoria Cross southern and northern station entrance shafts are designed as drained structures, whereas the Main Cavern is to be constructed as an undrained (tanked) structure. Bulk excavation of the shafts and the cavern (completed by the TSE contractor) will result in a temporary lowering of the groundwater during construction. After construction, groundwater levels will recover once the tunnel waterproofing is installed, although not to the previous levels due to on-going water loss from the drained shafts.

Throughout the operational phase, groundwater and surface water entering the shafts may be captured and treated separately. Surface water is to be discharged to stormwater and groundwater is to be treated at a purpose build water treatment plant prior to being discharged to stormwater. The operational shaft design will incorporate a permanent drainage system and sumps at low points to capture any groundwater ingress.

6 ASPECTS AND POTENTIAL IMPACTS

The key aspects and potential impacts associated with the management of groundwater measures during the delivery of VCISD works are listed in the table below.

Table 9 - Aspects and potential impacts/opportunities

Aspects	Potential impacts/opportunities	Management and Mitigation
Non-compliant water from construction works discharged from site	• Non-compliant water entering stormwater system waterways (i.e. polluting - not compliant with discharge criteria).	• Impliment water discharge criteria as per section 7.2.
Works with the potential to intercept Groundwater table	• Groundwater entering excavations without appropriate safeguards onsite could result in contaminated groundwater entering the site.	• Inflowing groundwater seepage will be directed to a centralised sump and treated by the WTP as required prior to discharge from site.
Water usage during construction activities.	• Excess usage of potable water for site activities leading to wastage	• Reuse of groundwater as appropriate, as per section 7.3
Storage of hazardous substances, leaking plant and equipment and spillage from refuelling	• Localised ground contamination / pollution of stormwater requiring clean-up and/or receiving fines. • Contamination of watercourse, riparian environment and groundwater ecosystems	• Appropriate hazardous chemcial storage facilities utilised on site. • Keep site maintained in good working order.
Groundwater drawdown in the surrounding area and settlement impacts	• There is potential for off-site impact around station excavations, where groundwater levels changes are outside of historic natural variation. Due to the permanent drained structures, there is expected to be a permanent lowering of groundwater levels in the area surrounding the station which will develop during tunnel and station shaft excavations completed by the TSE contractor. Groundwater drawdown has the potential to impact on any existing users of groundwater resources and any groundwater dependent ecosystems that may be within the surrounding area. Ground movement (or settlement) can affect nearby buildings and other structures, movement can result from ground consolidation following the drawdown of groundwater.	• Settlement monitoring of surrounding buildings will be undertaken as required by the VCISD Instrumentation and Monitoring Plan. Settlement is not anticipated to continue after completion of the excavation works by the TSE contractor. No groundwater users have been identified in vicinity of the VCISD project.

If any further aspects or potential impacts are identified through the ongoing risk assessment process implemented under the CEMP (or equivalent document) or VCISD Instrumentation and Monitoring Plan (refer section 7.5), relevant management and mitigation measures may be added to this CGMP.

7 GROUNDWATER MANAGEMENT

7.1 General Principles

Groundwater ingress to the excavations is predominantly expected to be encountered through fractures and joints in the excavation walls during station construction. This groundwater will be required to be directed into sumps at the base of the excavation where it will be pumped out. Lendlease will implement the following overarching measures relating to groundwater that is encountered during the VCISD works:

- Water sampling and testing of groundwater ingress water will be undertaken during construction to determine the most suitable treatment processes to meet the required water quality standards for discharge. Sampling and testing will be undertaken as per Section 8;
- Opportunities for groundwater reuse for construction purposes or recycling nearby will be investigated for utilisation. Should groundwater inflows and required treatment volumes be surplus to onsite construction purposes, the treated water product would be discharged into stormwater drainage;
- Discharges of groundwater from the construction water treatment plants will be subject to hold-points and be monitored to ensure compliance with the project discharge criteria;
- Intercepted groundwater to be tested and where required, treated to ensure that relevant project criteria and water quality guidelines are met, prior to discharge. A record of the water discharged off site will be kept.
- Condition surveys of buildings and structures identified as being at risk of damage would be carried out prior to the commencement of works.
- The ongoing risk assessment process set out in the VCISD CEMP and VCISD Instrumentation and Monitoring Plan will inform any changes that may be needed to groundwater management within this sub-plan.

7.2 NSW Water Quality Objectives

The NSW Water Quality Objectives (WQOs) are the agreed environmental values and long-term goals for NSW's surface waters. They set out:

- The community's values and uses for rivers, creeks, estuaries and lakes; and
- A range of water quality indicators to assess whether the current condition of waterways supports those values and uses.

WQOs have been agreed for marine waters. The objectives are consistent with the agreed national framework for assessing water quality set out in the ANZECC Guidelines. These guidelines provide an agreed framework to assess water quality in terms of whether the water is suitable for a range of environmental values. The WQOs provide environmental values for NSW waters and the ANZECC Guidelines provide the technical guidance to assess the water quality needed to protect those values. The ANZECC Guidelines provide government and the community (including regulators, industry, community groups and catchment and water managers) with a framework for conserving ambient water quality in rivers, lakes, estuaries and marine waters. As the WQOs and ANZECC Guidelines have been produced for the protection of aquatic ecosystems, drinking water, primary and secondary recreation, visual amenity and growing aquatic foods, they are not considered to trigger water pollution as defined in the Protection of the Environment Operations (POEO) Act 1997.

7.3 Water Treatment

Groundwater that seeps into the VCISD Lendlease cavern or shafts will be directed towards a designated sump (or similar) that will be pumped to a Water Treatment Plant (WTP), treated and

discharged offsite. Sampling and testing of ingress water will be undertaken to determine treatment requirements. The WTP design will consider a combination of the predicted groundwater seepage rates of 19 and 28 kL/day for the south and north shafts respectively, and also anticipated rainfall events.

The WTP is initially proposed to utilise a multi-barrier approach to the treating process consisting of the following stages:

- Primary: pre-treatment, chemical injection, coagulation, flocculation and settlement;
- Secondary: pH adjustment and continuous inline monitoring;
- Tertiary: deep bed media filtration, adsorption, and
- Sludge: sludge dewatering and offsite disposal of solids.

This treatment may be amended dependent on the actual water encountered on site. Treated groundwater quality will be sampled prior to controlled discharges from the VCISD works to confirm that the discharge criteria as detailed below are met. Water quality will be continuously monitored during the water treatment plant process prior to discharge to confirm that the discharge criteria as detailed below are met.

Table 10 – Standard discharge criteria

Parameter	Measurement and Assessment			Discharge Criteria
	Percentile Concentration Limit	Sample Method & Frequency	Units	
pH	100	Continuous/probe/grab sample. Prior to discharge	pH	6.5-8.5
Turbidity	100	Continuous/probe/grab sample. Prior to discharge	NTU	At a value calibrated to achieve <50 mg/l TSS
Total Suspended Solids	100	Continuous/probe/grab sample. Prior to discharge	mg/L	<50mg/L
Oil and grease	100	Visual	None visual	None visual

As per condition E107, the VCISD project must be constructed so as to maintain the NSW WQO's where they are being achieved and contribute towards achievement of the NSW WQOs over time where they are not being achieved. The below trigger levels will be implemented on the project for groundwater discharges at risk of containing the listed analytes. These trigger levels are subject to change during construction based on any further water quality monitoring and water impact assessments that may be completed.

WQOs have been agreed for marine waters. The objectives are consistent with the agreed national framework for assessing water quality set out in the ANZECC Guidelines. The Australian and New Zealand Guidelines for Fresh and Marine Water Quality provide a framework for setting trigger criteria based on background monitoring data. Trigger values are generally set as the 80th percentile of the median background value. Trigger values may be updated to reflect ongoing groundwater and receiving water data collection.

From section 5.5, the levels of copper and zinc were seen to be above the adopted guidelines. The dissolved iron concentration is elevated which is consistent with groundwater quality monitored elsewhere within the Hawkesbury Sandstone. Minor hydrocarbon contamination (0.016 µg/L) was detected for the volatile Total Recoverable Hydrocarbon (TRH) for the chain length (C6 – C10). As such, additional discharge criteria based on the WQOs are outlined below.

Table 11 – Additional NSW WQO discharge criteria

Analyte	Groundwater Range	80th percentile value from available data	ANZG (2018) guideline value (95% marine water)	Discharge Trigger Value
Copper (µg/L)	2-16	Insufficient data	1.3	1.3
Zinc (µg/L)	3-190	Insufficient data	15	15
Iron (µg/L)	12-4400	40	300	300

7.4 Reuse and Discharge

Where practicable the reuse of collected or treated water would be maximised through the construction works (dust suppression, etc.). Reuse on site may only occur if:

- there is no visible oil or grease;
- the pH levels are between 6.5 – 8.5;
- no erosion is caused from the discharge;
- any runoff generated by the reuse is controlled entirely within the site boundary and appropriate sediment controls are installed and maintained in accordance with the Blue Book;
- applicable health and safety standards are met.

Prior to any discharge off the premises a member from the environment team, or delegate, is to sign off that the water is suitable for discharge. Through maximising opportunities for reuse of rainwater, stormwater, wastewater and groundwater this will directly have a positive influence on further minimising use of potable water.

Offsite discharge of groundwater will generally be to the existing stormwater system.

7.5 Instrumentation and Monitoring Plan

Monitoring equipment installed in proximity to the construction site will be used to assess the potential for damage to structures, services, basements and other sub-surface elements due to strains associated with detailed excavation and potential impacts from settlement due to groundwater movement. Initial modelling indicates that there is not anticipated to be any impact as a result of drawdown on groundwater users or groundwater dependent ecosystems (in accordance with the aquifer interference policy).

As the station shafts are designed as drained structures, and tunnels are lined structures, drawdown of groundwater levels close to the project have been shown to be stable at the time of developing this plan. Groundwater level and drawdown is not anticipated to represent a risk to the VCISD project or be the result of any VCISD works as no bulk excavation is being completed. MCoA E59 and E60 requires all property owners of buildings identified as being at risk of damage will be offered a building condition survey before commencement of construction and again within three months of completion of construction. Monitoring equipment will be installed to monitor movements in proximity to the station works in accordance with the VCISD Instrumentation and Monitoring Plan. The VCISD Instrumentation and Monitoring Plan is a stand-alone document managed separately to this CGMP and describes the instrumentation and monitoring strategy to enable the verification of design assessments and inform management of works to protect adjacent / overlying structures, adjacent building and underground utilities. It focusses on the measurement of ground movements and the interaction of these with neighbouring assets. This specification provides information with regard to the following:

- Scope of works
- An outline of the works anticipated to cause stress changes in the ground and/or ground movements

- An outline description of the approach to instrumentation and monitoring
- Technical specifications, materials and workmanship for the instrumentation
- Reporting of instrumentation and monitoring.

8 GROUNDWATER MONITORING PROGRAM

The Water Quality Monitoring Program will measure the effectiveness of the mitigation measures applied as part of the Project and will be applied for the duration of the project. The methodology provided below sets out the program to be implemented to comply with condition C9 of project approval SSI 15_7400. The groundwater monitoring program will be reviewed by Sydney Metro and will be provided to NRAR for consultation, endorsed by the ER and be submitted to the Secretary (or delegate) of DPIE for approval at least one month prior to construction commencing. Consultation records are in Appendix A. This groundwater management plan and corresponding groundwater monitoring program, as approved by the Secretary 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 Secretary, whichever is the greater. Minor amendments approved by the ER may be of an administrative or minor nature and are consistent with the terms of the CSSI approval. These may include, but not be limited to, administrative amendments, amendments to monitoring frequencies or amendments to monitoring criteria. Any changes to the CGMP and corresponding groundwater monitoring program that are not considered to be minor would require approval from the Secretary, and may include changes to the potential impacts of the works where the result is not considered minor or where changes to existing conditions require reassessment and changes to groundwater monitoring requirements that are not trivial. Implementation of the groundwater monitoring program will be the responsibility of the VCISD Environment Manager, with support from the VCISD Construction Manager.

8.1 Objectives and Scope

8.1.2 *Objectives*

Activities that could result in water impacts are set out in Section 6. Lendlease's objectives for groundwater management during construction of the Victoria Cross Station are:

- Reduce the potential for drawdown of surrounding groundwater resources, as applicable to VCISD works;
- Prevent the pollution of groundwater through appropriate controls; and
- Reduce the potential impacts of groundwater dependent ecosystems.

8.1.3 *Scope*

Groundwater monitoring will be undertaken to compare actual groundwater performance outcomes against predicted performance outcomes.

8.2 Background/Baseline Data

Existing baseline groundwater quality is outlined in Section 5.5.

Existing baseline groundwater levels are outlined in Sections 5.3, 5.4 and Appendix B.

8.3 Groundwater Monitoring

Construction groundwater monitoring at the site is proposed below.

Table 12 - Groundwater Monitoring Plan

Monitoring Location	Groundwater Quality	
	Analysis Suite	Frequency
WTP – VCISD groundwater discharge only	pH, Suspended Solids, Oil and Grease, Iron, Copper, Zinc, Hydrocarbons.	*Prior to offsite discharge of VCISD groundwater from water treatment plant (WTP).
* Frequency of lab testing will consist of 3 batch tests to obtain confidence in WTP operation. This will then be reduced to daily in-line testing for the next week, then quarterly in-line testing thereafter.		

It is noted that the contribution of groundwater drawdown to subsidence in hard rock, as is the case at Victoria Cross, is minor to negligible. There is a comprehensive risk-based management process for the VCISD project with respect to subsidence in the project Instrumentation and Monitoring Plan outlined in section 7.5. Should the groundwater levels not be deemed acceptable upon completion of TSE monitoring, VCISD will continue groundwater level monitoring until such time that the groundwater levels are deemed sufficiently stable by the project designers. If no VCISD groundwater is encountered, no corresponding groundwater discharge monitoring report would be produced.

8.4 Reporting

The results of VCISD groundwater monitoring during construction will be reported on a 6 monthly basis to Sydney Metro and issued to DPIE for information via a VCISD Groundwater Monitoring Report. Groundwater monitoring will be reviewed and reported internally as per Table 12. All VCISD groundwater monitoring reports developed will be issued to NRAR 6 monthly. Should NRAR request not to receive the groundwater monitoring reports, they will not be issued.

8.5 Review

Groundwater quality will be compared against the compliance requirements outlined in Sections 1 and 7. Should water discharge criteria not be met, the water will be recirculated to onsite water storage and Water Treatment Plant (WTP) for further treatment. The WTP operation would be assessed in accordance with the supplier operation and maintenance manual to ensure it is working as designed and identify any required maintenance.

8.6 Groundwater quality

Groundwater that seeps into the VCISD site will be directed towards a designated sump and pumped to a Water Treatment Plant (WTP), treated (as required) and discharged offsite. Water sampling and testing of will be undertaken to determine treatment requirements to ensure compliance of discharged water with the project requirements.

The ANZECC guidelines and NSW Water Quality Objectives provide a framework for setting trigger criteria based on background monitoring data. Trigger values are generally set as the 80th percentile of the median background value and may be updated to reflect ongoing groundwater data collection. Relevant criteria are outlined in Section 7.

8.7 Risk Assessment

The ongoing risk assessment processes set out in the VCISD CEMP (or equivalent document) and the VCISD Instrumentation and Monitoring Plan and associated specification will inform any changes that may be needed to groundwater management measures detailed within this sub-plan.

As per the VCISD CEMP (or equivalent document), an Impacts & Hazards Risk Assessment (IHRA), will be completed prior to commencement of the construction stages of the project. The risk assessment will include any open or unresolved risks that require management in the construction stages of a project that were identified during design reviews. The completion of the IHRA is conducted in accordance with the methodology outlined in the LLB EHS Risk Management Procedure, which requires all key risks rated as moderate or greater specific to the project to be included in the IHRA. To ensure the IHRA remains current it will be reviewed:

- during project coordination meetings when reviewing the next 4-6 weeks of activities; and
- at maximum six (6) week intervals during Project Review Meetings.

Should additional mitigation measures be identified during the IHRA process, this CGMP will be reviewed and amended as required in consultation with the ER and, where required, DPIE.

Groundwater discharge criteria and quality will be assessed at the frequencies outlined in Table 12. Should any non-compliances be raised, this frequency will be reassessed in consultation with the ER.

The VCISD Instrumentation and Monitoring Plan and associated specification sets out the requirements for monitoring of structural elements within the VCISD remit to ensure these elements perform as per design predictions. Monitoring of deflections and movements will be completed throughout construction to verify the performance of the design and construction methods and help to identify any potential adverse effects on structural interfacing elements. By monitoring structural elements during construction, it is the intention that sufficient notice would provide the ability to identify any adverse effects and provide a safeguard to implement contingency measures to rectify potential problems during construction. Furthermore, the specification outlines the requirements of instrumentation and monitoring to enable a comparison of actual movements against acceptable design values.

Groundwater level and drawdown is not anticipated to represent a risk to the VCISD project or be the result of any VCISD works as no bulk excavation is being completed. It is also noted that the requirements of REMM GWG1 or GWG2 have not been applied to VCISD in the project Staging Report.

APPENDIX A – AGENCY CONSULTATION

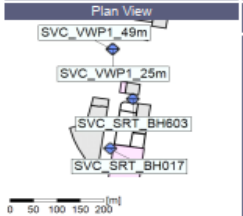
Stakeholder	CHMP revision and issue date	Comments received
DPI-Water (Natural Resources Access Regulator - NRAR) Note: this is for review of both the CGMP and corresponding monitoring program included in Section 8.	Rev A, 17/04/20	**01/05/20** – After follow up by Lendlease, NRAR acknowledge receipt of the CGMP and request for review received.
		22/06/20 – After follow up by Lendlease, NRAR confirmed they referred the CGMP review to DPIE Water.
		03/06/20 – Lendlease contacted by DPIE water to clarify if VCISD were completing any bulk excavation or tunnelling works that may impact groundwater levels, or if these works will be completed when VCISD commences. Lendlease clarified that the VCISD works did not include excavation of the station shafts, caverns or tunnels, and that these are completed and managed by the TSE contractor. Further to the above confirmation, verbal confirmation from DPIE Water received that they had no comments on the VCISD CGMP.
		09/07/20 – No comments from NRAR or DPIE Water received by finalisation of this plan on 09/07/20

APPENDIX B – ADDITIONAL TSE GROUNDWATER MONITORING RESULTS

Project: Metro2 TSE
Construction: SVC Water Level Monitoring
Location:

GEODATA

Plan View

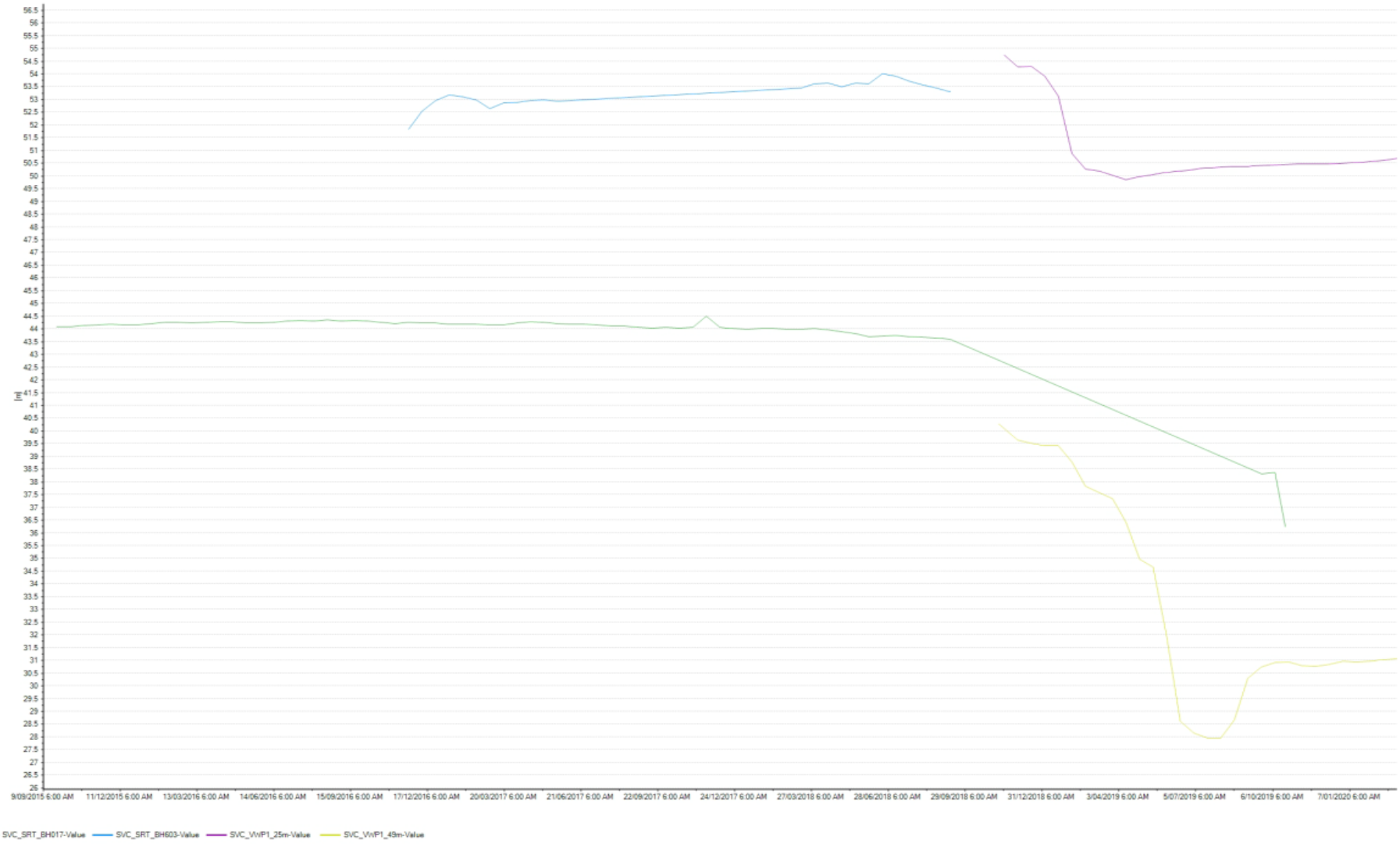


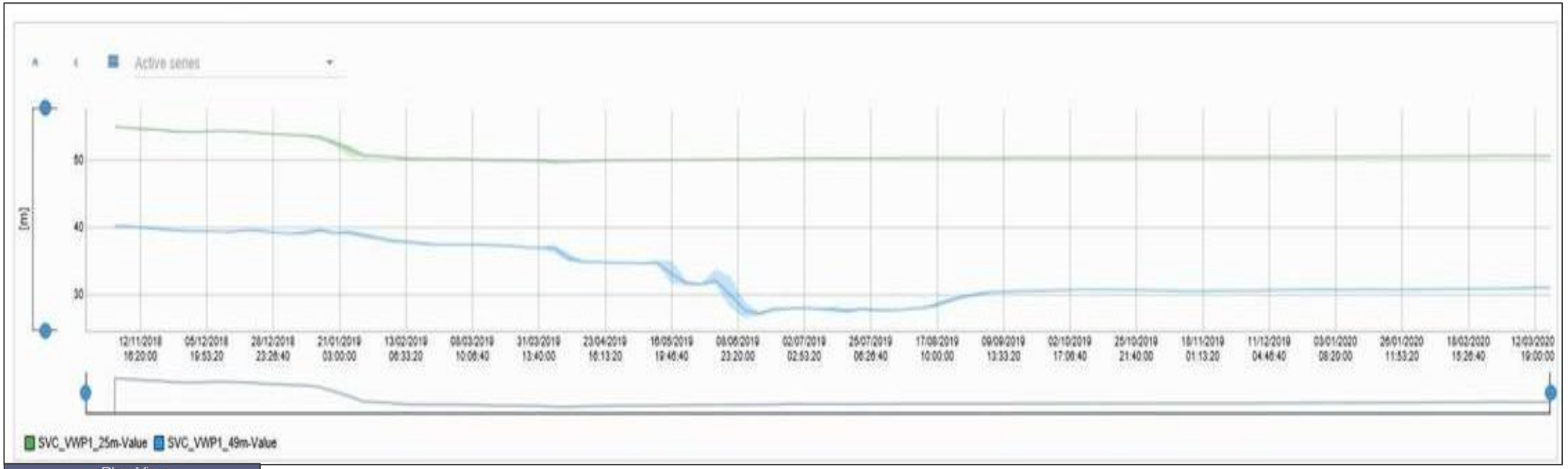
New zero measurements

- SVC_VWP1_49m **31/10/2018 3:00 PM**
- SVC_VWP1_25m **31/10/2018 3:00 PM**
- SVC_SRT_BH603 **16/11/2016 11:00 PM**
- SVC_SRT_BH017 **16/09/2015 4:00 PM**

Remarks

SVC_SRT_BH017 and 603 and SVC_VWP1

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31/03/2019 13:40:00
23/04/2019 17:13:20
16/05/2019 19:46:40
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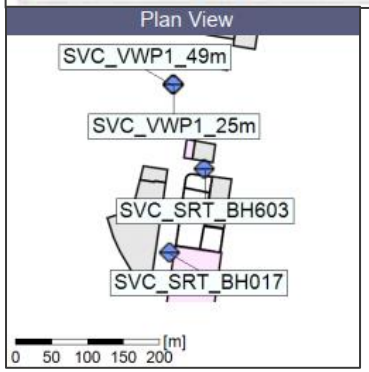
SVC_VWP1_25m-Value
SVC_VWP1_49m-Value


Plan View
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SVC_VWP1_25m
SVC_SRT_BH603
SVC_SRT_BH017
[m]
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