Construction Water Reuse Strategy

Western Harbour Tunnel - Southern Tunnelling Works

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Western Harbour Tunnel – Stage 3A

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Document control

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Contents

Glossary / Abbreviations

Table 1-1: Table of common abbreviations used within this document

Abbreviation	Definition
CoA	Conditions of Approval
CSSI	Critical State Significant Infrastructure
CWRS	Construction Water Reuse Strategy
IS	Infrastructure Sustainability
ISC	Infrastructure Sustainability Council
JHCPB	John Holland CPB Contractors Joint Venture
kL	Kilolitre
ML	Megalitre
The Project	Western Harbour Tunnel – Southern Tunnelling Works, Stage 3A of the Western Harbour Tunnel / Warringah Freeway Upgrade project
REMM	Revised Environmental Management Measure as outlined in the Submissions Report
Stage 3A	The Project
WTP	Water Treatment Plant

1 Introduction

1.1 Project description

The Western Harbour Tunnel and Warringah Freeway Upgrade comprises a new motorway tunnel connection across Sydney Harbour, and an upgrade of the Warringah Freeway to integrate the new motorway infrastructure with the existing road network and to enable the future connection of the Beaches Link and Gore Hill Freeway Connection project.

The Western Harbour Tunnel will connect the approved M4-M5 Link in Rozelle to the Warringah Freeway at North Sydney/Cammeray. Stage 3A (the Project and subject of this Strategy) of the project includes the following key features:

- A portion of the twin mainline tunnels connecting the M4-M5 Link at Rozelle to the Warringah Freeway, near Cammeray, of about 2 kilometres long and commencing from the stub tunnels at the M4-M5 Link in Rozelle and terminating underground at Birchgrove
- Ventilation cavern and tunnel excavation in Rozelle
- Limited in tunnel operational infrastructure including road pavement and drainage to enable Stage 3B works

The construction of the Project, Stage 3A, will be supported by two surface based ancillary facilities, located at the Western Harbour Tunnel cut and cover structure in Rozelle and at White Bay in Rozelle. The Western Harbour Tunnel and Warringah Freeway Upgrade project was declared to be Critical State Significant Infrastructure (CSSI) by the Minister for Planning and Public Spaces (the Minister) on 9 November 2020 and approved by the Minister on 21 January 2021.

In accordance with CoA E127, a Water Reuse Strategy must be prepared based on best practice and advice sought from relevant agencies, as required, which sets out options for the reuse of collected stormwater and groundwater during construction and operation.

1.2 Scope of this strategy

The scope is to identify water reuse for options for Stage 3A. Water reuse is limited to groundwater and rainwater collected within the Project boundary.

This strategy addresses and details the following issues:

- Water use requirements for tunnelling works.
- Rainwater harvesting and management, and
- Groundwater management throughout the tunnelling works, including treatment, storage and discharge.

The Construction Water Reuse Strategy (CWRS) must be applied prior to the commencement of tunnelling works and will be implemented throughout construction as applicable.

1.3 Objectives

This strategy must include, but not be limited to:

- Evaluation of reuse options.
- 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.
- Measures to avoid misuse of recycled water as potable water.

- Consideration of the public health risks from water recycling, and
- A time frame for the implementation of the preferred reuse option(s).

2 Environmental Requirements

2.1 Conditions of Approval

A Water Reuse Strategy is required by the Minister's Condition of Approval (CoA) E127. A description of compliance with the requirements of this CoA and where they are addressed in this strategy are detailed in Table 2.

Table 2-1: CoA relevant to this strategy

Approval Requirement	Requirement	Reference
CoA E127	Water Reuse Strategy must be prepared, which sets out options for the reuse of collected stormwater and groundwater during construction and operation. The Water Reuse Strategy must include, but not be limited to:	This Strategy
a)	Evaluation of reuse options;	Section 5
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 licenses or approvals that may be required;	Section 6
c)	Measures to avoid misuse of recycled water as potable water	Section 5.1.3
d)	Consideration of the public health risks from water recycling;	Section 5.1.3
e)	A time frame for the implementation of the preferred reuse option(s).	Section 6
	The Water Reuse Strategy must be prepared based on best practice and advice sought from relevant agencies, as required. The strategy must be applied during construction. Nothing in this condition prevents the Proponent from preparing separate Water Reuse Strategies for the construction and operational phases of the CSSI.	Section 5.1.6

2.2 Environmental Management Measures

The relevant Revised Environmental Management Measure (REMM), as identified in Part D of the Submissions Report, is listed in Table 3 below. This includes reference to wastewater generation and disposal in the construction phase, and where it has been addressed in the CWRS.

Table 2-2 Revised Environmental Management Measure relevant to this CWRS

Ref #	Phase	Commitment	Document reference	How Addressed
WM5	Construction	Opportunities for wastewater reuse and recycling, including recirculating water during tunnel excavation to use for dust suppression and offsite reuse, will be investigated and implemented where feasible and reasonable.	Submissions Report Part D	Section 6

2.3 Infrastructure Sustainability Council

As required by the CoA and REMMs, The Project must develop a strategy to achieve an 'Excellent' rating under the Infrastructure Sustainability (IS) Rating scheme. As part of the strategy, the Project is targeting the following IS Rating benchmarks relating to the Water Category. Note that these targeted credits and levels may alter throughout the life of the Project.

Table 2-3 Indicative IS rating targets

Credit	Name of credit	Target Level	Target Score	Comments
Wat-1	Water use monitoring and reduction	1	0	This credit requires operational water savings and cannot be achieved within the scope of Stage 3A if As Built rating is pursued as a standalone rating.
Wat-2	Replace Potable Water	0	0	This credit requires replacement of potable water across the project lifecycle. A technical clarification with the Infrastructure Sustainability Council may be required to change the evidence required just to the construction scope otherwise the Project will not be eligible for points from this credit.

2.4 Associated plans, approvals and reference documents

This CWRS has been developed in accordance with the Project documents and approvals listed below. This strategy supports but does not replace or supersede the following:

- Western Harbour Tunnel & Warringah Freeway Upgrade Environmental Impact Statement
- Western Harbour Tunnel & Warringah Freeway Upgrade Submissions Report and Preferred Infrastructure Report
- Stage 3A Construction Environment Management Plan and subplans:
    - Stage 3A Soil and Surface Water Management Plan
    - Stage 3A Groundwater Management Plan
- Stage 3A Sustainability Strategy

- Stage 3A Environmental Protection License

3 Water Requirements

3.1 Construction phase water requirements

The following water demands have been identified during construction;

- Tunnelling activities.
- General wash down and wheel wash exit controls.
- Drinking water and bathrooms, and
- Dust suppression.

Two ancillary facilities will support construction of the Project as detailed in Table 5. Compound WHT12 is required to support construction of the tunnels. Compound WHT3 may be utilised as a laydown.

Table 5 Project construction ancillary facilities water demand

Location	Water demand
WHT Tunnel site (WHT12) Predominantly underground beneath the WHT portal at City West Link Rozelle Operational 24 hours a day, 7 days a week	Drinking water Amenities Laundry Dust suppression Wheel washing Water treatment plant filter washing
WHT Support Site (WHT3)	None identified due to the activities proposed for the site.

3.1.1 Tunnelling Works

Tunnelling works will operate out of the Western Harbour Tunnel cut and cover structure (WHT12) to support the tunnelling works. Tunnelling will utilise both potable and non-potable water.

There is substantial demand for water within tunnel operations from the operation of roadheaders, associated drilling machinery and shotcreting activities. Roadheader machines in tunnelling operations on the Project will use a closed-loop system for cooling which significantly reduces water demand. Water used in tunnelling operations, such as spraying the cutterhead during excavation and dust suppression, have strict water quality requirements due to the potential for system blockages.

The specific activities within the tunnel construction that require water are:

- Operation of roadheader machines.
- Operation of bolter machines.
- Surface preparation prior to shotcrete.
- Dust suppression during tunnelling.
- Equipment washdown.
- Rock and concrete cutting, and

- Drinking water, wash and safety facility.

4 Initial Water Use Assessment

The Project will adopt the Water Use and Sourcing Hierarchy illustrated in figure 1.

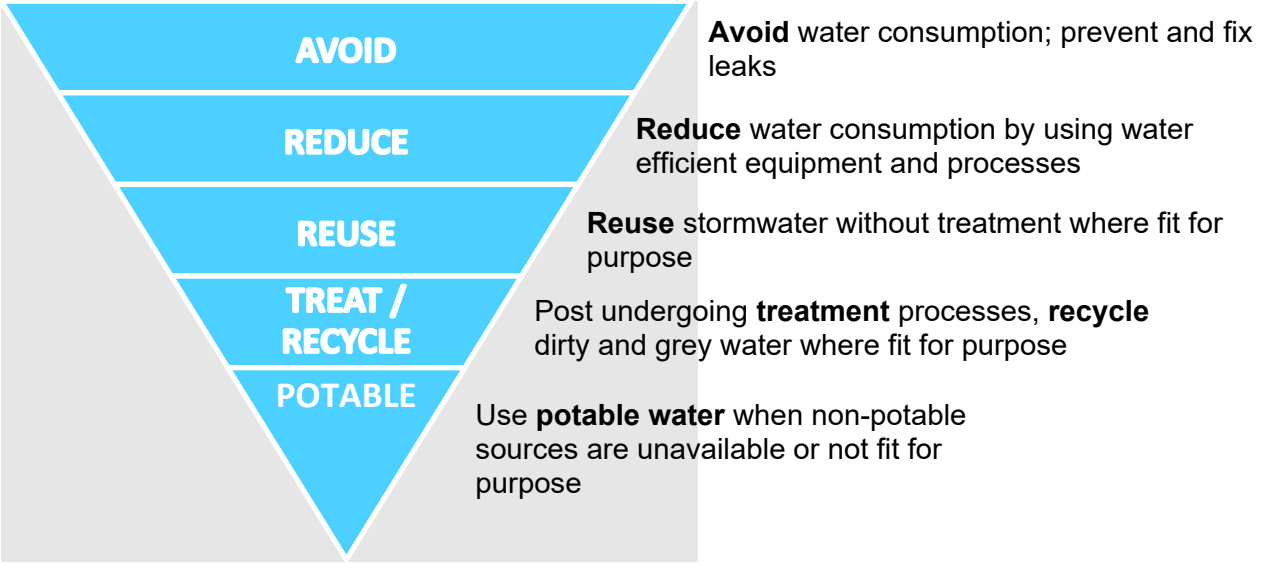


Figure 1: Water Use and Sourcing Strategy

The site will have access to potable water through metered connections to the Sydney Water network. During construction, potable water will supply the site offices and amenities and be used as feedwater to the tunnelling machinery in line with manufacturer's specifications.

Opportunities for the use of non-potable water in place of potable water have been assessed in accordance with the Project Sustainability Strategy. Use of non-potable water will depend upon workplace health and safety considerations, economic feasibility, any relevant manufacturers or design specifications and the availability and quality of non-potable water.

Treatment and reuse of non-potable water falls into two main categories:

1. Rainwater, and
2. Groundwater.

4.1 Rainwater

Rainwater harvesting using rainwater collection tanks will be a method of non-potable surface water capture on site. Rainwater may be used to flush toilets, wash down plant and dust suppression. Rainwater will be collected from the roof of the site offices.

4.2 Groundwater

Groundwater will enter the tunnels once excavation commences. The groundwater and any residual construction water (from rock bolting activities, etc.) will be combined and pumped to the water treatment plant as one stream. This water will then be treated to meet the discharge specifications of a NSW Environment Protection Authority issued Environmental Protection License.

The Project will have one construction WTP as detailed in Table 7. Testing, treatment, and discharge of groundwater will be undertaken in accordance with the Groundwater Management

Plan. Treated water may be used for flushing toilets, dust suppression, general wash down, cleaning, and wheel wash.

5 Evaluation of Reuse Options

The Project has evaluated the non-potable water reuse opportunities for the construction phase of the Project. Suitable, unsuitable, and preferred options are outlined in Table 5.

Table 5-1: Evaluation of reuse options

Non-Potable Water Source	Evaluation of Reuse Option	Justification	
Surface water: Stormwater	Unsuitable	As there is no surface capture area, storm water will not be captured for reuse.	
Recycled water network	Unsuitable	No network/pipeline exists within a feasible pumping distance for the Project to utilise. The use of any such network is prohibited by cost and distance.	
Surface Water: Rainwater	Suitable	Although the high variability of supply reduces the reliability of this source and the return on investment, the Project will capture and reuse rainwater. See Table 6 for further detail.	
Treated Groundwater: Groundwater ingress	Preferred	Due to the volume and consistency of supply, there is a significant opportunity for reuse of groundwater once treated. See Table 7 for further detail.	

5.1 Considerations for water reuse

5.1.1 Climate Conditions

The combination of periodic droughts in Sydney and high demand places stress on the potable water supply. The Project is committed to the efficient consumption of water inclusive of reuse, where feasible and reasonable, to help alleviate the pressure on potable water demand.

5.1.2 Rainwater collection

The demountable site offices are the only part of the WHT12 ancillary facility not underground. The roofs of the site offices can be used to capture rainwater which can be stored in tanks. Storage tanks adjacent to the site office make collected rainwater suitable for supply to office amenities. The relatively small roof size will not come close to collecting sufficient rainwater to meet the commonly used 4-year payback threshold typically used to assess such initiatives. Regardless the Project will implement a collection system. During periods where the rainfall does not supply sufficient water, the tanks can be topped up with treated groundwater.

5.1.3 Public Health

The Project has considered the potential health risks associated with reusing treated water on site. Reuse strategies identified in Table 6 aim to mitigate these risks. Furthermore, measures such as treating groundwater through an additional chlorination layer, implementing a water quality

monitoring program, and clearly labelling non-potable infrastructure, will prevent any health risks to on-site workers or misuse of recycled water. The public will not have contact with treated or reused water under the above system, therefore public health risks are considered negligible, and advice was not required from relevant agencies.

5.1.4 Concrete

Concrete will arrive to the Project pre-mixed and the use of non-potable water for batching plant production will be encouraged. The primary concrete supplier to the Project is Hanson. Hanson will use recycled water wherever possible and report monthly on the non-potable usage.

5.1.5 Recycled water network

No network/pipeline exists within a feasible pumping distance for the Project to utilise. The use of any such network is prohibited by cost, distance and scope of the Project.

5.1.6 Best Practice and Advice

This Strategy has considered water use practices and advice from similar major infrastructure projects in NSW. These projects include;

- Warringah Freeway Upgrade
- M4 East
- M8 (New M5)
- Parramatta Light Rail Stage 1
- M6 Motorway Stage 1
- Sydney Metro – Tunnels, Stations and Civil works
- Sydney Metro – Systems and Station Fit-out
- Western Sydney Airport
- Western Sydney Airport Metro – Stations, Boxes and Tunnel works
- M4-M5 Link
- Rozelle Interchange

In accordance with this Strategy, water reuse will be taken up at all identified opportunities within the scope of JHCPB's work. There are no potential uses where water is not being reused where agency consultation is required to achieve best practice. Therefore, agency consultation is not required at this stage.

5.1.7 Groundwater reuse in tunnelling operations

Tunnelling water use is detailed in Section 3.1.1.

To transfer water into the tunnel, industrial potable water lines are installed along the tunnel wall and equipped with booster pumps at designated intervals. This water is then readily accessible for use in tunnelling operations.

Recycled water will be used at the plant washdown bay.

Recycled water was investigated for use in the grout mixing process where 6L of water is required for every 20kg of grout. A specially developed high yield thixotropic cable bolt grout is required for the encapsulation of roof bolts and cable anchors during tunnel support operations. Specifications for this product state that only potable water is to be used in the process of mixing grout. Therefore, treated recycled water is deemed unsuitable specifically due to chloride and sulphate levels.

6 Preferred Options and Reuse Activities

Based on the evaluation detailed in Section 5, the Project has determined the most feasible and reasonable option for water reuse on the Project is the use of treated groundwater for tunnelling activities such as plant wash down, dust suppression and wheel wash, combined with rainwater capture for office amenities.

Table 6 below details and evaluates each of the reuse opportunities.

Table 6-1 WHT water reuse options and activities

Western Harbour Tunnel site (WHT12)				
Non Potable Water Source	**Available Volume for Reuse per annum**	**Reuse Activities**	**Considerations/ Justification**	**Implementation Period**
Construction Water treatment plant	126Ml treated construction water 30kL storage tank	Treated water will be used for activities such as wheel wash, plant wash down and dust suppression.	The WHT site will comprise of a single WTP located under the cut and cover structure of the WHT. Treated water will be pumped into a 30kL tank then diverted for onsite reuse or discharged into the registered discharge point in accordance with the Project Environmental Protection License. Available treated water for reuse will be governed by the volume of water generated and demand. The 30kL tank is a header tank and will continually fill as water is treated and drawn off for reuse. As treated water doesn't meet drinking water standards it will not be for domestic purposes such handwashing and laundry cleaning. The use of treated water to wash plant underground has been assessed. Hardness and conductivity tests have been undertaken to compare to plant specifications. Reuse will be implemented for this purpose.	Treated groundwater will be available for reuse after the WTP has been installed, tested and commissioned and when groundwater ingress is occurring within the excavated tunnels.
Rainwater	1Ml rainwater (based on average annual historic precipitation)	End uses for water from rainwater tanks may include toilet flushing, uniform laundering and compound cleaning.	Two 5kL tanks will capture rainwater from the WHT12 site offices during construction. This water will be reused and feed the toilets and plant washdown area.	Rainwater collection and storage will commence following installation of the site office and the WTP.

7 Monitoring and Reporting

To monitor performance a quarterly sustainability report will be produced by JHCPB and provided to Transport for NSW. This report will include monthly volumes of potable water consumption and the volume of total water reuse on site.

The Project will monitor water consumption (including non-potable usage) throughout construction using the following control methods:

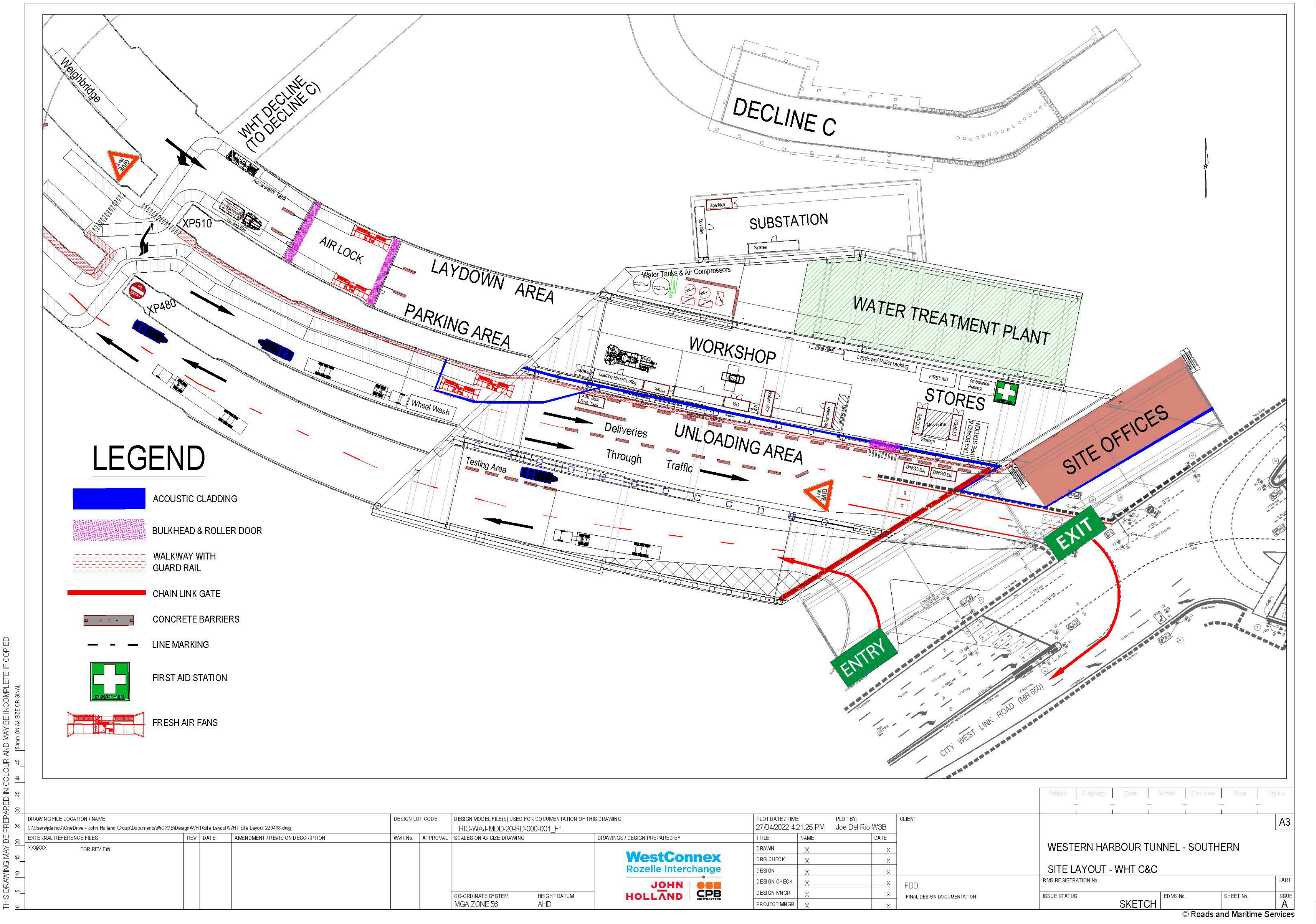
- Smart metering at key locations to allow site water consumption to be monitored and recorded;
- Flow meters in WTP to monitor discharge and reuse volumes;
- Smart meters at water cart refill outlet; and
- Monthly Supplier and Subcontractor reporting (where applicable e.g. concrete).
- Rainwater capture will be monitored by using site rainfall data combined with catchment area and storage capacity.

Potable and non-potable water usage will be reviewed and reported quarterly as part of the WHT quarterly sustainability reporting. The ISC targets detailed in Section 2.3 will be reviewed periodically as part of the JHCPB IS rating submission/s and Independent Sustainability Reviews.

8 Conclusion

The Project is committed to using non-potable water sources whenever they are available and fit for purpose. At the peak of tunnel construction, the WTP on the Project will treat and discharge upwards of 345kL of groundwater per day (based on max. 4 L/s peak flows). As detailed in Section 6, storage tanks will be installed at the tunnelling compound for water reuse during wheel washing, plant cleaning, dust suppression and cleaning of the tunnel compounds. The combination of treated groundwater and rainwater reuse will significantly ease the pressure placed on potable water demand. As construction progresses, JHCPB will continue to investigate future potential water reuse options on the Project.

9 Appendix A – Site Layout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SUBSTATION
Water Tanks & Air Compressors
WATER TREATMENT PLANT
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SITE OFFICES
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Traffic
UNLOADING AREA
Testing Area
EXIT
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LEGEND
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