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Belmont Desalination Plant

Construction Groundwater Management Plan

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Revisions and Distribution

Revisions

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Glossary/ Abbreviations

Abbreviations	Expanded text
ANZECC	Australian and New Zealand Environment Conservation Council
ANZG	Australian and New Zealand Guidelines
Assessment Documentation	Hunter Water Corporation Belmont Desalination Plant Environmental Impact Statement, prepared by GHD dated 2019 Hunter Water Corporation Belmont Desalination Plant Amendment Report and Submissions Report prepared by GHD dated 2020 Hunter Water Corporation Belmont Desalination Plant Modification Report Environmental Impact Statement prepared by Jacobs dated 2024 Hunter Water Corporation Belmont Desalination Plant Modification Report – Submissions Report prepared by Jacobs dated 2024
BTEX	Benzene, Toluene, Ethylbenzene Xylene and Naphthalene
CoA	Conditions of Approval
CoC	Chain of Custody
CSWMP	Construction Soil and Water Management Sub-plan
EIS	Environmental Impact Statement
EPA	Environmental Protection Authority
EPL	Environment Protection Licence
ER	Environmental Representative
HWC	Hunter Water Corporation
NATA	National Association of Testing Authorities
PAH	Polycyclic Aromatic Hydrocarbon
PFAS	Per- and polyfluoroalkyl substances
PQL	Practical quantification limit
QA	Quality Assurance
REMM	Revised Environmental Management Measures
SWL	Standing Water Level
TARP	Trigger Action Response Plan
TDS	Total dissolved solids
TPH	Total petroleum hydrocarbons
TRH	Total Recoverable Hydrocarbons
TSS	Total Suspended Solids
WQ	Water Quality

1. Introduction

1.1 Context

This Construction Groundwater Management Plan (CGMP) is an appendix of the Construction Environmental Management Plan (CEMP) for the Belmont Desalination Plant Project (The Project).

This CGMP has been prepared for the Project, to address the requirements of the Minister's Conditions of Approval (CoA), the measures listed in the Environmental Impact Statement (EIS) as amended by the Modification Report Submissions Report (known as the Revised Environmental Management Measures (REMMs)), and all applicable legislation.

1.2 Scope of the CGMP

The scope of this CGMP is to describe how the groundwater will be monitored during the delivery of the Project. This CGMP has been prepared under and consistent with the CEMP, considering relevant sensitive receivers and construction activities.

Operational monitoring measures do not fall within the scope of the construction phase and therefore are not included in this CGMP.

HWC appointed consultants have been engaged to undertake pre-construction monitoring of the receiving surface water and groundwater for the Project. Following Department of Planning, Housing and Infrastructure (DPHI) approval of this document and the CEMP, John Holland (JH) will commence monitoring and reporting during construction. A copy of this CGMP will be kept on the premises for the duration of construction.

1.3 Environmental Management Systems overview

The Environmental Management System (EMS) for the Project is described in the CEMP. To achieve the intended environmental performance outcomes, JH have established, implemented, maintained and continually improved an EMS in accordance with the requirements of ISO14001:2015.

This CGMP has been developed consistent with the CEMP and the EMS.

1.4 Approval, review and modification

This CGMP will be reviewed by the HWC Environmental Manager (or delegate) and the ER to confirm it is consistent with, and incorporates, all relevant requirements, prior to submission to the Planning Secretary.

Construction of the Project will not commence until the CEMP, including this CGMP, are endorsed by the ER and approved by the Planning Secretary.

The CGMP will be implemented for the duration of construction and for any longer period set out in this CGMP or specified by the Planning Secretary, whichever is the greater. This CGMP will be reviewed if there are any changes to construction techniques with the potential to affect groundwater management or monitoring in consultation with HWC. Minor amendments to this CGMP will be approved by DPHI as detailed in the CoA.

Any amendments to the CGMP will be documented in subsequent revisions of this CGMP. A copy of the updated CGMP and changes will be distributed to all relevant stakeholders. Site personnel with responsibilities relevant to groundwater monitoring will be informed of any amendments to the CGMP and training provided, where required.

2. Purpose and objectives

The purpose of this CGMP is to describe how, where and when JH will monitor for groundwater during construction of the Project including:

- Provide procedures to manage and monitor for groundwater impacts during construction of the Project
- Provide procedures for the monitoring of groundwater removed from excavations for all construction methods
- Provide procedures to prevent groundwater contamination
- Meet the requirements of the relevant conditions of approval and REMMs for the Project
- Meet any relevant legal and other requirements for the Project.

The CGMP is based on the groundwater monitoring methodology, indicators and the monitoring locations identified in the assessment documentation, along with the Preliminary Groundwater Assessment (Ramboll, 2024) for the project.

The key objective of the CGMP is to ensure that impacts to the groundwater table are minimised. To aid in achieving this objective all CoA, environmental mitigation measures and licence/permit requirements relevant to groundwater management are described, scheduled and assigned responsibility as outlined in:

- Environmental Assessment Documentation
- Infrastructure Approval CoA (SSI 8896)
- Sustainability Strategy
- All relevant legislation and other requirements.

3. Environmental Requirements

3.1 Conditions of Approval

The NSW CoA relevant to this CGMP and their applicability to each stage of the Project are listed in Table 3-1. A cross reference is also included to indicate where the condition is addressed in this CGMP or other project management documents.

Table 3-1: NSW CoA relevant to the preparation of this CGMP

CoA	Groundwater REMM	JH Action / Document Reference
C11	Prior to the commencement of construction, the Proponent must submit a Construction Environmental Management Plan (CEMP) to the Planning Secretary for approval. The CEMP must include, but not be limited to, the following: (iv) groundwater management plan including measures to prevent groundwater contamination;	• This Plan, specifically Section 6.2

3.2 Revised Environmental Management Measures

The REMMs relevant to this CGMP and their applicability to each stage of the Project are listed in Table 3-2. A cross reference is also included to indicate where the condition is addressed in this CGMP or other project management documents.

Table 3-2: REMMs relevant to the preparation of this CGMP

ID	Groundwater REMM	JH Action / Document Reference
WR9	• Use of sheet piling, or similar, to support excavations and reduce groundwater inflow for all construction methods will be investigated during detailed design. This applies to all construction methods.	• Detailed design reviews have identified the construction of the shaft for the intake pipeline would be undertaken via a Tunnel Boring Machine (TBM). This methodology will involve the utilisation of a caisson and piling to construct the shaft which will produce limited groundwater inflows. Refer to Section 5.2.1
WR7	• A Trigger Action Response Plan (TARP) will be prepared as part of the Groundwater Management Plan that will detail the monitoring of groundwater levels in accordance with the Aquifer Interference Policy (AIP) level 1 impact criteria. Groundwater monitoring will be undertaken during construction of the project and will include the installation of loggers with a minimum of monitoring on two already established bores and may include at sites GW105 and GW108 if identified in the TARP as the appropriate locations for monitoring.	• Refer to Section 7.3

ID	Groundwater REMM	JH Action / Document Reference
WR8	• Groundwater monitoring at sites GW105 and GW108. The CGMP will include continuous monitoring of groundwater levels and routine sampling for groundwater quality, in particular the change in EC associated with the fresh/ saline groundwater interface. Groundwater level and quality triggers will be established based on baseline monitoring data.	• Refer to Section 7.3
WR10	• Undertake additional Acid Sulphate Soil (ASS) sampling within the zone of groundwater drawdown during detailed design phase to confirm the risk of exposure of ASS due to drawdown.	JH have completed the sampling and testing program for ASS and have identified the ASS materials and treatment required. This information is included in the Construction Soil and Water Management Plan (CSWMP)
WR11	• Biodegradable drilling fluids will be used during drilling works for CM 1 (HDD). • Undertake an ASS investigation in the vicinity of each excavation as part of the detailed design phase to determine the risk of exposure of PASS and prepare and implement an ASSMP if necessary. This is a modification of the mitigation measure identified in the EIS.	• Biodegradable drilling fluids will be used during drilling works for CM 1 (HDD). • An ASS investigation for the project Intake pipeline has been completed by Douglas Partners. Relevant information is included in the Construction Soil and Water Management Plan (CSWMP).
WR12	• Prior to construction, either a new EPL will be obtained or EPL 1771 will be modified to authorise the discharge of dewatered groundwater during construction and additional proposed discharges from the Project to the Belmont WWTW outfall during operation.	JH understand this requirement has been or will be fulfilled by HWC JH will provide information as required for HWC to obtain licences.
SGC9	• Prepare an incident emergency spill plan as part of the CEMP to be implemented during construction. Include procedures for the storage and handling of hazardous materials including fuel and chemicals within the CEMP, including: – No refuelling to occur on-site unless an appropriate bunded area is available – Storage of hazardous materials on-site to be kept to a minimum and will be in accordance with national guidelines and the Safety Data – Sheets relating to bunding, coverage, storage of incompatible materials, etc. – Construct the bunded hazardous materials storage area within the desalination plant project site as early as possible within the construction schedule so that this area could be used for storage of any hazardous materials required during construction.	Refer to Section 6.2

ID	Groundwater REMM	JH Action / Document Reference
SGC10	• Locate chemical storage and delivery areas within bunded areas with a capacity of 110 per cent of chemical storage volume	Section 6.2.3
SGC11	• Store chemicals in accordance with Australian Standards and maintain in accordance to equipment supplier recommendations • Implement safe work procedures for the handling of all chemicals including transfer, storage, spill prevention and clean up requirements • Develop an emergency response plan that includes dangerous goods spill scenarios	Section 6.2.3
HR6	• Fuel store to be designed to appropriate standards • Fuel to be stored in an intrinsically safe hazardous area as per appropriate standards • Implement appropriate fire protection systems.	Refer to Section 6.2

4. Existing Environment

4.1 Initial EIS groundwater assessment report (GHD, 2019)

The groundwater assessment to support the EIS for the SSI application for the drought response desalination plant included:

- Desktop review to collate relevant climatic, geological and hydrogeological data as well as the identification of groundwater receptors (GDEs and registered groundwater supply works)
- Site investigations, including:
  - Drilling and construction of eight monitoring wells
  - Sample collection during drilling for particle size distribution (PSD) analysis
  - Conductivity profiling during drilling and post well installation
  - Geophysical surveying of the subsurface via electrical resistivity imaging (ERI) and seismic refraction
  - Long term groundwater level monitoring (September 2018 through May 2019)
  - Seven groundwater monitoring events (September 2018 through April 2019)
  - Aquifer pumping test
  - Development of an updated conceptual hydrogeological model based on the desktop review and field investigation
  - Construction of a numerical groundwater model to predict groundwater extraction volumes and groundwater drawdown
  - Groundwater impact assessment in accordance with the NSW AIP.

Results of the groundwater assessment indicated:

- Groundwater is shallow (with elevation ranging from approximately 0.3 to 1.2 m AHD across the site) and flows in a westerly direction. Temporal variation in groundwater levels is relatively small (approximately 0.5 m) due to the close proximity to the ocean and occur as a result of tidal variation and rainfall recharge. Tidal effects decrease with distance from the coast.
- Groundwater is near neutral (pH 7-8), saline (at depth, approximately 50,000-60,000 µS/cm) and of Na-Cl type. Dissolved oxygen (DO) levels are less than 6.5 mg/L and the redox state is generally oxidative. Metal, organic and pathogen concentrations are low at depth but vary in concentration in the upper part of the aquifer.
- Sand extends to approximately 30 m depth and thinning to less than 15 m eastwards. The underlying clay was interpreted to be more than 30 m thick (and also thinning to the east less than 5 m thickness), with basement rock inferred beyond these depths. Groundwater was inferred to lie 1 to 5 m below ground level (bgl).
- Based on geophysical investigations the fresher groundwater zone ranges from approximately 2 to 15 m thick above a lower saline region ranging in thickness from 3 to 30 m. The location of the freshwater/saltwater interface is variable, occurring between -2 to -10 m AHD, and becomes shallower closer to the ocean.
- Based on electrical conductivity (EC) profiling, the fresher groundwater (up to 10,000 µS/cm) extends up to 10 m below the water table on average and thins towards the east. The transition to saline conditions occurs via a mixing zone (10,000 – 50,000 µS/cm) of approximately 5 m thickness. Saline water (> 50,000 µS/cm) extends to the base of the aquifer.
- The beneficial use of the deeper groundwater would be limited due to its high salinity. There is also limited use of the fresher shallow groundwater in the vicinity of the site as demonstrated by the absence of registered bores. However, there is interaction between the shallow groundwater and aquatic

ecosystems and therefore it is considered that the beneficial use category of the groundwater in the vicinity of the site would be ecosystem support.

- Hydraulic conductivity was estimated to be approximately 0.00026 m/s (22 m/day) based on particle size distribution (PSD) analysis. Slug tests indicated sand hydraulic conductivity ranging from 0.00013 to 0.00039 m/s (approximately 11 to 34 m/day), however interpretation of results was difficult due to small displacements and rapidly falling water levels. Results of the pumping four stage step-test indicates a transmissivity of 380 m 2/day and hydraulic conductivity of 13 m/day, but this assumed confined conditions which does not match GHD's conceptualisation of the system.

Based on the design of the desalination plant and the data from the groundwater field investigations, GHD developed a conceptual hydrogeological model from which a numerical model of site hydrogeology using a variant of MODFLOW (2005) was prepared to assess potential impacts to groundwater during construction:

- Installation of the intake structure would involve groundwater interception and dewatering, mostly for the installation of the caisson. However, the extent and duration of dewatering during construction is expected to be less than the dewatering and drawdown during operation. As a worst-case scenario for construction, an indicative operational groundwater drawdown model from the EIS is provided in Figure 4-1.
- Construction activities also have the potential to introduce contaminants into the groundwater system, particularly hydrocarbons as a result of the operation of the drilling equipment, as well as leakage or spillage of hydrocarbon products from vehicles, wash down areas, workshops and refuelling bays and fuel, oil and grease storages.

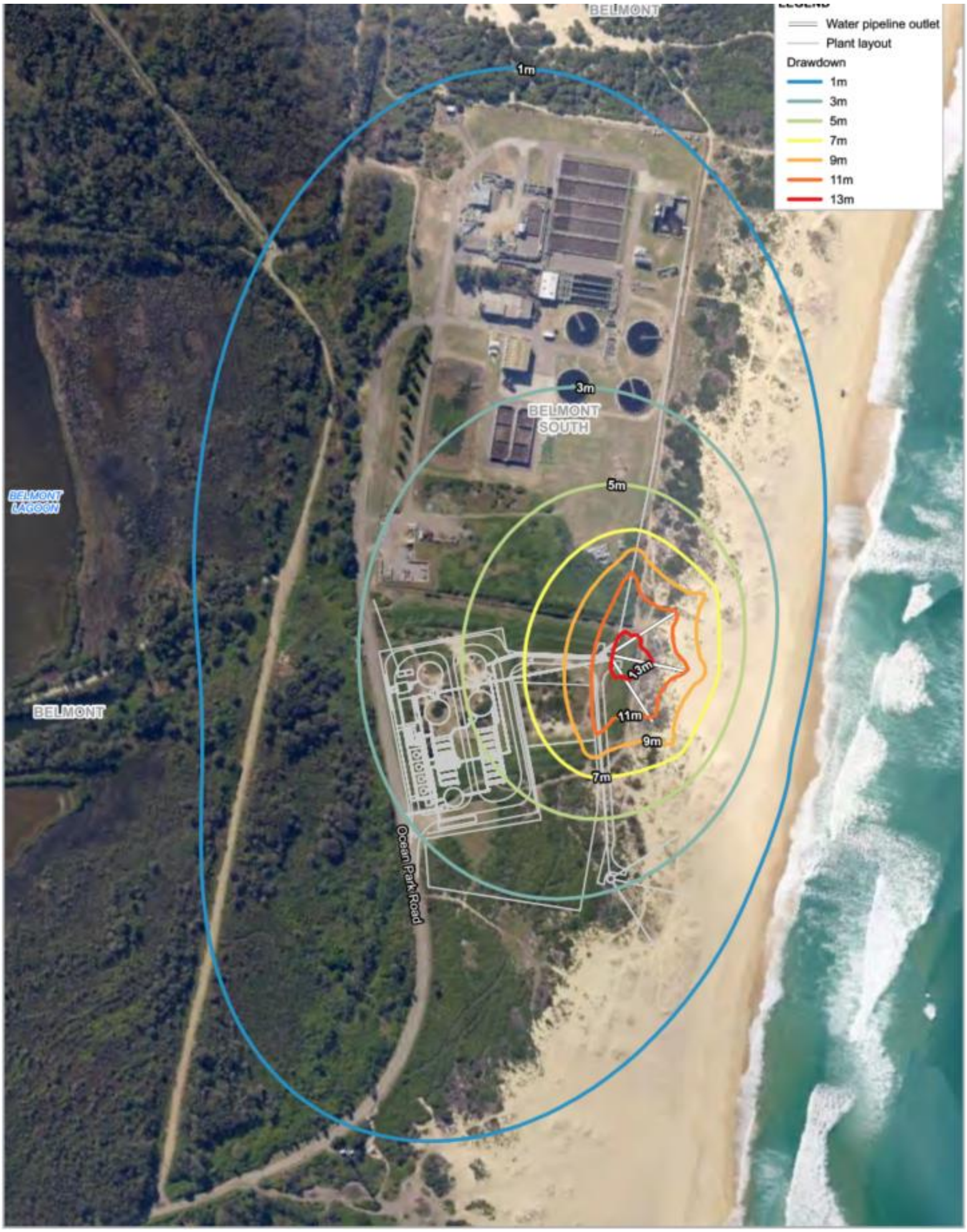


Figure 4-1: Indicative Groundwater Drawdown Modelling from the EIS (GHD 2020)

4.2 Amendment Report – Groundwater Report (GHD, 2020)

This groundwater assessment was prepared to support the Amendment Report in response to SEARs requirements. The report also assessed the revision of the drought response desalination plant design included assessment of potential groundwater impacts and mitigation measures associated with changes to the plant design, which predominantly comprised direct ocean intake (DOI) instead of extraction from a sub-surface saline aquifer.

This assessment included review of potential groundwater impacts and mitigation measures associated with DOI construction comprising the construction of the sea water pump station and the intake pipeline compared to the EIS design. It is noted that GHD only considered groundwater impacts during the construction phase, since operation phase of the DOI would not impact groundwater.

The results of the assessment identified the following information relevant to this CEMP:

- The total groundwater take volume resulting from the construction and operation of the amended design is less than the take predicted for the operation of the EIS design (up to 19.5 ML/day) due to the extraction of groundwater via the sub-surface seawater intakes.
- Fresh groundwater extracted from the excavations during construction may be disposed by infiltration back to groundwater at a distance from the construction area. Based on a sand infiltration rate of 0.02 m/hr, an infiltration area of approximately 3.5 hectares would be required to manage the highest inflow rate of 196 L/s. GHD note that seawater would be extracted in excavations beyond 10 m depth and require an alternative disposal method to infiltration. The saline groundwater (seawater) may be discharged to the ocean via the existing WWTW ocean outfall following appropriate treatment.
- With the use of sheet piles or similar, it is considered that there would be minimal drawdown of groundwater external to each excavation during construction (for each construction method). The potential for groundwater drawdown during construction would be substantially less than the drawdown predicted during operation of a sub-surface seawater intake.

Where excavations may expose PASS, there is potential for the generation of acid and localised impacts on groundwater quality. Therefore, in order to mitigate this impact, it is necessary to undertake an ASS investigation in the vicinity of each of these excavations as part of the detailed design phase to determine the risk of exposure of PASS and prepare and implement an Acid Sulfate Soil Management Plan (ASSMP) if necessary. This is a modification of the mitigation measure identified in the EIS Groundwater Assessment (GHD, 2019) which recommended additional ASS sampling within the zone of groundwater drawdown resulting from the operation of the sub-surface seawater intakes, to confirm the risk of exposure of ASS due to drawdown and to reduce the groundwater drawdown if necessary (refer to JH CSWMP).

4.3 Preliminary Groundwater Assessment (Ramboll 2024)

Hunter Water commissioned Ramboll (March, 2024) to undertake a preliminary groundwater assessment to update existing information and inform the modification application for the proposed construction of the Belmont Desalination facility in terms of potential impacts to the local groundwater aquifer in response to the construction and operation of the permanent desalination plant.

Assessment included review of background information, including previous investigations and field works comprising measurement of water levels and sampling and analysis of groundwater from three existing site wells. An attempt was made to complete preliminary aquifer tests, however the test method was not able to sufficiently stress the aquifer to produce meaningful results.

Groundwater quality parameters were measured in the field prior to sampling to ensure collection of water that is representative of groundwater conditions. The groundwater quality parameters are summarised below:

- pH measurements ranged from pH 7.1 – 7.6, indicating neutral to slightly alkaline conditions.
- EC measurements indicate brackish/slightly saline conditions at GW109 (13,463 µS/cm) and saline conditions at GW105 (46,017 µS/cm) and GW108 (56,220 µS/cm).
- DO ranged from 0.08 mg/L at GW109 to 3.43 mg/L at GW108, indicating oxic (DO > 0.5 mg/L) conditions in GW108 and GW105 (2.46 mg/L), while anoxic (DO < 0.5 mg/L) conditions are present in GW109.

- Reducing conditions were reported in all wells (-211.4 mV to -425 mV) with strongly reducing conditions reported in GW109 (-425 mV).
- TDS concentrations are consistent with the EC measurements, indicating slightly saline conditions in GW109 (8,762 mg/L) and saline conditions in GW108 (16,530 mg/L) and GW105 (19,861 mg/L).

Based on comparison of the analytical results with the adopted criteria, the following was noted:

- Dissolved metals, including boron, cobalt, copper, iron, manganese and molybdenum, variably exceeded adopted site criteria in all wells
- E.coli and total coliforms were detected in GW108 and GW109
- Sulfate exceeds NHMRC (2011) Australian Drinking Water Guidelines (ADWG) in all wells
- PFAS species were detected in the groundwater, but below the adopted criteria.

The following major conclusions were drawn from the assessment:

- Site hydrogeology comprises a shallow aquifer in the Quaternary-aged medium to fine grained dune and marine sand underlying the site. Depths to groundwater were found to be approximately 0.5 to 4 m with flow generally in a westerly direction, although dependent on tide and atmospheric conditions, with a fresher groundwater lens (up to 10,000 µS/cm) extends up to 10 m below the water table on average and thins towards the east.
- Limited aquifer testing, conducted in previous investigations, indicated hydraulic conductivities in the range 1 – 4 x10 -4m/sec, consistent with the sandy lithology of the coastal aquifer.
- Sampling conducted as part of this assessment confirmed previous groundwater monitoring results (GHD, 2019) which had indicated metals, organics and pathogen concentrations to be low at depth but variable in concentration in the upper part of the aquifer.
- There is limited beneficial use for the groundwater due to the high salinity of the deeper groundwater and the fresher lens little use indicated by the absence of registered bores in the vicinity of the site.
- There is interaction between the shallow groundwater and local aquatic ecosystems and it is considered that the beneficial use category of the groundwater in the vicinity of the site would be ecosystem support (the Belmont Lagoon Swamps to the west of the site and a terrestrial Banksia coastal shrubland the seaward side of the sand dunes).
- The results of the assessment confirmed the extensive hydrogeological study completed by GHD in 2019 (GHD, 2019).
- GHD‘s assessment (GHD, 2019) included preparation of a hydrogeological conceptual model and numerical modelling of scenarios of operation of the then planned temporary desalination facility. The results of the modelling indicated that there would be no significant impacts on groundwater beyond the site from the operation of the former design (which proposed land based groundwater pumping from infiltration structures). From this, GHD implied that impacts from dewatering (during construction) would thus be minimal.

Based on a review of available information and the data collected for the Ramboll 2024 assessment, Ramboll considers that the preliminary groundwater assessment has confirmed the findings of the 2019 GHD comprehensive hydrogeology study remain valid.

Given the marginal beneficial use of the groundwater underlying the site and the higher hydraulic conductivity of the aquifer it is further considered that drawdown effects and water quality impacts as a result of short-term excavation and dewatering will not significantly affect the groundwater outside of the site area.

5. Environmental Aspects and Impacts

5.1 Construction Activities

Key aspects of the Project that could result in adverse groundwater impacts include:

- Use of site compounds and chemical storage / spill / refuelling.
- Dewatering works for the Project.

Key constructability considerations that have been incorporated into the development of the detailed design as follows:

- Utilisation of piling and caisson techniques (refer to Section **Error! Reference source not found.**).
- Optimisation of the design aspects of the project
- Regular inspection and maintenance during construction.

5.2 Potential Impacts

Potential impacts to groundwater depend on the nature, extent and magnitude of construction activities. These impacts have the potential to affect the groundwater table and may include:

- Changes to groundwater volume / drawdown and flow.
- Groundwater contamination if chemical storage areas are breached and hazardous chemicals migrate offsite.
- Increase in groundwater impact of properties and groundwater bores in the vicinity of the Project.

5.2.1 Dewatering Impacts

Dewatering is any activity that involves the removal of ponded stormwater or infiltrated groundwater from any location within the Project (including from excavations or sediment basins) and the subsequent reuse or discharge of that water.

The approach to dewatering of any:

- Ponded stormwater
- Infiltrated groundwater
- Captured water
- Water table lowering for excavations
- Displaced groundwater

will follow the below hierarchy:

I. Investigate opportunities for reuse. Onsite reuse may include applications such as dust suppression, earthworks compaction, vegetation establishment/rehabilitation, and plant/vehicle wash-down.

II. Discharge offsite to meet EPL requirements for ocean outfall of the Belmont WWTW EPL.

JH will plan to avoid and minimise discharges as much as practicable, while complying with the conditions of the HWC EPL, and undertake dewatering activities in a manner to minimise erosion and pollution of the environment. The Project is subject to the modified Belmont WWTW EPL which includes discharge criteria for licenced discharge points.

JH will minimise groundwater extracted from the project, as fully as practicable, utilising caisson construction and piling techniques which minimise inflow of groundwater during excavations.

Predicted groundwater drawdown due to temporary construction dewatering are typically of limited extent and short duration. A summary of the proposed dewatering requirements for the construction of the project are provided in Table 5-1**Error! Reference source not found.** below.

Table 5-1: Summary of Dewatering Requirements for the Project

Location	Description	Groundwater management
Main building trench services	Prior to construction of Main Building, fibre reinforced polymer (FRP) works are required to construct the deep service trenches. Depths range up to relative level (RL) 0.7 m AHD which is approximately 300 mm within the groundwater limits	Depth below assumed groundwater table – 300 mm. Dewatering spears around perimeter, shoring boxes/piles for support
Ocean outfall chamber	Open excavation required for tie-in to existing discharge outfall	pile shoring with dewatering pumps
Ocean outfall discharge tank	Open excavation to allow pit construction	pile shoring with dewatering pumps
Brine discharge line	Pipeline runs from outfall discharge tank to outfall chamber. Depths average 4m along alignment	pile shoring with dewatering pumps

For dewatering activities where the water table is required to be temporarily lowered, it is estimated that the maximum volume to be about 1,376ML during construction. This is likely to be higher than the volume to be dewatered for proposed CM1 (HDD) of the Direct Ocean Intake (DOI), since two caissons were to be installed for the EIS design compared to one for the DOI. The EIS referenced 3047 Ml/year for three years total extraction volume. Based on the limited and relatively short duration of the dewatering required, it is not considered that construction dewatering would lead to cumulative impacts.

Given the relatively short durations of dewatering, and the initial pH conditions, the potential risk of acid generation resulting from short term dewatering is expected to be minor. Any potential for oxidation is likely to be limited to oxidation within the exposed faces in the excavation, and the volume of acid generated is not expected to be significant.

5.2.2 Modification Groundwater Assessment

The Proposed Modification included changes in design and activities that could potentially impact the groundwater environment during Project construction. The changes include:

- An option to bury the brine pipeline to the Belmont WWTW, comprising the excavation of a trench approximately 310 metres long and up to 5 metres deep and on average 4 metres deep
- Dewatering of some deep excavations within the desalination site associated with service trenches, sumps, ocean outfall chamber and ocean outfall discharge tank. For the purposes of this assessment, it is assumed that there would be five excavations each some 10 metres by 10 metres by average of 4 metres deep (i.e. 2 metres below the groundwater) supported by sheet pile shoring and either dewatering pumps or spears for 6 weeks.

The initially approved Project consent includes a groundwater take of 3,047 ML, which was based on modelling that showed a low risk of impacts to adjacent GDEs and registered bores. JH have committed to a construction methodology that is expected to entail considerably less dewatering compared to that assessed in the Amendment Report for the land caisson (which is used to launch the micro-TBM and which ultimately is converted to the seawater pumpstation) has been proposed. As a result, the Modification does not seek any further increase in groundwater take compared to the approved Project.

The modification included a review of previous modelling and assessment of groundwater impacts. While no further modelling was undertaken, calculations were completed to ascertain the likely groundwater inflows associated with brine trench and deeper excavations in the Project area.

The potential groundwater impacts that were reviewed as part of the modification were water table drawdown, and groundwater inflow to open excavations, as a result of dewatering of the proposed brine pipeline and various deep excavations. The findings of the groundwater assessment completed for the modification show that the predicted impacts associated with the modification are not greater than those already approved.

Therefore, the modification report determined that there was no need for additional monitoring of groundwater levels changes and inflow rates beyond that which is already proposed and approved via the EIS and amendment documentation.

5.3 Cumulative impacts

The construction of the project within the vicinity of the Belmont WWTW have the potential to cause groundwater impacts, however it is noted that the scale of impact is dependent upon timing, location and type of construction activities.

Interface meetings will be undertaken as required with government authorities, the neighbouring Belmont WWTW operation and stakeholders as detailed in the CEMP and within the Community Communication Strategy.

6. Environmental Mitigation and Management Measures

6.1 Dewatering Management

Metering of groundwater dewatered from excavations will be metered and monitored on a daily basis, including discharge rates, treatment undertaken, water quality and destination. This information will be provided in monthly reporting to HWC and the ER. JH will implement a dewatering permit process for the site.

Where a flocculant or coagulant other than gypsum is proposed to treat site water, the Project Environmental Manager (or delegate) will demonstrate that the proposed flocculant or coagulant is suitable for use.

6.1.1 Reuse

Reuse on site will only occur if:

- Water is not observed to contain signs of gross contamination (i.e. obvious odour, colour change, oil slick).
- 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.
- Reused groundwater or surface water must not be permitted to enter any surface waterways. Field parameters will be tested prior to reuse (pH, EC).

6.1.2 Offsite discharge

The EPL for the Belmont WWTW outfall prescribes the water quality parameters for the purposes of the monitoring and the setting of limits for discharges of pollutants to water and quantity of water discharged.

The concentration of a pollutant discharged at a Licenced Discharge Point, or applied to that area, must not exceed the concentration limits discussed in Section 7.2.2.

In situ water quality parameters will be recorded and grab samples collected for laboratory analysis (as required). Water quality testing will be undertaken less than 24 hours, prior to a controlled discharge and daily for any continued controlled discharge or when rainfall causes runoff to the source of water under controlled discharge. Where practical, water testing will be undertaken within an hour of discharge occurring.

Water discharge will only occur following approval by the Project Environmental Manager (or delegate) who will issue a Permit to Discharge. The Permit to Discharge will only be issued once the water quality criteria have been met.

6.1.3 Water treatment

Water treatment measures will include treatment of pH and flocculation to manage total suspended solids (TSS). If hydrocarbons and/or other chemicals are identified in the waters to be treated prior to discharge, the appropriate mitigation measures will be employed to clean-up the water (e.g. booms and other measures) prior to discharge, or dispose of as appropriate. These measures will be employed in accordance with the spill response procedure. Water treatment will occur within designated treatment tanks to be installed onsite for the treatment of extracted groundwater prior to discharge.

Prior to water treatment activities, the Project Environmental Manager (or delegate) will demonstrate that the proposed flocculant or coagulant is suitable for use. Where flocculation is necessary to settle suspended sediment, the proposed flocculant or coagulant will be applied as the flocculating agent to settle the sediments. Before applying a flocculating agent, the amount of the agent that is appropriate for the volume to be treated will be determined.

The Project Environmental Manager (or delegate) will ensure that flocculants and other water treatment chemicals are appropriately stored on site. Bulk flocculants will be covered and positioned within erosion and sediment controls away from areas with the potential for water runoff. All treatment chemicals will be stored in appropriately bunded and covered locations. Requirements of the Safety Data Sheets will be followed.

6.2 Contamination Prevention

6.2.1 Spill prevention

In order to minimise potential for groundwater impact as a result of contamination, spill prevention techniques will be utilised. These techniques are further discussed below.

Spill kits will be located to allow for timely response to uncontained spills including:

- Construction ancillary facilities compounds
- At construction works site
- Within supervisors site vehicles.

All spills will be cleaned up and reported as an environmental incident. Site inductions will include a briefing on the use of spill kits. The following activities will have an Activity Method Statement (AMS) outlining the mitigation measures required to be implemented to minimise groundwater pollution risk:

- Refuelling or maintenance and cleaning of plant and equipment including concrete agitators and any equipment entering the shaft for tunnelling purpose (e.g. TBM and pumps).
    - Refuelling will not occur onsite unless an appropriate bunding / drip trays are available.
    - Fuel store to be designed to appropriate standards.
    - Fuel to be stored in an intrinsically safe hazardous area as per appropriate standards.
    - Implement appropriate fire protection systems.
- Drilling and the management of drilling fluids.
- On-site batching of grout, concrete and/or asphalt.
- Bulk fuel or chemical deliveries.
- Removal and disposal of excess chemicals and water used for washing down of equipment.
- Decanting operations such as for fuel, chemicals and bitumen.

The AMS(s) will include the following, as a minimum:

- Details of the management of the bunded areas including monitoring of the bunded areas, drainage requirements and measures to ensure that bund capacities are maintained.
- Details of the management associated with the removal and transportation of chemical drums from bunded areas.
- Routine maintenance requirements of machinery, pumps and other equipment to prevent and/or minimise leaks. Inspect all plant and equipment daily for leakages of fuel, oil or hydraulic fluid. Repair any defective or deteriorated equipment that may result in leaks before using plant or equipment.
- Maintain records of plant inspections.
- Installation of controls for the capture and filtering of all chemicals that may runoff in storm events, for example wax and hydrocarbon curing compounds, bitumen tack coat and saw cutting material.
- Safety procedures - safe work procedures for the handling of all chemicals including transfer, storage, spill prevention and clean up requirements.

Machinery or equipment found leaking must be repaired before use or replaced with properly maintained equipment. Where possible, significant repairs of plant and equipment are to take place off the Construction Site.

6.2.2 Drilling fluids

As part of a separate process, all drilling fluid that is extracted during TBM activities will be temporarily stored in a surface storage dam. This process is further discussed in the CSWMP. The drilling contractor will prepare a Drilling Management Plan. The Drilling Management Plan will include methods for:

- Managing drill fluids onsite
- Monitoring fluid volumes
- Disposal of fluids

Biodegradable drilling fluids will be used during drilling works for the TBM. For the purposes of this CEMP, it is understood that any material not able to stay onsite as engineered fill, will be waste classified and removed from site to an appropriately licenced landfill. Refer to the Construction Waste Management Plan for further waste related details.

6.2.3 Refuelling, washdown and chemical storage

All fuels, chemicals, and liquids will be stored:

- in bunded areas
- on relatively flat land, and
- outside of flood prone areas.

The storage, handling and use of dangerous goods and hazardous substances will be at a minimum and will be stored in accordance with the *Work Health and Safety Act* 2011, the Storage and Handling of Dangerous Goods Code of Practice (WorkCover NSW, 2005), the EPA “Bunding and Spill Management Guidelines” contained within EPA Environmental Protection Manual for Authorised Officers, and all relevant legislation and Australian standards.

The Safety Manager (or delegate) will obtain Safety Data Sheets (SDS) for dangerous goods and hazardous substances prior to their arrival on site. All hazardous substances will be transported in accordance with relevant legislation and codes, including the Road and Rail Transport (Dangerous Goods) (Road) Regulation 1998 and the ‘Australian Code for the Transport of Dangerous Goods by Road and Rail’ (National Transport Commission, 2008).

The bunded hazardous materials storage area will be constructed within the desalination plant as early as possible within the construction schedule so that this area could be used for storage of any hazardous materials required during construction. Bunded areas will have a capacity of 110% of the chemical storage volume.

JH will develop the following as part of site safety documentation:

- Implement safe work procedures for the handling of all chemicals including transfer, storage, spill prevention and clean up requirements
- Develop an emergency response plan that includes dangerous goods spill scenarios

Designated impervious bunded chute washdown facilities for concrete trucks and other vehicles will be provided at least 100 metres from areas prone to flash flooding or 50 metres away from other natural and built drainage lines. Chute concrete washdown bays may be provided in the form of fabricated, mobile washout receptacles.

Plant and vehicle maintenance, including washdown, will be undertaken in designated areas to minimise the potential for offsite discharge and mud tracking.

7. Compliance Management

7.1 Responsibilities

Site personnel or sub-consultants with suitable experience and qualifications will undertake the monitoring outlined in this CGMP. An overview of aspects and responsibilities in provided in Table 7-1.

Table 7-1: Responsibilities

Aspect	Responsibility
Groundwater well quality and level monitoring	• Appointed consultant
Groundwater dewatering discharge monitoring	• Project Environment Manager or delegate
Groundwater dewatering management and spill prevention	• Project Environment Manager or delegate • Site foreman

7.2 Monitoring criteria

7.2.1 Groundwater bore quality and levels

Continuous monitoring for groundwater level will be undertaken throughout construction via the installation of groundwater loggers in groundwater monitoring well locations (GW105 and GW108). These groundwater monitoring locations are identified in Figure 7-1 and required to have Groundwater level and quality triggers based on baseline monitoring data, as a result of REMM GW03. Given a lack of baseline data, groundwater levels and quality in the vicinity of the project are poorly understood for the purposes of selection of trigger levels.

For the EIS, continuous groundwater level monitoring was undertaken for a 6-month period and seven groundwater quality sampling events were undertaken spanning 2018 and 2019. Combined with the one round of groundwater monitoring for the Ramboll 2024 assessment, this combined eight rounds of monitoring is considered insufficient for the development of site-specific trigger values. Instead, JH propose to review data against the range of historic values for certain analytes tested and groundwater levels.

Groundwater quality samples will be collected quarterly from GW 105 and GW 108 and will be monitored and analysed for the parameters assessed in the baseline data (refer to Appendix 1). If analytes tested are outside the historic range for analytes tested from the baseline data, JH will investigate the potential for any impact as a result of construction activities. This will be undertaken via the adaptive management process discussed in Section 7.3.4.

Based on assessment documentation, the likelihood of significant drawdown is considered unlikely. Further information on monitoring for potential impact to Groundwater Dependent Ecosystems (GDEs) is included in the Construction Biodiversity Management Plan.

7.2.2 Site discharge from dewatering

The Project commits to discharging dewatered groundwater to the HWC Belmont WWTW outfall pipeline as described in the project EIS / Modification Report. The EPL for the Belmont WWTW prescribes the water quality parameters for the purposes of the monitoring and the setting of limits for discharges of pollutants to water. The limits for discharges of pollutants set in the EPL only apply to the licensed monitoring and discharge points.

The concentration of a pollutant discharged at the Belmont WWTW Licenced Discharge Point (at LDP 18), must not exceed the concentration limits specified for that pollutant in the Table 7-2.

Table 7-2: Offsite Water Discharge Concentration Limits

Analyte	Unit of measure	Concentration Limit (3DGM percentile)
Oil and grease	• mg/L	• 15
pH	• pH	• 6.5-8.5
Turbidity	• nephelometric turbidity units (NTU)	• 60

In all other circumstances, HWC and JH must comply with section 120 of the *Protection of the Environment Operations Act 1997*.

JH will liaise with HWC to confirm that daily and annual discharge volumes, and EPL load limits will meet HWC limits in accordance with the Belmont WWTW EPL.

7.3 Groundwater monitoring methodology and procedures

7.3.1 Sampling locations

The Project groundwater bore monitoring sites that are to be monitored during construction are listed in Table 7-3 and shown on Figure 7-1. Only groundwater bores GW105 and GW108 will be monitored for the project.

Table 7-3: Groundwater bore monitoring locations

ID	Sampling type	Frequency	Responsibility
GW105	• Groundwater quality and level	• Quality – via sampling every 3 months • Level – continuous via groundwater logger	• JH
GW108	• Groundwater quality and level	• Quality – via sampling every 3 months • Level – continuous via groundwater logger	• JH

Figure 7-1: Groundwater monitoring locations and standing water level (Ramboll 2024)

7.3.2 Sampling methodology

Technical guidance

Groundwater from wells GW105 and GW108 will be sampled in accordance with:

- *Australian Standard 5667:1998 Water Quality – Sampling, Part 1: Guidance on the design of sampling CGMPs, sampling techniques and the preservation and handling of samples (AS 5667.1:1998) and*
- *Australian Standard 5667:1998 Water Quality – Sampling, Part 11: Guidance on the Sampling of Groundwaters (AS 566.11:1998)*

Sampling

Groundwater quality samples will be collected in laboratory supplied containers made of the appropriate material and suitably preserved for the required analytes, according to well-established analytical standards.

All sample containers will be clearly labelled with:

- Sample ID
- Job number
- Sampler name
- Date and time.

All samples will be placed in an insulated storage container (esky) containing ice for transport to the laboratory, along with a chain of custody form describing the sample identification details and required analysis.

Exceptions to this methodology include when water quality (WQ) parameters do not stabilise over a long period of time (for example, greater than one hour of purging) and samples are collected prior to stabilisation.

Another exception is when a well is low-yielding and has poor recovery, in which case the standing water level (SWL) may not stabilise and samples may need to be collected to ensure collection of a sample prior to the well pumping dry.

In each of these cases, comprehensive field notes detail the rationale for collecting samples when stabilisation of WQ parameters and/or SWL are not attained.

Field observations will also be recorded including:

- Depth to groundwater
- Weather conditions
- Observations of activities in the area
- Visual observations of oil /grease, water odour, colour and clarity
- Photographic records.

Analytical suite

All samples will be analysed by a NATA accredited laboratory for the following indicators:

- Field parameters (electrical conductivity, pH, turbidity)
- chloride, hardness, silica (calculation from Si), sodium adsorption ratio, sulphate (as SO4), TKN (as N), total nitrogen (as N), TSS
- nutrients: ammonia (NH3), nitrate (NO3), total nitrogen (N), oxidised nitrogen (N), phosphate
- dissolved metals: aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, tin, zinc
- hydrocarbons: BTEXN, TRH and PAH
- PFAS
- microbiological compounds including E.coli and total coliforms

7.3.3 Site discharge

Treatment and water monitoring of captured stormwater and groundwater will be undertaken prior to water being discharged from site in accordance with the Project EPL requirements. JH will treat via the method described in Section 6.1.3.

Prior to discharge, monitoring the concentration of Oil and grease (visually) and pH, EC and turbidity (via water probe) will be undertaken and recorded and compared with the EPL criteria provided in Section 7.2.2.

Any Laboratory sampling will be undertaken in accordance with Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (EPA, 2004) unless another method has been approved by the EPA in writing before any tests are conducted.

7.3.4 Adaptive management / Trigger Action Response Plan

Groundwater Quality

Groundwater quality samples will be collected quarterly from GW 105 and GW 108 and will be monitored and analysed for the parameters assessed in the baseline data (refer to Appendix 1). If analytes tested are outside the historic range for analytes tested from the baseline data, JH will investigate the potential for any impact as a result of construction activities.

Should borehole groundwater monitoring results from monitoring (attributable to the Project) exceed the historical range in Appendix 1 of this CGMP for key analytes pH, EC, Total TRH, Total BTEX, Total PAH, heavy metals and detectable PFAS the following Trigger Action Response Plan (TARP) will be undertaken:

- Analysis of the results by the JH Environment Manager, in consultation with the appointed consultant and HWC, in more detail with a view of determining possible causes for the exceedance, including potential climatic drivers and other factors outside of JH control (i.e. heavy rainfall / period of drought, vandalism etc) and if ruled out, identifying the Project stage (or stages) possibly responsible for the issue
- Site inspection by the Environment Manager
- Advising relevant personnel of the problem
- Identifying and agreeing on actions and/or additional monitoring or mitigation measures to resolve or mitigate the exceedance. This may include:
    - Assessing the monitoring frequency that is being undertaking and increasing it based on the risk of the activities being undertaken. Examples include:
        - Increasing the groundwater monitoring frequency in the event of exceedances or significant spill that has the potential to cause impacts to the groundwater

  - Increasing the analytical suite to determine if potential contaminates are observed or based on exceedances (e.g. If TPH are observed and the source is not identifiable, an increase scope of full suite of volatile / semi-volatile organic compounds may be undertaken to determine if a specific analyte is causing contamination)
- Implementing actions to rectify or mitigate the exceedance, as directed by the ER / HWC
- Identifying and implementing additional mitigation measures.

Where historical results are exceeded, the Project Environment Manager (in consultation with the appointed consultant and HWC if applicable) will identify the source of the exceedance and implement any additional measures available to reduce the impacts on the receiving environment. The Project Environment Manager will verify and document the effectiveness of any management measures or preventative / corrective actions implemented to avoid further exceedances.

Groundwater Level

Following the completion of dewatering activities, if groundwater level in GW105 or GW108 persists for longer than one month at 1 m or more below the historical range of groundwater level for these bores (refer to Appendix 1 Table 1), JH will investigate the potential for possible groundwater drawdown impact. This will involve:

- Analysis of the results by the JH Environment Manager, in consultation with the appointed consultant and HWC, in more detail with a view of determining possible causes for the exceedance,
- Review potential for climatic drivers and other factors outside of JH control (i.e. heavy rainfall / period of drought, vandalism etc)
- Site inspection by the Environment Manager - Identifying the Project stage (or stages) possibly responsible for the issue
- Advising relevant personnel of the problem
- Identifying and agreeing on actions and/or additional monitoring or mitigation measures to resolve or mitigate the exceedance. This may include:
  - Assessing the volume / rate of groundwater dewatering completed to determine if it was in accordance with predictions and assessment of activities undertaken pre-construction:
  - Determine if groundwater dewatering was impacted by climatic conditions (i.e. extended periods of heavy rainfall)
  - Continue groundwater logger level monitoring to confirm that recharge of groundwater level is occurring to satisfactory level (in line with historical range)
- Implementing actions to rectify or mitigate the exceedance as directed by the ER / HWC
- Identifying and implementing additional mitigation measures.

The need for additional monitoring will be investigated, and, if necessary and having ruled out other potential factors, incident reporting processes will be triggered if drawdown levels continue to be greater than predicted.

7.4 Reporting

7.4.1 Environmental report

The Project Environment Manager (or delegate) will prepare Monthly Environmental Reports for the duration of the construction for incorporation in the Project Monthly Reports and submission to the HWC Environment Manager (or delegate) and HWC Project Manager for review. Information to be detailed in the reports will provide a high-level summary of the recent sampling undertaken and includes:

- Flow and water quality results of all dewatering discharge events
- Comparison of the statistics to the baseline data and identification of any exceedances
- Outliers and extreme data points, which may indicate significant deviances resulting from in extreme events, are also identified and the reasons for any exceedances
- Details of any groundwater lowering occurring during the period (level and duration)
- Results summary and analysis of the environmental monitoring
- Summary of monthly rainfall data and/or significant rainfall and storm events
- Discussion and analysis of the results and recommendations arising from the monitoring and detail of any management and mitigation measures that were implemented to address the exceedances during the reporting period.
- Summary of any complaints received that are related to groundwater.

7.4.2 Reporting on non-compliances and exceedances

In the event that the criteria identified in Section 7.2 are exceeded, JH Senior Management Team will undertake a review of the monitoring data against the criteria and analyse the potential cause of the exceedance in accordance with Section 7.3.4. The outcomes of the review and any actions taken will be reported to the HWC Project Manager, HWC Environment Manager (or delegate) and ER. if resulting in an incident (i.e. groundwater impact) HWC will report to DPHI within seven calendar days of identification of the exceedance. Details of exceedances will be provided in the Monthly Environmental Reports and Monitoring Reports.

Where an exceedance has caused, is causing or is likely to cause, material harm to the environment, the environmental incident notification and reporting procedures detailed in the CEMP and the Environmental Incident Procedure (refer to the CEMP) will apply.

The Project Environmental Manager will immediately notify the HWC Project Manager and HWC Environment Manager (or delegate) of any exceedance that has caused, is causing or is likely to cause, material harm to the environment. HWC will provide the Secretary with a record of any such notification immediately or within 24 hours of becoming aware of an incident, as required by NSW CoA A26-A27. Written notification will be given to the Secretary in accordance with Appendix A of the NSW CoA.

Pollution incidents will be managed in accordance with the Project Pollution Incident Response Management Plan (PIRMP), as required by the EPL.

The PIRMP includes a description and likelihood of hazards on site, including an inventory of potential pollutants, pre-emptive actions to be taken to minimise or prevent risk of pollution incidents and harm to site personnel, safety equipment available, a list of contact details for response or notification and community communication tools. The PIRMP will also set out detailed descriptions of the actions to be undertaken in the event of a pollution incident to reduce or control pollution, and training for staff in the use and implementation of the PIRMP.

HWC will provide a written report of the event to the EPA within seven days of the date on which the event occurred in accordance with EPL requirements.

The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by HWC/JH. JH Senior Management Team will provide such further details to HWC for submission to the EPA within the time specified in the request. JH Senior Management Team will also complete an incident form in sufficient detail as may be required for HWC to report to EPA within three business days of the occurrence of the event.

8. Review and Improvement

8.1 Continuous Improvement

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

The continuous improvement process will be designed to:

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

The Project Environment Manager (or delegate) is responsible for ensuring stage-specific environmental risks are identified and included in the Project risk register and appropriate mitigation measures implemented throughout the construction (including those contained within this CGMP), as part of the continuous improvement process. The process for ongoing risk identification and management during construction is outlined in the CEMP.

8.2 CGMP Updates and Amendments

The processes described in the CEMP may result in the need to update or revise this Plan. This will occur only as needed throughout the duration of construction.

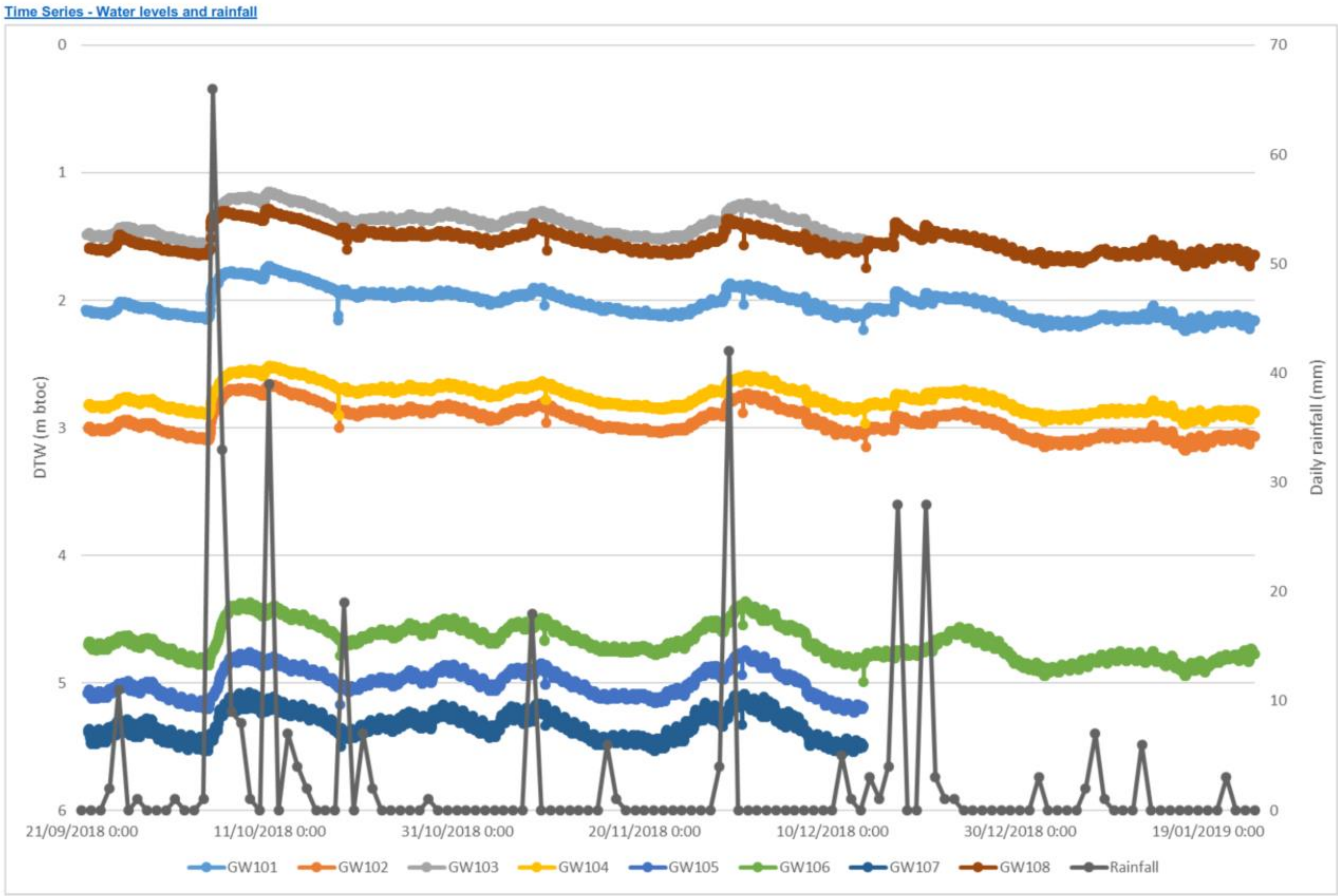
Only the Project Environment Manager (or delegate) has the authority to approve changes to the requirements of this Plan. Minor amendments to the Plan may be approved by the ER in accordance with the CEMP. Amendments not considered minor by the ER need to be approved by the Planning Secretary.

A copy of the updated Plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure.

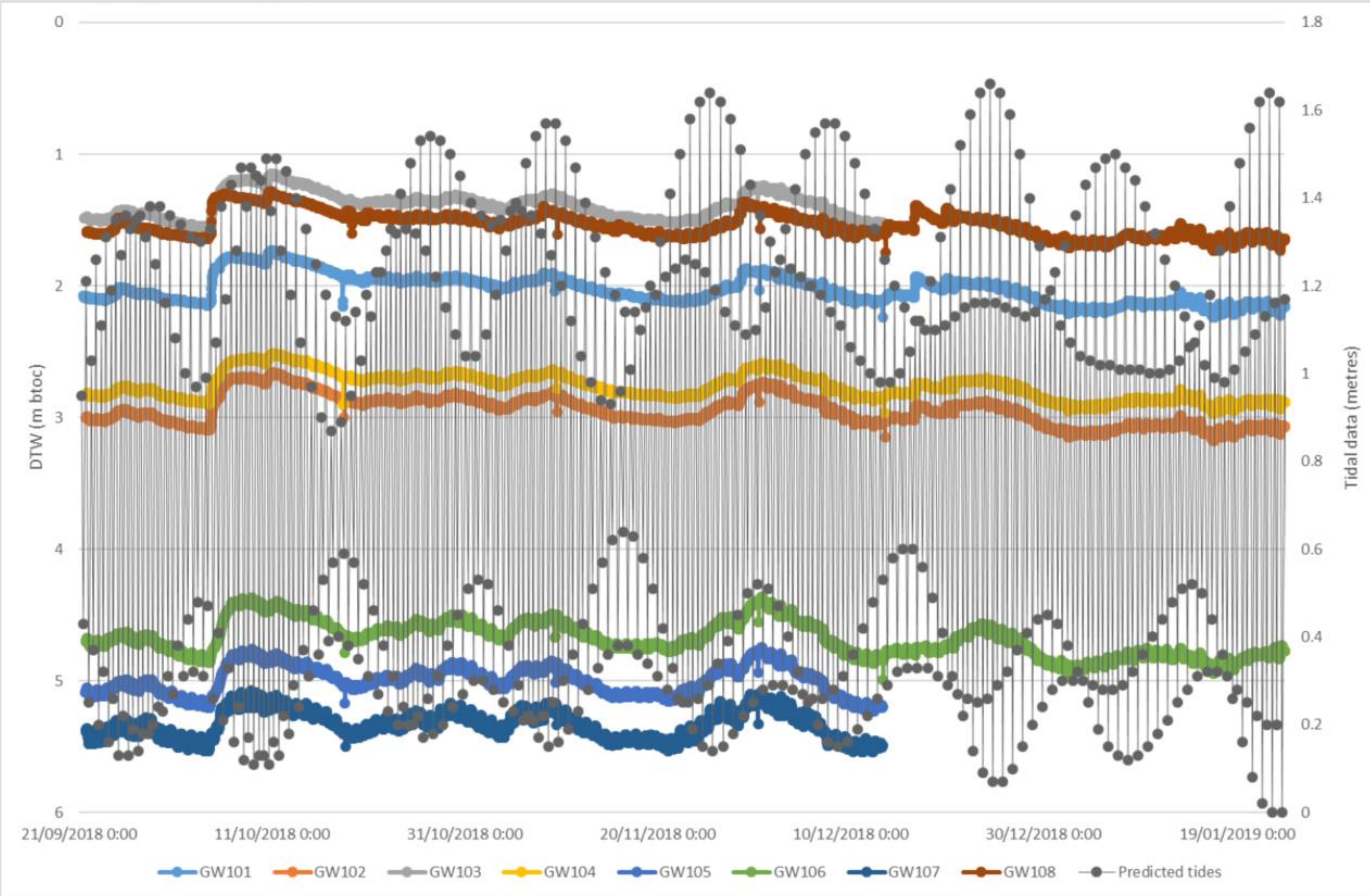
Appendix 1: Baseline Groundwater Data

Baseline groundwater level and quality monitoring results are provided below.

Appendix 1 - Table 1-1: Baseline groundwater level data (EIS)



Time Series – Water levels and predicted tides



Appendix 1 - Table 1-2: Baseline groundwater quality monitoring data (EIS (GHD) and Ramboll 2024)

			Field Parameters						Inorganics						Major Ions						Nutrients							
			Salinity (Field)	pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field) (filtered)	Redox (Field)	Temperature (Field)	Electrical conductivity (lab)	Total Dissolved Solids (est.)	Salinity	Turbidity	Total Suspended Solids	Silicon as SiO2 (filtered)	Calcium (filtered)	Magnesium (filtered)	Potassium (filtered)	Sodium (filtered)	Chloride	Sulfate (filtered)	Ammonia as N	Nitrate (as N)	Nitrite (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Reactive Phosphorus as P	Kjeldahl Nitrogen Total	Phosphorus (Total)
			PSU	pH Units	µS/cm	mg/L	mV	°C	µS/cm	mg/L	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL									1	1	1E-05	0.1	5	0.1	1	1	1	1	1	1	0.01	0.01	0.01	0.01	0.1	0.01	0.1	0.01
NSW Master GILs for Marine Water																					0.91							
Date	**Field ID**	**Location Code**																										
14/09/2018	GW105	GW105	34.95	7.76	52,914	4.02	136.9	19.3	54,200	40,000	0.0358	143	211	1.8	396	1,160	353	9,680	19,500	2,760	0.06	1.31	<0.01	1.31	1.3	0.04	<1.0	0.18
18/10/2018	GW105	GW105	34.96	7.98	52,942	3.91	132.7	19.3	60,600	41,300	0.0407	52.8	88	1.6	508	1,460	454	12,300	23,400	3,120	0.12	0.66	<0.01	0.66	0.7	0.04	<0.5	0.19
9/11/2018	GW105	GW105	35.73	7.85	53,981	3.35	56.1	19.2	58,400	35,000	0.039	0.5	6	<0.5	428	1,260	389	10,500	19,500	2,820	<0.10	0.64	<0.01	0.64	<1.0	0.04	<1.0	<0.10
30/11/2018	GW105	GW105	35.44	8.01	53,621	3.06	0	19.4	49,100	32,000	0.032	1.1	<5	1.8	414	1,200	372	10,200	16,800	2,900	<0.10	0.77	<0.01	0.77	<1.0	0.04	<1.0	<0.10
13/12/2018	GW105	GW105	32.42	7.77	49,291	4.62	219.8	19.4	53,500	39,000	0.0353	0.7	<5	1.9	453	1,290	401	10,900	17,900	2,860	0.12	0.65	<0.01	0.65	<1.0	0.04	<1.0	<0.10
11/12/2023	GW105	GW105	-	7.63	46,017				N/A																			
14/09/2018	GW108	GW108	34.53	7.42	52,333	3.73	145.5	18.9	53,200	39,300	0.0351	350	446	5.3	402	1,200	357	9,990	19,100	2,640	0.05	0.62	<0.01	0.62	<1.0	0.04	<1.0	0.29
19/10/2018	GW108	GW108	33.87	7.6	51,465	4.1	146.8	19.1	56,800	34,100	0.0421	135	196	5.3	405	1,270	391	10,600	18,500	2,820	<0.10	0.55	<0.01	0.55	<1.0	0.04	<1.0	0.17
9/11/2018	GW108	GW108	35.17	7.67	53,219	4.09	69.4	19.2	57,400	34,000	0.0382	3.1	12	3.8	410	1,230	379	10,300	18,900	2,720	<0.10	0.47	<0.01	0.47	<1.0	0.04	<1.0	<0.10
30/11/2018	GW108	GW108	34.98	8.02	52,924	3.46	16.7	19.4	50,000	31,600	0.0327	1.4	<5	6.1	412	1,220	370	10,200	16,400	2,920	<0.10	0.49	<0.01	0.49	<1.0	0.04	<1.0	<0.10
13/12/2018	GW108	GW108	32.76	7.62	50,026	5.25	162.9	19.5	53,100	40,200	0.035	1.6	<5	5.8	444	1,290	395	10,900	18,800	2,840	0.09	0.48	<0.01	0.48	<1.0	0.04	<1.0	<0.10
24/01/2019	GW108	GW108	34.77	7.65	52,669	5.22	153.6	19.9	54,200	37,100	0.0358	1.2	<5	6.3	452	1,290	394	10,800	20,800	3,280	<0.10	0.4	<0.01	0.4	<1.0	0.04	<1.0	<0.10
11/12/2023	GW108	GW108	-	7.13	56,220				N/A																			

			Metals																					
			Aluminium	Aluminium (filtered)	Arsenic	Arsenic (filtered)	Barium	Boron	Cadmium	Cadmium (filtered)	Chromium (III+VI)	Chromium (III+VI) (filtered)	Copper	Copper (filtered)	Iron	Iron (filtered)	Lead	Lead (filtered)	Manganese	Manganese (filtered)	Mercury	Mercury (filtered)	Molybdenum	Nickel
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.01	0.01	0.001	0.001	0.001	0.05	0.0001	0.0001	0.001	0.001	0.001	0.001	0.05	0.05	0.001	0.001	0.001	0.001	0.0001	0.0001	0.001	0.001
NSW Master GILs for Marine Water					0.036	0.036			0.0007	0.0007			0.0013	0.0013	0.3	0.3	0.0044	0.0044	0.08	0.08	0.00094	0.00094		0.007
Date	**Field ID**	**Location Code**																						
14/09/2018	GW105	GW105	16.5	<0.10	0.02	<0.010	0.012	5.39	<0.0010	<0.0010	0.013	<0.010	<0.010	<0.010	7.62	<0.50	<0.010	<0.010	<0.010	<0.010	<0.0001	<0.0001	0.017	<0.010
18/10/2018	GW105	GW105	3.47	<0.10	<0.010	<0.010	<0.010	4.02	<0.0010	<0.0010	<0.010	<0.010	<0.010	<0.010	1.59	<0.10	<0.010	<0.010	<0.010	<0.010	<0.0001	<0.0001	0.012	<0.010
9/11/2018	GW105	GW105	0.13	<0.10	<0.010	<0.010	<0.010	4.08	<0.0010	<0.0010	<0.010	<0.010	<0.010	<0.010	<0.10	<0.10	<0.010	<0.010	<0.010	<0.010	<0.0001	<0.0001	<0.010	<0.010
30/11/2018	GW105	GW105	<0.10	<0.10	<0.010	-	<0.010	5.17	<0.0010	-	<0.010	-	<0.010	-	<0.10	<0.10	<0.010	-	<0.010	<0.010	<0.0001	-	0.011	<0.010
13/12/2018	GW105	GW105	<0.10	<0.10	<0.010	-	<0.010	5.2	<0.0010	-	<0.010	-	<0.010	-	<0.10	<0.10	<0.010	-	<0.010	<0.010	<0.0001	-	<0.010	<0.010
14/09/2018	GW108	GW108	24.3	<0.10	0.016	<0.010	0.021	5.72	<0.0010	<0.0010	0.024	<0.010	<0.010	<0.010	14.8	<0.50	0.013	<0.010	0.016	<0.010	<0.0001	<0.0001	0.02	<0.010
19/10/2018	GW108	GW108	2.92	<0.10	<0.010	<0.010	0.011	4.86	<0.0010	<0.0010	<0.010	<0.010	<0.010	<0.010	1.01	<0.10	<0.010	<0.010	<0.010	<0.010	<0.0001	<0.0001	0.013	<0.010
9/11/2018	GW108	GW108	0.19	<0.10	<0.010	<0.010	<0.010	3.9	<0.0010	<0.0010	<0.010	<0.010	<0.010	<0.010	<0.10	<0.10	<0.010	<0.010	<0.010	<0.010	<0.0001	<0.0001	0.011	<0.010
30/11/2018	GW108	GW108	<0.10	<0.10	<0.010	-	<0.010	4.81	<0.0010	-	<0.010	-	<0.010	-	<0.10	<0.10	<0.010	-	<0.010	<0.010	<0.0001	-	0.011	<0.010
13/12/2018	GW108	GW108	<0.10	<0.10	<0.010	-	<0.010	4.93	<0.0010	-	<0.010	-	<0.010	-	<0.10	<0.10	<0.010	-	<0.010	<0.010	<0.0001	-	0.012	<0.010
24/01/2019	GW108	GW108	<0.10	<0.10	<0.010	-	<0.010	4.34	<0.0010	-	<0.010	-	<0.010	-	<0.10	<0.10	<0.010	-	<0.010	<0.010	<0.0001	-	0.012	<0.010

			Metals					BTEXN							TRH - NEPM 2013							TRH - NEPM 1999					PAHs				
			Nickel (filtered)	Strontium	Tin	Zinc	Zinc (filtered)	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX (Sum of Total) - Lab Calc	F1 (C6-C10 minus BTEX)	C6-C10 Fraction	F2 (>C10-C16 minus Naphthalene)	>C10-C16 Fraction	F3 (>C16-C34 Fraction)	F4 (>C34-C40 Fraction)	>C10-C40 (Sum of Total)	C6-C9 Fraction	C10-C14 Fraction	C15-C28 Fraction	C29-C36 Fraction	C10-C36 (Sum of Total)	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene
			mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL			0.001	0.001	0.001	0.005	0.005	1	2	2	2	2	2	1	20	20	100	100	100	100	100	20	50	100	50	50	1	1	1	1	0.5
NSW Master GILs for Marine Water			0.007		0.01	0.015	0.015	500	2,500	43			100			3,700		640									40	30			
Date	**Field ID**	**Location Code**																													
14/09/2018	GW105	GW105	<0.010	9.6	<0.010	<0.052	<0.050	<1	<2	<2	<2	<2	<2	<1	<20	<20	<100	<100	<100	<100	<100	<20	<50	<100	<50	<50	<1.0	<1.0	<1.0	<1.0	<0.5
18/10/2018	GW105	GW105	<0.010	8.54	<0.010	<0.052	<0.050	<1	8	<2	<2	<2	<2	8	<20	<20	<100	<100	<100	<100	<100	<20	<50	<100	<50	<50	<1.0	<1.0	<1.0	<1.0	<0.5
9/11/2018	GW105	GW105	<0.010	8.34	<0.010	<0.052	<0.050	<1	<2	<2	<2	<2	<2	<1	<20	<20	<100	<100	<100	<100	<100	<20	<50	<100	<50	<50	<1.0	<1.0	<1.0	<1.0	<0.5
30/11/2018	GW105	GW105	-	8.94	<0.010	<0.052	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13/12/2018	GW105	GW105	-	7.91	<0.010	<0.052	-	<1	<2	<2	<2	<2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/12/2023	GW105	GW105												-		-		-			-										
14/09/2018	GW108	GW108	<0.010	9.1	<0.010	<0.052	<0.050	<1	<2	<2	<2	<2	<2	<1	<20	<20	<100	<100	<100	<100	<100	<20	<50	<100	<50	<50	<1.0	<1.0	<1.0	<1.0	<0.5
19/10/2018	GW108	GW108	<0.010	8.14	<0.010	<0.052	<0.050	<1	10	<2	<2	<2	<2	10	<20	20	<100	<100	<100	<100	<100	<20	<50	<100	<50	<50	<1.0	<1.0	<1.0	<1.0	<0.5
9/11/2018	GW108	GW108	<0.010	8.28	<0.010	<0.052	<0.050	<1	5	<2	<2	<2	<2	5	<20	<20	<100	<100	<100	<100	<100	<20	<50	<100	<50	<50	<1.0	<1.0	<1.0	<1.0	<0.5
30/11/2018	GW108	GW108	-	7.87	<0.010	<0.052	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13/12/2018	GW108	GW108	-	8.33	<0.010	<0.052	-	<1	4	<2	<2	<2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24/01/2019	GW108	GW108	-	7.9	<0.010	<0.052	-	<1	3	<2	<2	<2	<2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/12/2023	GW108	GW108												-		-		-			-										

			PAHs														VOCs				Biological			
			Benzo[b+j]fluoranthene	Benzo(k)fluoranthene	Benzo(g,h,i)perylene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Naphthalene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene	PAHs (Sum of total) - Lab calc	Total 8 PAHs (as BaP TEQ)(zero LOR) - Lab Calc	Chloroform	Bromodichloromethane	Bromoform	Chlorodibromomethane	Trihalomethanes	Faecal Coliforms	Total Coliforms	E. Coli	Enterococci
			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	CFU/100mL	CFU/100mL	CFU/100mL	CFU/100mL
EQL			1	1	1	1	1	1	1	1	1	1	1	0.5	0.5	5	5	5	5	5	1	1	1	1
NSW Master GILs for Marine Water								8	50	30		4.6				3,200	3,200	3,200	3,200					
Date	Field ID	Location Code																						
14/09/2018	GW105	GW105	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<0.5	<5	<5	<5	<5	<5	<2	20	<2	<2
18/10/2018	GW105	GW105	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<0.5	<5	<5	<5	<5	<5	<1	-	<1	<1
9/11/2018	GW105	GW105	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<0.5	<5	<5	<5	<5	<5	<1	<1	<1	<1
30/11/2018	GW105	GW105	-	-	-	-	-	-	-	-	-	-	-	-	-	<5	<5	<5	<5	<5	<1	<1	<1	<1
13/12/2018	GW105	GW105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<5	<1	<1	<1	1
11/12/2023	GW105	GW105												-								N/A		
14/09/2018	GW108	GW108	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<0.5	<5	<5	<5	<5	<5	<2	<2	<2	<10
19/10/2018	GW108	GW108	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<0.5	<5	<5	<5	<5	<5	<2	<2	<2	<10
9/11/2018	GW108	GW108	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<0.5	<5	<5	<5	<5	<5	<1	40	<1	<1
30/11/2018	GW108	GW108	-	-	-	-	-	-	-	-	-	-	-	-	-	<5	<5	<5	<5	<5	<1	2	<1	<1
13/12/2018	GW108	GW108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<5	<1	<1	<1	<1
24/01/2019	GW108	GW108	-	-	-	-	-	-	<5	-	-	-	-	-	-	<5	<5	<5	<5	<5	~<1	<1	~<1	<1
11/12/2023	GW108	GW108												-								N/A		