

FINNISS LITHIUM PROJECT BP33 UNDERGROUND MINE

Water Management Plan

November 2021

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Appendices

Appendix A Baseline surface water and groundwater quality RAW data

ACRONYMS

AEP	annual exceedance probability
AMD	acid, saline or metalliferous drainage
ANCOLD	Australian National Committee on Large Dams
ARI	average recurrence interval
AS	Australian Standard
AS/NZ	Australian and New Zealand Standards
ASS	acid sulfate soils
BoM	Bureau of Meteorology
BTEXN	Benzene, Toluene, Ethylbenzene, Xylene, Naphthalene
DENR	Department of Environment and Natural Resources (Northern Territory)
DEPWS	Department of Environment, Parks and Water Security (Northern Territory)
DMS	dense medium separation
DO	dissolved oxygen
DPIR	Department of Primary Industry and Resources (Northern Territory)
DSO	direct shipping ore
EC	electrical conductivity
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
ESCP	Erosion and Sediment Control Plan
EY	exceedance per year
GDE	groundwater dependent ecosystem
GL	gigalitre (10 ⁹ litres)
ha	hectare
IECA	International Erosion Control Association
IFD	Intensity-Frequency-Duration design rainfalls
K	Hydraulic conductivity
kL	kilolitre (10 ³ litres)
LOR	limit of reporting for laboratory analysis
mAHD	metres above Australian Height Datum
mBGL	metres below ground level
MCA	Minerals Council of Australia
MCP	Mine Closure Plan
ML	megalitre (10 ⁶ litres)
ML	Mineral Lease (granted)
ML/a	megalitre per year
MMP	Mining Management Plan
MSD	mine site dam
Mt	million tonnes
MWD	mine water dam
NATA	National Association of Testing Authorities Australia
NOI	Notice of Intent
NT	Northern Territory
NT EPA	Northern Territory Environment Protection Authority
ORP	oxidation reduction potential

pH	power of hydrogen
Project/ Proposal	Core Lithium Limited's Finnis Lithium Project BP33 Underground Mine
Q	design flood peak discharge
RAR	return air raise
RFFE	Regional Flood Frequency Estimate: method developed by Engineers Australia to estimate design flood peak discharge (Q)
RoM	run of mine pad
RWD	raw water dam
SER	supplementary environmental report
SILO	Scientific Information for Land Owners - online climate database
SSTV's	site-specific trigger values: contaminant concentrations derived using the ANZECC 2000a guidelines methodology above-which water quality impacts may be occurring and investigation of the cause is recommended.
SWL	standing water level
TDS	total dissolved solids
TPH/TRH	Total Petroleum Hydrocarbons NEPM 1999 suite / Total Recoverable Hydrocarbons NEPM 2013 suite
TSF	tailings storage facility
TSS	total suspended solids
WDL	Waste Discharge Licence
WMP	Water Management Plan
WQMP	Water Quality Monitoring Plan
WRD	waste rock dump

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1 INTRODUCTION

Core Lithium Limited (Core) propose to develop and operate an underground lithium mine at the BP33 resource (the mine) located approximately 20 km west of Berry Springs, on the Cox Peninsula in the Northern Territory (NT); see Figure 1-1. This mine forms part of Core's wider Finnis Lithium Project.

Core currently holds Mining Authorisation (MA) 1020-01 pursuant to the *Mining Management Act* for open pit mining and processing of the Grants ore resource on Mineral Lease (ML) 31726; referred to as the Grants Lithium Project. The BP33 resource, planned for subsequent mining, is located approximately 4.5 km south-east of the Grants resource on ML32346 and the smaller southern portion of MLN16. The adjacent ML32074 encompasses Observation Hill Dam, planned as a water source for mining operations. Ore from the BP33 mine will be taken to the Grants processing plant via a purpose-built haul road.

This draft Water Management Plan has been prepared to provide a risk-based framework for avoiding and minimising impacts to flow regimes and water quality of both surface and groundwater resources. The plan includes baseline surface and groundwater water quality data compiled by EcOz, a site groundwater model prepared by specialist consultants Groundwater Enterprises (2021) and a site water balance model prepared by specialist water consultants WRM (2021). The plan documents the current state of knowledge with respect to the surface water and groundwater receiving environments, potential impacts and mitigation measures, and provides a plan for addressing knowledge gaps and uncertainties prior to commencement of mining. This draft WMP will be updated for submission with the Mining Management Plan (MMP) that is required to be submitted to gain a Mining Authorisation under the *Mining Management Act*.

This WMP is presented in accordance with the NT Government *Template for the Preparation of a Mining Management Plan, Section 6 Water Management* (DPIR 2017). The content in this draft version of the plan has been tailored to addressing the additional information required by the NT Environmental Protection Authority (NT EPA) in order to complete their assessment of the proposal under the *Environment Protection Act 2019*. In this context, the content currently focuses on assessment, avoidance and mitigation of potentially significant impacts. As the mine design is further developed over the coming period, the scope of the plan will be expanded to provide assessment and management of all risks to water, in accordance with the requirements of the *Mining Management Act*.

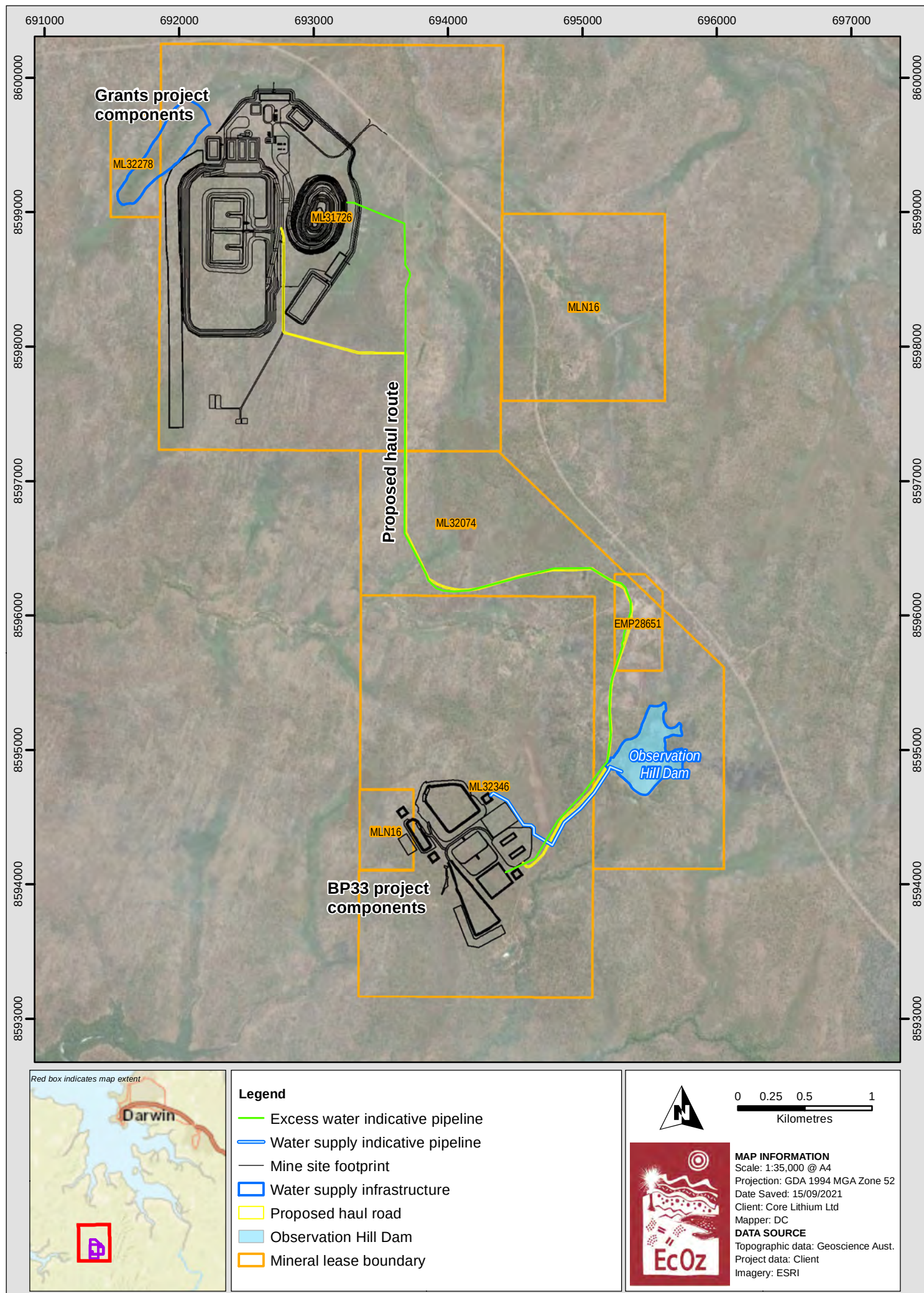
The environmental objectives for mining operations relating to water management are to:

- Maintain the quality of groundwater and surface water so that environmental values including ecological health, land uses, and the welfare and amenity of people are protected
- Maintain the hydrological regimes of groundwater and surface water so that environmental values are protected

The scope of this WMP includes:

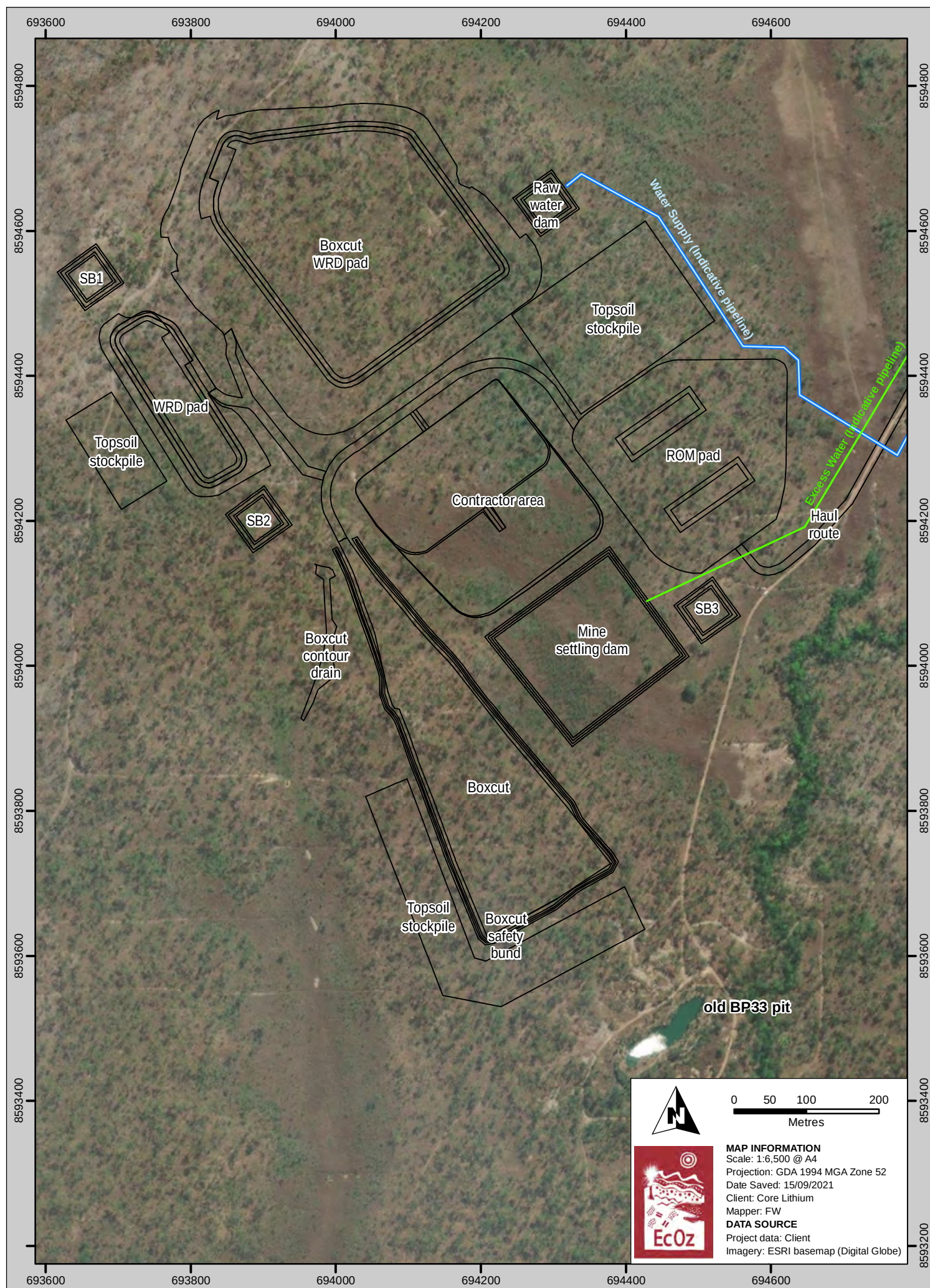
- Water aspects of mining operations within Mineral Lease ML32346 and southern portion of MLN16 (referred to as mine site/mine area/mine footprint); i.e. that associated with the box-cut, box-cut safety bund, waste rock dump (WRD) pads, run of mine (RoM) pad, access/haul roads, water storages and holding dams, stormwater drains and sediment ponds, and contractor's area (ablutions and office facilities), see Figure 1-2.
- Water stores and infrastructure located in the adjacent ML32074 i.e. Observation Hill Dam (OHD) and pipeline linking OHD to the mine site (Figure 1-1).
- Surface and groundwater systems influenced by mining operations, including those up-gradient and down-gradient of the mine area, and down-gradient of OHD.

This WMP does not include water management at the Grants mine, which is covered by the Grants Lithium Project WMP. This includes the processing of ore from the BP33 mine, which will be undertaken at the Grants ore processing plant.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ20208 - BP33 Supplementary Environmental Report\01 Project Files\Report maps\Figure 1-1. Map of Finnis Lithium Project location and components.mxd

Figure 1-1. Map of Finnis Lithium Project location and components



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ20208 - BP33 Supplementary Environmental Report\01 Project Files\Report maps\Figure 1.2. Map of BP33 mine site layout.mxd

Figure 1-2. Map of BP33 mine site layout

2 PROJECT DETAILS

This section outlines the mine details relevant to water management i.e. mine infrastructure, operations, schedule, water requirements, sources and storages, dewatering of mine workings, ore processing, hazardous materials, waste rock management and other waste management.

2.1 Project overview

The project proposes to mine a near-vertical pegmatite (Figure 2-1) that contains the lithium-bearing mineral spodumene ($\text{LiAlSi}_2\text{O}_6$). Drilling to date indicates the ore body is approximately 400 m deep, by ~40 m wide. The ore body will be accessed via a box-cut from the surface (surface footprint approx. 6 ha), a portal will be installed at the base of the box-cut, and a 400 m long decline utilised to access the underground mine. The box-cut will be excavated by conventional truck and shovel methods.

The underground mine will comprise ten production levels, with the deepest extending to more than 300 m below ground level. The mining method is underground Sub Level Open Stope (SLOS). Each level will contain stope access from the decline, sump/drainage, ventilation network and a turning/stockpile bay. The underground mine will be ventilated via a dedicated raise bored return air raise (RAR) to the surface (Figure 2-2).

Around 2.09 million tonnes (Mt) of ore is planned for extraction over the expected 55-month mine life, 44 months of which the underground portal will be mined. Once underground mining is complete, the box-cut and underground mine will be backfilled to 65% with the original material excavated from the box-cut and waste rock from underground mining. Topsoil originally stripped from the site and stockpiled will be re-spread across the site and the site revegetated.

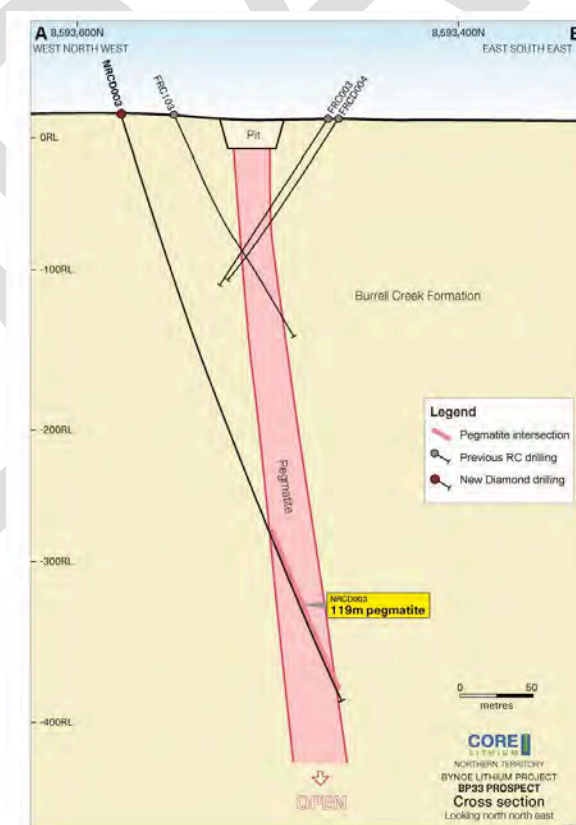


Figure 2-1. Cross section at BP33 showing pegmatite intersections in previous and recent drilling

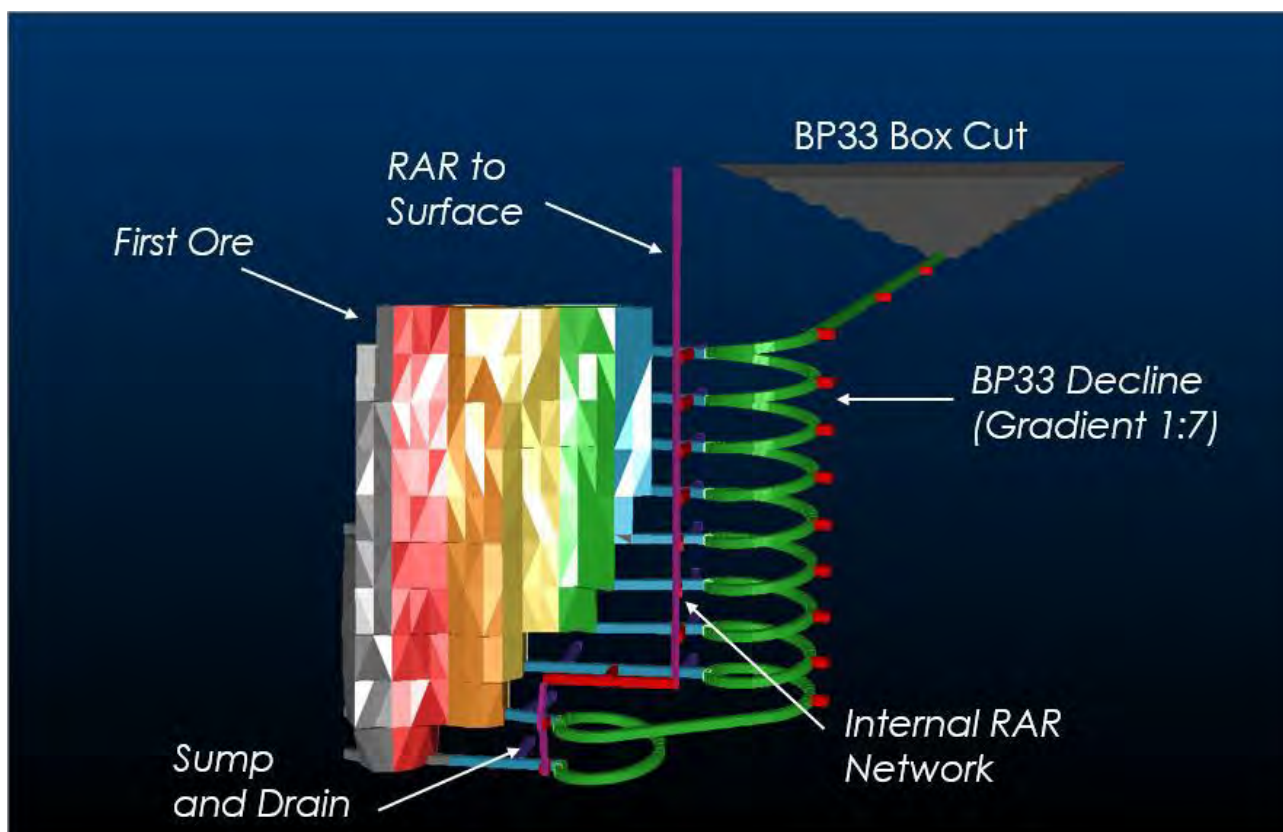


Figure 2-2. BP33 underground design for life of mine

2.2 Mine components

Mine components are shown in Figure 1-2 and are listed below in Table 2-1. Components relating to water management, or with implications for hydrological processes or water quality are outlined in the section below.

The mine site area (mine footprint) covers approximately 88 ha. The footprint of the haul road from BP33 to Grants is approximately 12.5 ha (13 m wide by 7.3 km long). Areas outside the mine footprint but within ML32346 and MLN16 will remain largely undeveloped.

The mine components in the adjacent ML32074 include the existing OHD, located around 800 m directly north-east of the mine, and a proposed 1.4 km-long underground water pipeline linking this dam to the mine. An additional 0.4 ha will be required for installation of the water pipeline.

Table 2-1. Mine components

Components within the mine footprint inside ML32346	
Contractor's area	incorporating site offices, equipment laydown, light vehicle (LV) parking and wash-down, emergency facilities, heavy vehicle (HV) workshop, wash-down, and refuelling.
Box-cut	and associated heavy vehicle access ramps and haul roads. The box-cut will cover an area of six hectares and will be excavated to at least 10 m below the oxidised waste rock, equating to a depth of approx. 60-70 m below ground level.
Box-cut safety bund	around the western side of the box-cut to prevent surface water run-off entering the box-cut. This bund will be 2 m high with a base width of 7.3 m.
Underground mine	comprising a portal installed near the base of the box-cut and a 400 m decline used to access the top of the ore body. A further 1.7 km of decline constructed over the life of mine will provide access to each production level, down to an elevation of approximately -360 mAHD. The underground mine will comprise ten production levels (5 stope horizons). Each level will contain stope access from the decline, sump/drainage, ventilation network and a turning/stockpile bay. The underground mine will be ventilated via a dedicated raise bored Return Air Raise (RAR) to the surface.
Drains and erosion and sediment controls	within the mine site to prevent stormwater run-off into the box-cut and operational areas, and to direct run-off into drains, through erosion and sediment controls (e.g. rock check dams), and into sediment ponds for treatment and testing prior to release off-site.
Explosives compound	will be relocated from the Grants mine site for re-use.
Mine settlement dam (MSD)	to temporarily store and treat water dewatered from the box-cut, decline and underground workings for later use in underground dust suppression.
Raw water dam (RWD)	to hold water from Observation Hill Dam (OHD) supplying potable/non-potable water to mine operations centre, and dust suppression of the haul route
Run of mine (RoM) stockpile pad	for temporary stockpiling unprocessed ore prior to transport to the Grants processing facility.
Topsoil stockpile	areas will be flat ground areas allocated to storage of topsoil and subsoil stripped from the site.
Waste rock dumps (WRDs)	two to be established; one with material from the box-cut and the other with material from the underground mine. These WRD's are temporary, and the material will be returned to the box-cut and underground workings once mining is completed.
Components within ML32074	
Haul road	will be an internal route for transport of ore from the BP33 RoM pad to the Grants processing facility.
Observation Hill Dam (OHD)	existing dam, located approximately 800 m north-east of the mine to supply water to RWD.
Underground pipeline	(1.4 km long) to transport water from OHD to mine site.
Proposed pipeline from MSD to Grants pit	to take water in the MSD derived from dewatering the box-cut, decline and underground workings to the Grants pit.

2.3 Mining schedule

Construction of the aboveground mine components and excavation of the box-cut is expected to take approximately 6 months. The production phase associated with extraction of 2.09 Mt of ore is expected to be 44 months. Mine closure and rehabilitation is expected to take a further five months following removal of the last ore. An indicative schedule is provided in Table 2-2.

Table 2-2. Indicative mining schedule

Schedule	Months 1-6	Month 7-50	Months 51-55	Month 66 onward
Phase	Construction	Production	Closure and rehabilitation	Post-closure
Duration	6 months	44 months	5 months	Ongoing
Activities	Construction of infrastructure and box-cut; removal of oxide waste	Underground construction, mining, ore processing and transport to Port	Backfilling to 65%, removal of infrastructure and revegetation.	Monitoring of the mine site until rehabilitation completion criteria are achieved and the site is relinquished.

2.4 Water demand and sources

The estimated water demand for the mining operation is 1.04 ML/day, which includes haul road dust suppression (0.42 ML/day), underground demand (0.5 ML/day) and ablutions/surface facility demands (0.12 ML/day). Water will be sourced from the Observation Hill Dam (OHD) and from dewatering. Initially the OHD will be the main water source; however, as the box cut and decline are developed, dewatering is expected to supply the projects non-potable water demand.

2.4.1 Observation Hill Dam

Core submitted a surface water extraction licence application under the *Water Act* on 7 April 2021 (pending approval) for use of surface water from the existing Observation Hill Dam (OHD). The assessment of potential environmental impacts to areas downstream of OHD were assessed as part of the Grants Project environmental approvals and Core's existing Mining Authorisation provides approval for raising of the dam wall and sourcing water from OHD, under a Water Extraction Licence. Water sourced from OHD for the BP33 mine, will be pumped via a purpose-built pipeline to the raw water dam (RWD) to be constructed at the BP33 mine.

OHD was originally constructed to supply water for tin and tantalite mining and ore processing that occurred in the 1980's and 1990's (Frater 2005). The estimated dam volume when full is around 364 ML (EnviroConsult 2018). To ensure water security for the project in the event of lower-than-average rainfall, the dam wall will be raised by 1.4 m at the embankment and 1.5 m at the spillway (to 31.4 m AHD) increasing the storage capacity from 364 to 620 ML.

The water in OHD collects natural catchment run-off during the wet season. Baseline water quality data has been collected by EcOz for OHD since October 2017, the water quality is a combination of rainwater mixed with groundwater seepage. A summary of the water quality data of OHD is provided in section 4.5.2.

2.4.2 Underground and box-cut dewatering

The box-cut, decline and underground workings will require constant dewatering and this water will be used to supply the mine sites non-potable water demand as much as possible. Inflows into the box-cut will mainly comprise groundwater seepage, with a small component of incident rainfall. The decline and underground workings are only subject to groundwater inflows. Figure 2-3 shows the predicted inflows into the BP33 boxcut and underground adopted in the site water balance based on estimates provided in the site groundwater model (CloudGMS, 2021), which are up to 7,000 kL/day by end of mining. The underground and box-cut water will be pumped to the MSD for storage prior to use for dust suppression. The site water balance indicates the MSD does not have capacity to store the estimated quantity of water required to be pumped from the underground. The management of surplus water is discussed further in section 2.5.3.

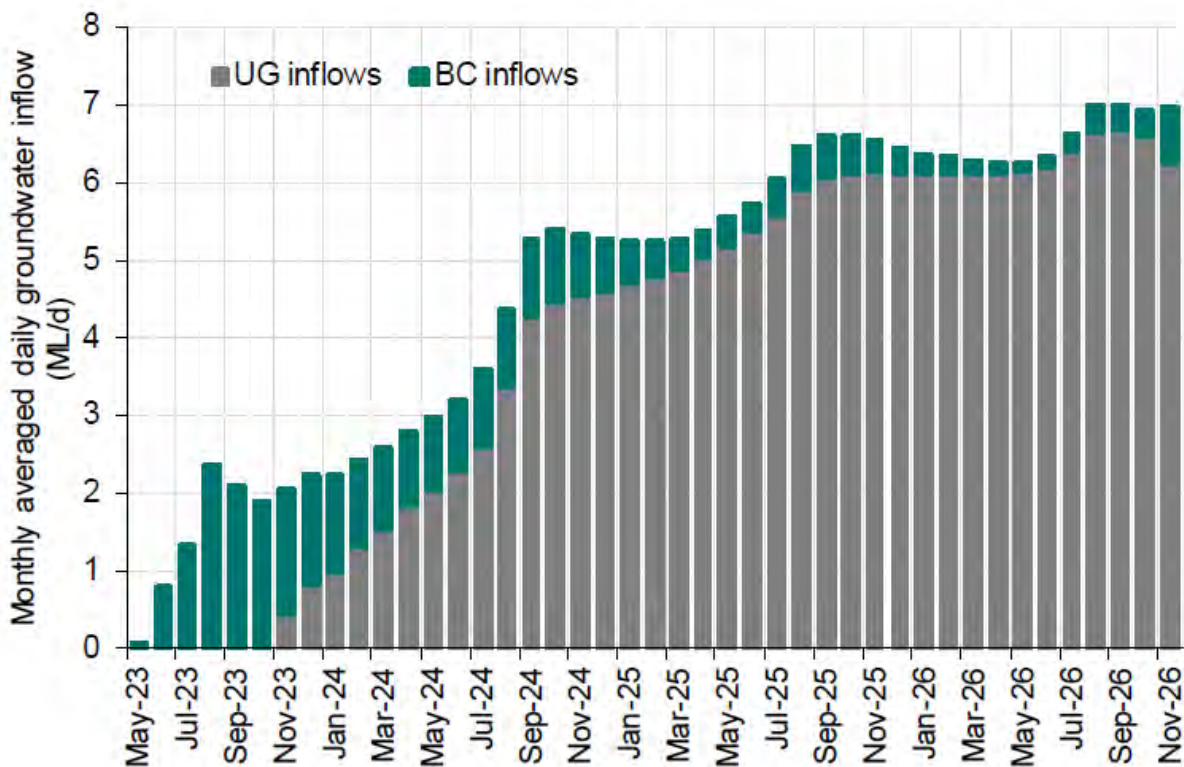


Figure 2-3. Predicted groundwater inflows into the BP33 box cut and underground (Source: WRM, 2021)

2.5 Water management system

The water management objectives for BP33, adopted in the site water balance modelling (WRM, 2021), are to:

- Manage surface water such that community values and ecosystems are maintained downstream of the BP33 mine lease.
- Ensure all onsite water demands are met (including the underground demand and haul road dust suppression).
- Site and operate all mine water storages to limit the risk of uncontrolled offsite spills.
- Design and operate the water management system to limit the risk of underground interruption (interruption due to water inundation).
- Where possible, divert clean runoff from undisturbed areas around areas disturbed by mining activities and allow to drain from the site.
- Capture suspended sediment in site runoff in accordance with an Erosion and Sediment Control Plan. This will include controlling sediment-laden runoff and passing it through sediment control structures prior to releasing it to limit any potential downstream sedimentation.
- Contain mine water in on-site water storages for reuse as a water supply to the mine demands
- Mine runoff and groundwater inflows will drain to collection sumps and be pumped to dedicated on-site storage dams or, if required, to the completed Grants pit.

The site water management system is shown schematically in Figure 2-4.

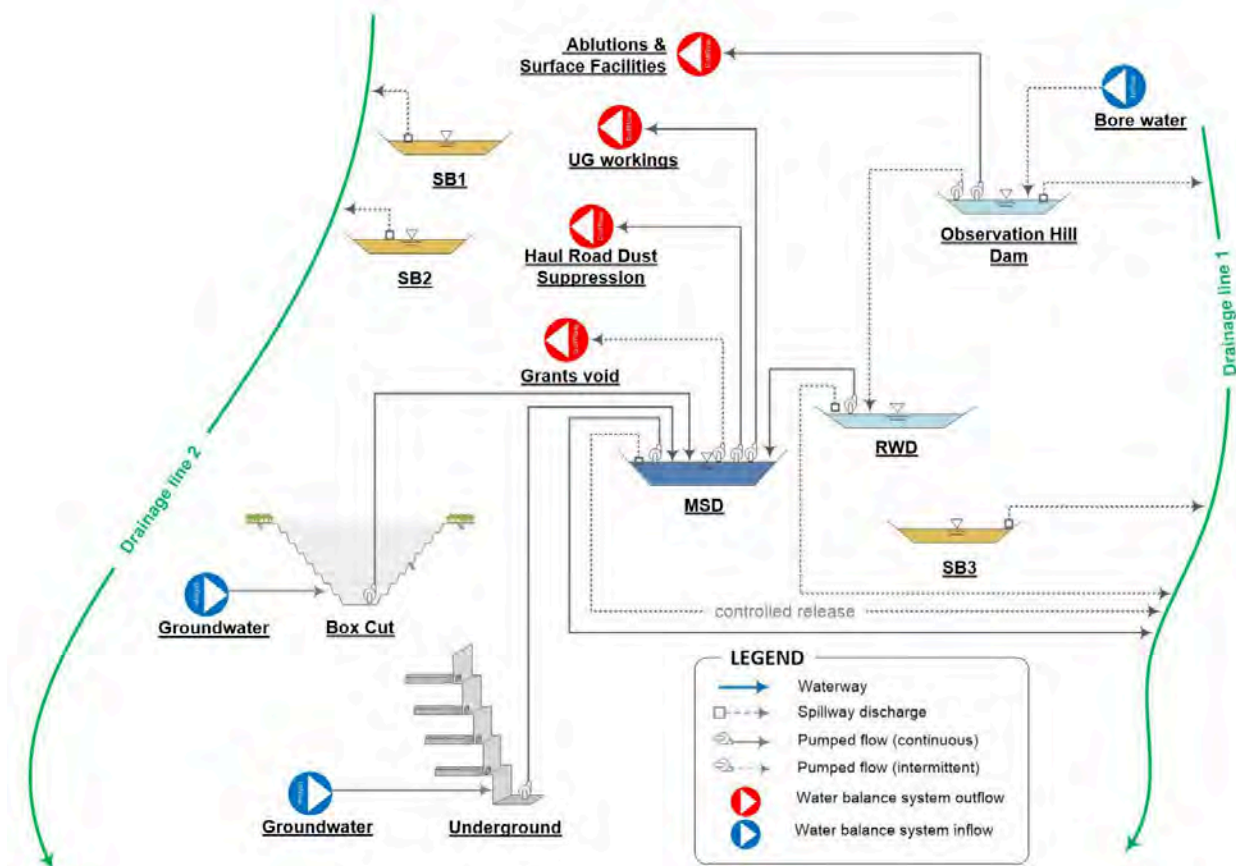


Figure 2-4. Schematic of the proposed BP33 mine water circuit (Source: WRM, 2021)

2.5.1 Water management infrastructure

Two internal mine site holding dams will be constructed for the management and use of water: the raw water dam (RWD) from different sources i.e., underground and box-cut dewatering and surface water storages, remain separate and are used appropriately in accordance with their water quality. The dam designs are at preliminary concept stage, the final designs will be prepared on completion of site investigations and testing of the foundation and embankment materials. The design concept is a full perimeter embankment, with materials for construction won from within the storage areas (cut / fill balance). The designs will include a low permeability basal liner, erosion protection and designed to ANCOLD specifications by an appropriately qualified person.

Raw water dam

The RWD will be constructed to hold water pumped from OHD (and/or Grants Area if required) for use in dust suppression and to supply the mine site facilities (offices, potable, ablution, vehicle washdown, workshops etc) for the life of the mine. The preliminary design capacity is 6.25 ML, with a maximum operating volume of 5 ML, which will be refined through the detailed design phase. The site water balance indicates that an initial 40 ML will be required to be pumped to the RWD during the first month of mining to fill the dam, and an ongoing requirement of 17 ML/month will be required during median climatic conditions.

Mine settlement dam

The mine settlement dam (MSD) will be constructed to store and treat water removed (dewatered) from the underground workings and box-cut. The MSD will be of turkey's nest-type construction and will allow for the settlement and removal of sediments so that the water can either be reused underground for dust suppression or discharged at a suitable quality. The planned maximum operating volume of the MSD is 120 ML; however, the modelled groundwater inflows and site water balance (see Section 2.2 below) indicate this will likely be

insufficient to store all water. Various water management options are being investigated as part of the detailed design phase. Section 9.1 details this information gap and how it will be addressed.

2.5.2 Site water balance

WRM (2021) developed a site water balance model for the period covering the start up and operation phases of the BP33 mine, within an indicative starting date of May 2023 and ending date November 2026. The model simulates water inputs and outputs for a range of climatic conditions. Inputs comprise groundwater and surface water inflows into the box-cut and underground, and water sourced from OHD. Outputs comprise water used for dust suppression and in on-site ablutions and facilities (potable water, vehicle wash-down etc). Loss through evaporation from the RWD and MSD is another output.

Table 2-3 provides the total average input and output volumes derived by the model for the entire period; May 2023 to November 2026. This water balance shows that total water inputs are more than 4 times greater than the outputs. Options for disposing of this surplus water were explored in WRM (2021), comprising transfer to the Grants open pit, irrigating to land and controlled releases from the MSD into the drainage line south-east of the mine. These options are discussed in Section 2.5.3 below. WRM provided additional options for surplus water management in the event of higher than expected groundwater inflows are experienced, these are increased storage capacity of the MSD and utilising evaporator fans at the Grants pit to increase water disposal opportunity.

Table 2-3. BP33 mine water balance summary for the period May 2023 to November 2026
(Source: WRM, 2021)

Description		Average (ML/period)
Water Source (Inputs)	Surface water inflows	400
	Groundwater inflow	6,359
	Inflows from OHD	403
	Bore water inflows	0
	Total Input	7,164
Water Losses and Usage (Outputs)	Evaporation (from water storage)	288
	BP33 demands ¹	3,039
	Offsite overflows	0
	Total Output	3,327
Site water balance excluding water disposal measures	Total Input-Total Output	3,837
Water disposal measures	Transfers to Grants area	3,197
	Irrigation loss	176
	Controlled releases offsite	342
	Total Disposal	3,715
Site water balance including water disposal measures	Total Input-Total Output-Total Disposal	122

¹ Includes haul road dust suppression, underground demand and ablutions/surface facility demands

2.5.3 Surplus water management strategies

Water removed from the box-cut and underground workings will be pumped to the MSD, from where it will be reused in mine operations; however, the site water balance indicates there will be large volumes of surplus water that will need to be managed. The volume of surplus water that will need to be managed over the life of mine estimated by WRM (2021) is approximately 3,837 ML. Options under consideration are summarised below. The final strategy using a combination of these options, and/or other alternative options will be further developed through the detailed design phase and detailed in the Mining Management Plan.

Controlled release from MSD

Controlled release from the MSD into the drainage line south-east of the mine is one option for disposing of a proportion of surplus water. The volume of water that can be disposed of in this manner will be limited by the water quality, as well as the restricted timing of discharges to periods when the ephemeral drainage line would naturally flow i.e. discharge would not be permitted during the dry season. This option would require a Waste Discharge Licence (WDL) under the *Water Act*.

The MSD release water quality has been predicted using baseline groundwater data collected since the instalment of monitoring bores on the site in September 2020 (see section 5.5). Groundwater removed from the box-cut and underground is likely to be naturally high in arsenic, phosphorus and salinity (electrical conductivity) in comparison to the surface water quality measured in the receiving waterway. Discharge could only occur if concentrations were reduced by:

- Treatment in the MSD prior to discharge, and/or
- Limiting volume and timing of discharge to periods where water flows in the receiving waterway were sufficient to dilute and reduce concentrations to less than the site-specific trigger value (SSTV); see Section 8.2.6 for SSTVs.

Arsenic requires the greatest dilution, and as such, if sufficient dilution is achieved for arsenic, then it should also be achieved for phosphorus and salinity. Based on the median arsenic concentrations in groundwater (see Section 5), the dilution required ranges from 1:12 to 1:17. Figure 2-5 shows the modelled controlled discharge volumes from the MSD to achieve the required dilution in the receiving environment. This figure shows that in very wet (1%ile) climatic conditions, the MSD could release up to 150 ML/month in the peak of the wet season. In median (50%ile) climatic conditions, the MSD could release up to 25 ML/month, equating to a total of only 151 ML for the entire construction and operations phase of the mine. It is likely therefore, that treatment to reduce arsenic concentrations in the MSD will be required prior to discharge to allow a greater volume to be discharged. An alternative disposal option, such as pumping to the Grants pit and irrigation to land, will also be needed during the dry season, when controlled release into the drainage line would not be permitted.

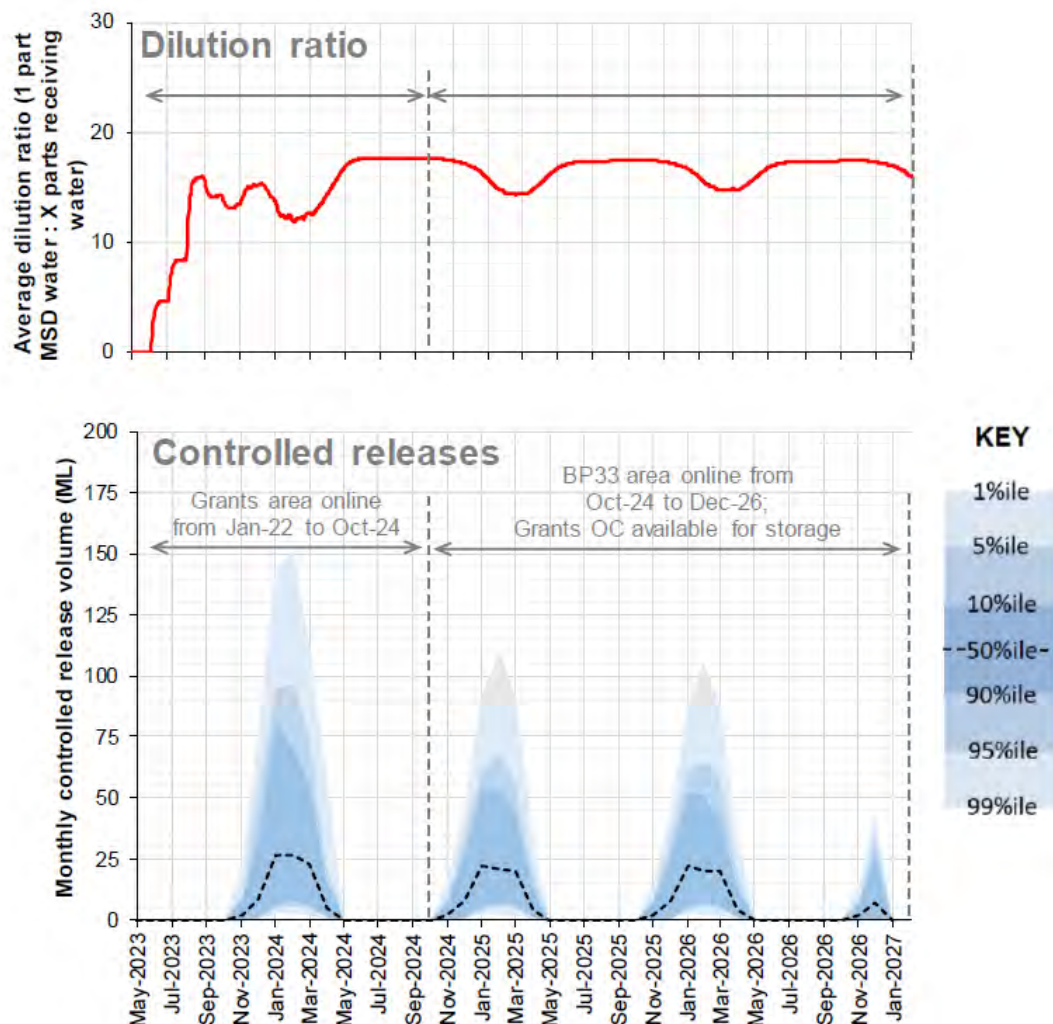


Figure 2-5. Allowable controlled discharge volumes from MSD (Source: WRM 2021)

Transfer to Grants pit

Transfer of surplus water from the MSD to the Grants pit is considered the most feasible water management option. This option does not result in the discharge of MSD water to surface waterways and as such, treatment and/or dilution is not required. Seepage of the water from the Grants pit back into the aquifer is not considered a risk given the water quality of the groundwater at Grants is very similar to that at BP33 (see [Grants WMP](#)). The storage volume available in the Grants pit is not limiting i.e. the pit will have a storage capacity of over 13,000 ML, which is well in excess of the 3,837 ML needing to be disposed of.

Because the Grants pit will still be operational at the time mining commences at BP33, there is likely to be a period during which transfer to the Grants pit is not a viable water management option. There is a 16-month overlap during which the box-cut is being excavated and open-cut mining at Grants is still occurring. During this time, excess water will need to be managed by controlled discharge and irrigation (see section below).

Figure 2-6 shows the monthly volumes of water to be transferred to the Grants open pit from July 2024 onwards, and Figure 2-7 shows the Grants open pit filling with this transferred water.

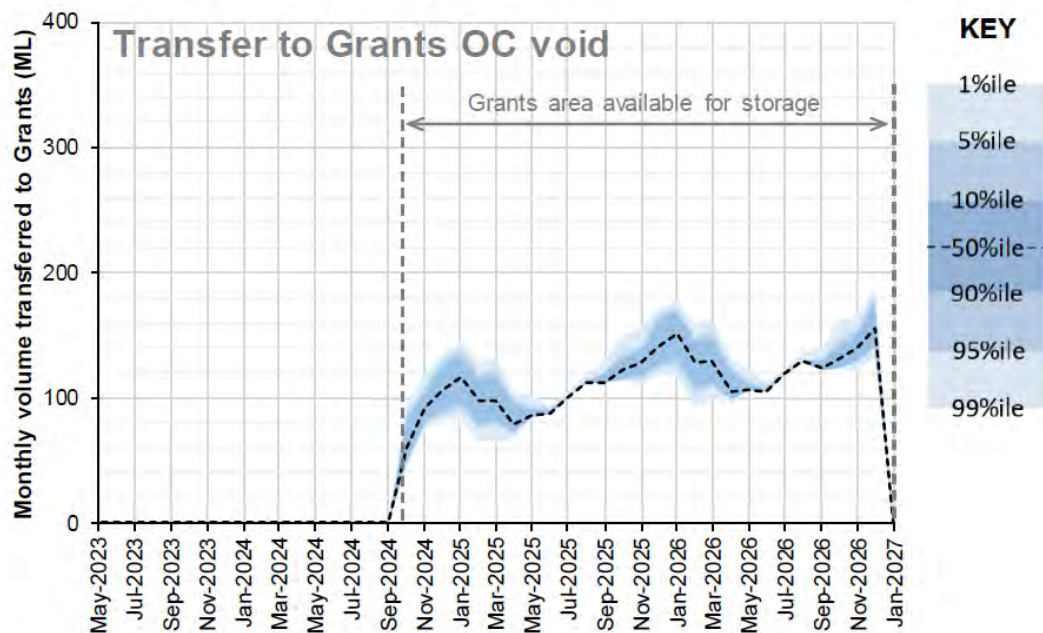


Figure 2-6. Monthly volume of water transferred to Grants pit (Source: WRM,2021)

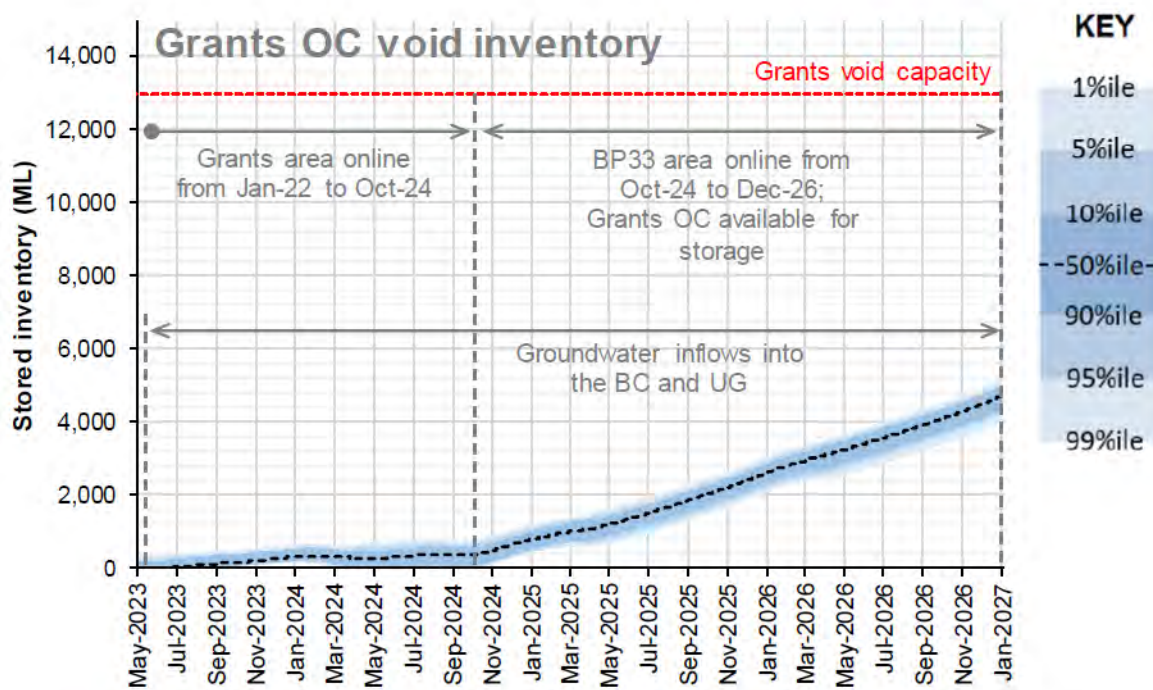


Figure 2-7. Grants open cut inventory (Source: WRM,2021)

Irrigation to woodland environment

WRM (2021) investigated the option of irrigating the excess MSD water. The total volume of water requiring disposal during the first 16 months of BP33 operations, when the Grants pit is unavailable, was estimated to be between 120 ML to 210 ML. Based on modelling outcomes, it was found that an irrigation area of 20ha would be sufficient to accept these volumes of water during most climatic conditions. If a combination of daily fluctuations in water volumes of groundwater inflows increased and no irrigation days occurred due to wet days the water, up to 120ML of water would require additional management. This could be managed through increasing the available capacity of the MSD. The required total irrigation area could be reduced by increasing the available MSD water storage capacity to contain the additional 1% AEP wet season catchment runoff inflows. Further work planned during the detailed design phase, to refine the sizing of the storages and irrigation areas required to provide for short-term management of surplus water during the period of overlap between mining at Grants and BP33, is detailed in section 9.

2.6 Contaminant sources

Details of key contaminant sources and management measures are provided below.

2.6.1 Stormwater runoff

Bund walls around the mine site will act to prevent stormwater run-off flowing into the box-cut or other operational areas, where it may become contaminated. Internal mine site stormwater will be directed into drains and into one of three sediment basins (SB1, SB2 or SB3) for treatment and testing prior to release off-site. The basins will be located at the base of the WRD1, WRD2 and RoM pad (Figure 1-2). A toe drain will be constructed around the perimeter of the WRDs and RoM pad to direct surface flows into the sediment basins. The sediment basins will be sized and constructed appropriately to manage the infrastructure catchment flows.

Erosion and Sediment Control Plan

An Erosion and Sediment Control Plan (ESCP) for the mine site will be developed by a Certified Practitioner in Erosion and Sediment Control consistent with the *International Erosion Control Association, Best Practice Erosion and Sediment Control* (IECA 2008). The ESCP will detail the controls to be implemented across the site to minimise erosion and sedimentation, and prevent contamination of stormwater by directing it around operational areas and capturing all mine site runoff in sediment basins for treatment prior to release off site. Detailed ESCPs with site-specific dimensioned plans will be developed for each stage of the mining project, and will address the specific seasonal conditions (wet season/dry season) under-which the stage occurs.

Sediment basin design and operation

The design and operation of the sediment basins is of particular relevance for this WMP. As with all erosion and sediment controls across the site, the design of sediment basins and method of release of water from these basins will be in accordance with IECA (2008).

Sediment basins proposed for the mine site are initially designed as Type D basins, which assume dispersive soils requiring the use of a flocculating agent to settle. This is a conservative approach, representing the worst-case scenario. Table 2-4 below provides the minimum design criteria for the sediment basins.

The water quality of sediment basins will be monitored and tested as part of the Monitoring Plan (see Section 8). The results of this testing will guide how this water is treated with flocculants etc, and also identify any issues requiring action such as sources of contamination or improving erosion and sediment control measures.

Table 2-4. Sediment basin design criteria

Location	Capacity
• Located to maximise collection of sediment-laden runoff generated within the site • Not within a waterway or drainage channel • Above the 1 in 5 year ARI • Have suitable access for maintenance • Placed in close proximity to site perimeter for ease of dewatering	• Large enough to hold a 5-day, 85th percentile rainfall amount for Darwin; 46.2 mm (Table B6, IECA 2008) • Based on project catchment areas and potential soil loss (as provided in the ESCP) • Based on project area runoff coefficients for 100 mm rainfall event: - o 1 for heavily impacted areas (haul roads, pads, high traffic, compacted) - o 0.75 for vegetated or less compacted (Table B7 IECA 2008) • Minimum combined capacity of sediment basins is calculated in the ESCP based on the current site layout.
Construction	Management and operation
• Earth embankments to be certified as structurally sound by geotechnical engineer/specialist • Stable inflow system (eg. rock chute) • Minimum 3:1 length to width ratio (may require internal baffles) • Primary outlet (eg. siphon, perforated riser) for controlled release • Emergency spillway (minimum design storm 1 in 50 year ARI) • Marker to identify the sediment storage zone depth	• Discharged within 5 days of cessation of rainfall (min 25 mm) • Prior to discharge, water quality to meet project discharge criteria (see below), flocculent or coagulant may be required • Designed to ensure easy and safe access to dose retained water with flocculants as required • Marker peg to be installed to indicate sediment storage capacity • Removal of sediment where sediment storage capacity exceeds 50% and disposal/management of sediment so as not to create an erosion or pollution hazard
Water quality monitoring	Discharge criteria
• Routine water quality monitoring to be undertaken in accordance with the Monitoring Plan (Section 8) involving: - o <u>Prior to any controlled release</u> field parameters (electrical conductivity, temperature, turbidity, pH, dissolved oxygen) are to be measured to confirm water quality meets discharge criteria - o <u>Weekly</u> field parameters during wet season (Nov – Apr) regardless of discharge - o <u>Weekly</u> laboratory parameters (hydrocarbons, heavy metals, nutrients) when discharging - o <u>Monthly</u> laboratory parameters during wet season (Nov – Apr) regardless of discharge • Additional sampling may be required to investigate any water quality issues detected during routine monitoring and validate that management measures have addressed any issues and water quality is suitable for release.	• Discharge criteria is as per the Monitoring Plan (Section 8), this includes for field parameters: - o Turbidity 90th percentile NTU not exceeding 100, and 50th percentile NTU not exceeding 60 - o pH between 5.0 and 8.0 - o EC less than 200 µS/cm - o DO between 50 - 100 %saturation • Assessment criteria for weekly and monthly routine sampling includes the above plus: - o Laboratory parameters as per Monitoring Plan (Section 8) - o Parameters at downstream surface water quality monitoring sites to meet the assessment criteria in Monitoring Plan (Section 8).

Sediment basin flocculation

Flocculation of basins will be required where the contained water does not meet discharge criteria within five days of cessation of rainfall. The application of a coagulant is to occur within 12 hours of the receipt of runoff producing rainfall. Typically, gypsum (calcium sulfate) is used for this purpose. This requires application across the sediment basin surface (spray or hand cast) at a rate of 32 kg per 100 m³ of water volume.

There are also a range of anionic polymers which may provide a more effective flocculation option. These are also well suited to flow-activated dosing systems, reducing labour associated with flocculation. An option for the site is installation of 'high efficiency sediment basins' as outlined in Department of Environment and Science, Queensland (2018) *High efficiency sediment basins – Wetland info* ([link here](#)).

The final choice of flocculant and dosing methods will be managed adaptively based on monitoring of sediment basin performance over the first wet season of operations.

Receiving waterways and discharge water quality criteria

The discharge standard recommended for sediment basins in IECA (2008) will be adopted as follows:

90th percentile NTU reading not exceeding 100, and 50th percentile NTU reading not exceeding 60

Once discharged, the turbidity of water from the sediment basins is expected to reduce rapidly with dilution in the receiving drainage lines, combined with the filtering effect of the vegetation growing within the drainage lines. The assessment criteria outlined in the Monitoring Plan (Section 8), applying to all routine surface water monitoring sites downstream of the mine will still apply for turbidity.

2.6.2 Run of Mine Pad

Ore will be stored on the ROM pad prior to be transported to the Grants Processing Facility, which is managed under a separate Mining Management Plan (Authorisation 1021-01). Geochemical testing of BP33 ore samples (EGi, 2021) indicates that ore stored in the ROM pad while awaiting transport to the processing plant will present little risk of producing acidic metalliferous drainage; however, there could be potential for elevated Aluminium concentrations in any run-off/leachate produced from ore stockpiles. Further kinetic testing underway (described below) will indicate the timeframe over which Al leaching could occur, which will determine whether specific controls are required to capture and treat run-off from the ROM pad.

2.6.3 Waste rock dumps

No Waste Rock Dumps (WRD's) will remain on the surface once mining operations are complete as the mine closure concept involves all waste rock backfilled into the underground mine, decline and box-cut. The waste rock will infill 65% of the total underground void. Two separate WRD's will be established for temporary storage of waste rock during mining (i.e. a period of approximately four years):

- **WRD1** will have capacity to accept 2 million m³ of oxide waste rock excavated from the box-cut. The waste rock will be backfilled into the box-cut once mining is complete.
- **WRD2** will have the capacity to accept 170,000 m³ of transitional and fresh waste rock from the underground, and will be progressively backfilled into the underground as each protection level is complete to maintain stability as the mine progresses.

On completion of mining, a remaining quantity of waste rock will be used to backfill the decline.

Acid and metalliferous drainage potential

Geochemical characterisation of BP33 waste rock and ore samples is reported in EGi (2020, 2021). The results of static and short-term leach tests indicate that Acid Rock Drainage (ARD) and Saline Drainage (SD) are unlikely to occur; but there is potential some metals could mobilise from waste rock at neutral to slightly alkaline pH (i.e. Neutral Mine Drainage NMD).

Results of the water extraction tests indicate:

- Ore stockpiles could produce run-off with elevated concentrations of Aluminium (Al)
- The mobility of aluminium concentration in all waste rock, and arsenic in fresh waste rock, when incorporated in water, has the potential to result in elevated concentrations of Al in seepage from WRD1 and Al and As from WRD2.
- Concentration of arsenic in the water extraction of transition and fresh waste rock were similar to groundwater quality sampling in the deep aquifer of the Burrell Creek Formation (BCF). It is expected that backfilling the underground with fresh mine rock (with no extensive weathering) will not significantly impact groundwater in relation to mobilisation of arsenic.

The results of peroxide extraction tests indicate:

- Should extensive oxidation of waste rock in WRD2 occur, the concentrations of several metals/metalloids including Al, As, Co, Cr, Cu, U and Zn may be elevated in comparison to background water quality.

The likelihood that significant oxidation and metal/metalloid release will occur during short-term surface storage is being investigated using kinetic leach column testing currently underway. These tests will also investigate metal mobility under saturated conditions (simulating mine backfill after groundwater rebound) following a period of exposure to oxidative conditions.

2.6.4 Non-mineral waste and hazardous materials

The mine involves activities that produce domestic and industrial wastes, and storage/handling of hazardous materials. Sources of waste and methods proposed for storage and disposal are described in the sections below.

Predicted waste streams

The industrial and domestic wastes expected during mining activities are:

- General domestic putrescible waste
- Construction and demolition waste
- Recyclable wastes (packaging, metals, wood, tyres)
- Waste oils, lubricants, coolants and filters
- Wash-down facility wastewater
- Sewage.

All industrial and domestic waste will be segregated for removal from site by a licenced waste contractor. Domestic waste will be stored in lidded receptacles and removed from site regularly to prevent odour and flies, and access by vermin. Receptacles for recyclable waste will be lidded commingle receptacles. Construction waste, scrap metal and tyres will be placed in open-top skipped bins. Waste oils will be stored in bulk containers and other workshop wastes such as used chemical containers and batteries, will be segregated and stored undercover to prevent ingress of rainfall and subsequent release of contaminated water from storage areas.

General domestic waste, construction wastes and recyclables would be taken either to the nearest Litchfield Shire Waste Transfer Station that accepts commercial waste (i.e. Humpty Doo) or directly to the Shoal Bay Landfill. Hazardous wastes would need to be taken directly to Shoal Bay Landfill as they are not accepted at Humpty Doo. The ultimate approach used for waste segregation, storage, collection and disposal, will be determined by the waste management contractor engaged to manage this aspect of the site operations.

Wastewater produced at the wash-down facility will enter a sump fitted with an oil/water separator for removal of hydrocarbon contaminants. Solid waste (sediments) accumulating in the sump will be removed as required and disposed of to the WRD's, or by a licenced waste contractor if contaminated with hydrocarbons.

Analysis of hydrocarbons in surface water sites and groundwater bores down-gradient of the site is included in the Monitoring Plan (see section 8). The objective for these is for concentrations to remain below laboratory detection limits.

Hazardous materials

Diesel fuel will be used to power the on-site generators. The maximum quantity of ~110,000 litres of diesel will be stored at the mine site in multiple locations using wrap tanks or bunded storage facilities ranging in size from 5,000 to 50,000 litres.

Diesel will be stored in above-ground tanks that comply with Australian Standard *AS1940 Storage and handling of flammable and combustible liquids*. Diesel fuels will be supplied by a licenced contractor as required and all plant and equipment will be refuelled on site in the refuelling area. Diesel spill response measures are incorporated in the mine's Environmental Management Plan.

Other hazardous materials and indicative quantities to be stored on site include:

- Greases, oils and lubricants – multiple locations using wrap tanks or bunded storage facilities
- ranging in size from 5,000 litres to 50,000 litres
- Oxygen and Acetylene
- Cleaning chemicals – degreasers in 1,000 litre tanks.

All hazardous substances will be stored, used and managed in accordance with their Safety Data Sheets (SDSs) (including appropriate bunding requirements). Core will maintain a hazardous substance register for the site, which will include storage location, summary of hazardous/dangerous goods status and links to SDSs. The register will be located in the site office as well as in the chemical store.

Sewage treatment

Wastewater from ablutions will be treated using either a 'no release' or 'secondary treated' wastewater management system. The final system design will be subject to Building Advisory Services approvals as the project is within the Darwin Building Control area. If a secondary treated system is adopted, a land capability assessment will be undertaken to select a suitable land disposal site.

3 ENVIRONMENTAL SETTING

This section describes the environmental setting and environmental values (beneficial uses) of the surface waterways and groundwater aquifers potentially impacted by the mine.

3.1 Climate

The project area lies within the wet-dry tropics. The wet season is typically November to March, and the dry season April to October. Figure 3-1 shows average monthly rainfall and evaporation data generated for the project site (coordinates 12°42'S, 130°80'E) from the SILO (Scientific Information for Land Owners) database ([link here](#)).

Average annual rainfall is 1,530 mm, with almost all of this occurring during the wet season. The wettest months are typically January and February. Usually no rain falls during the dry season months of June, July and August.

Average annual potential evaporation is 2,280 mm, which exceeds average annual rainfall by 750 mm. The highest potential evaporation occurs between September and October, and lowest between February and March. Average monthly rainfall exceeds evaporation for only four months (December – March).

Average maximum temperatures change very little throughout the year, ranging from 34.4°C in October to 30.9°C in June and July. July is the coolest month, with an average minimum temperature of 17.9°C.

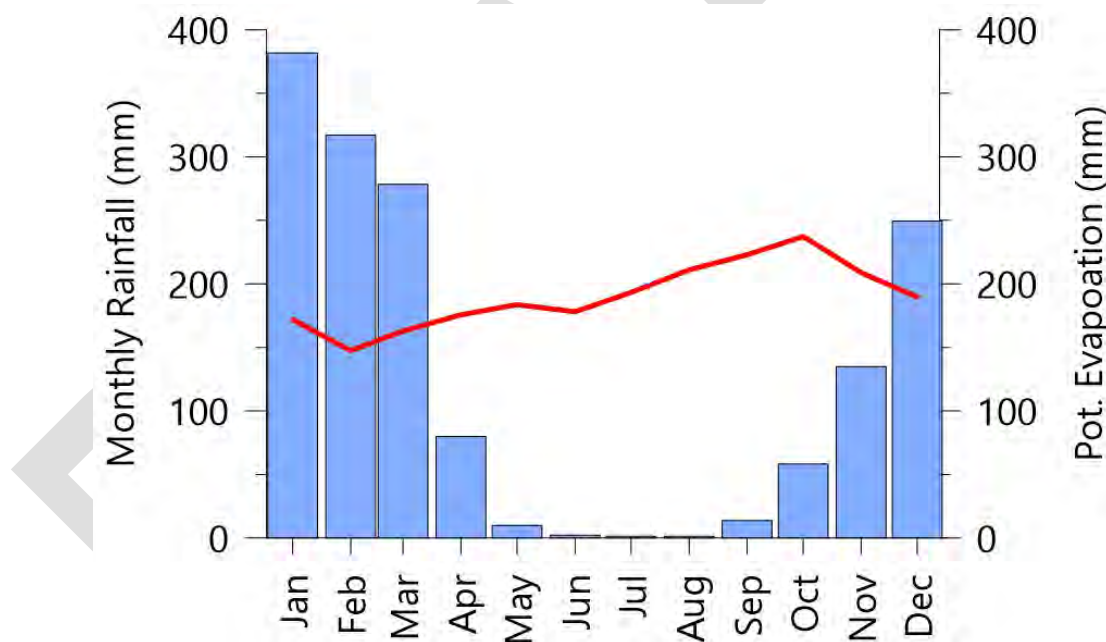


Figure 3-1. Average monthly rainfall (blue) and potential evaporation (red) generated for the project site from the SILO database; records 1900 to 2020

3.2 Topography, landform and soils

The mine is situated on subdued undulating terrain (Figure 3-2). The MSD and contractor's area are located in a broad, low-lying drainage line, whereas the box-cut, WRDs and RoM pad are located on slightly higher ground around this drainage line. The lowest elevation within the mine footprint is 15 mAHd, where the MSD is situated, and the highest is 38 mAHd, where the WRD for the box-cut is situated.

The land surface falls away to the south-west of the mine footprint to where it eventually meets the tidal reaches of the Charlotte River and Bynoe Harbour (around 2.6 km to the south-west). Elevations are higher north-east of the mine, where Observation Hill Dam and the Cox Peninsula Road are situated. The maximum elevation

for the local region of 52 mAHD occurs near to the Cox Peninsula Road and marks the catchment divide between Bynoe Harbour and Darwin Harbour. This catchment divide extends from this point to the north-west and separates the BP33 mine, which is in the Bynoe Harbour catchment, from the Grants mine, which is in the Darwin Harbour catchment.

The mine site landform broadly comprises well drained low hills and rises, with rudisol soils, intersected by seasonally waterlogged drainage systems and alluvial plains with hydrosol soils.

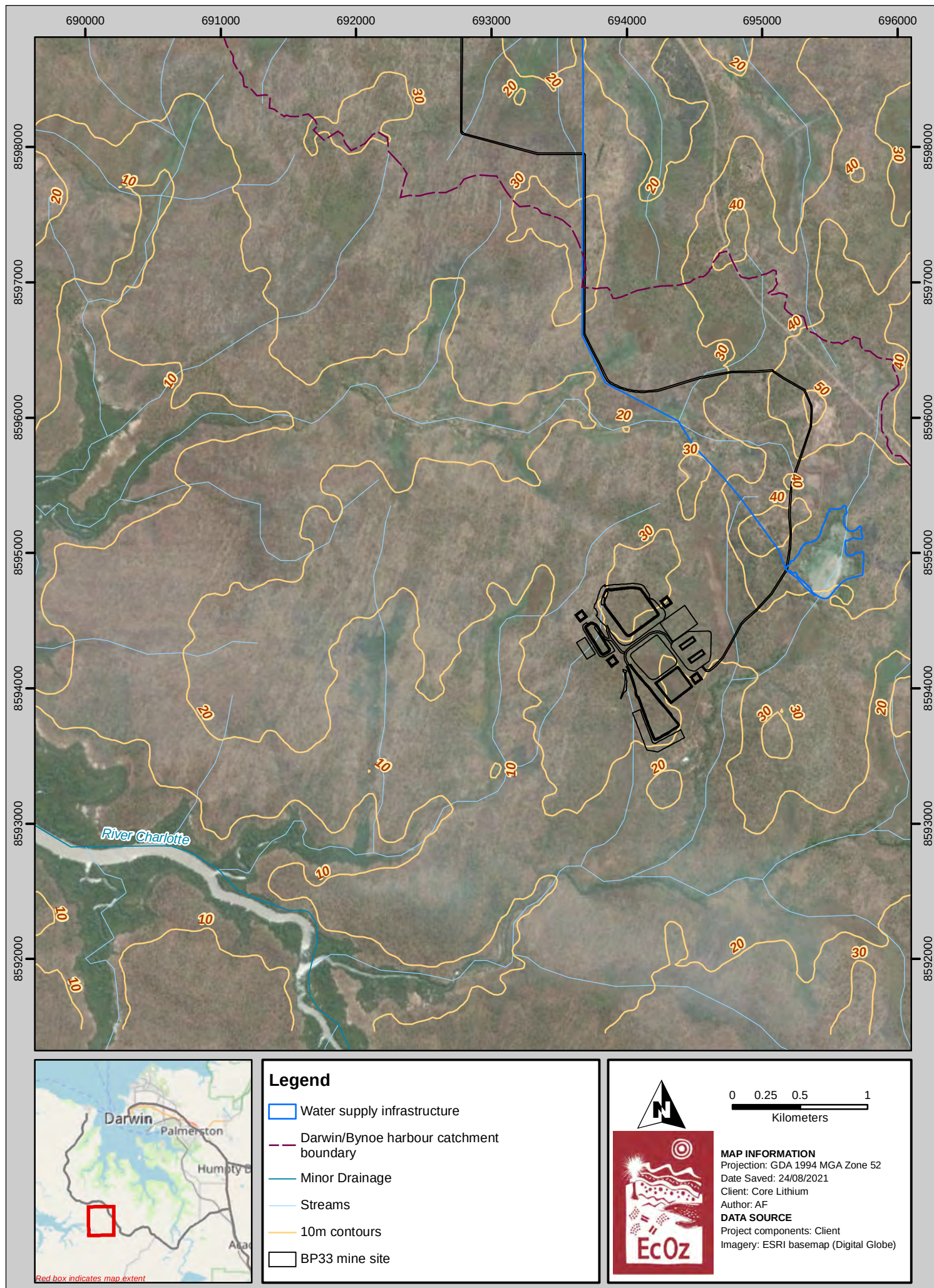
The box-cut, RoM pad and northern half of the WRDs are situated on terrain mapped as land unit '2a1', comprising rudisol type soil's, and described as 'Low Rises, gradient to 4%; shallow gravelly lithosols: *Eucalypt* Open Woodland, minor Woodland' (DLRM 2015). The southern half of the WRDs lie within land unit '6b' comprising 'Broad lowland plains; gradient <1.5%; shallow to moderately deep siliceous sands: *Grevillea/Melaleuca* Tall Shrubland to Low Open Woodland, minor Open Woodland'.

The MSD and contractor's area are situated at the upper end of a broad drainage line mapped as land unit '5a', 'Narrow upland alluvial plains; gradient <1%; hard-setting apedal mottled yellow duplex soils: Grassland with scattered trees'. This land unit also covers the broad southward-trending drainage lines on the eastern side of the RoM pad and western side of the box-cut. The drainage line immediately upstream and downstream of Observation Hill Dam is also mapped as land unit 5a. Further south, where this drainage line becomes a more defined waterway directly east of the mine site, the land unit is mapped as '5b2'

Some areas along the drainage line downstream of Observation Hill Dam, can retain saturated soils and/or pools into the early dry season. A survey targeting the threatened wetland plant *Stylidium ensatum* undertaken by EcOz Environmental Consultants in June 2018 (EcOz 2018) recorded shallow pools remaining in the wet areas downstream of Observation Hill Dam.

The project area, including ML32346, MLN16 and Observation Hill Dam, are mapped as having no acid sulfate soil risk; see the *Acid Sulfate Risk Categories of the Greater Darwin Area* Map (DIPE 2004). There are no areas mapped as 'High' risk within 10 km of the project area. The closest risk of acid sulfate soils ('Moderate') is the Bynoe Harbour intertidal area, which is greater than 2.3 km downstream of Observation Hill Dam.

The BP33 mine is well above the storm surge risk zone (see EnviroConsult 2020). The level of the 2100 primary storm tide is 4.6 mAHD, this elevation is at least 10 m below, and a further 2 km downstream of, the mine site infrastructure.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ20208 - BP33 Supplementary Environmental Report\01 Project Files\Report maps\Figure 3 2. Map of topo.mxd

Figure 3-2. Map of topography and surface water drainage of the BP33 mine site and surrounds

3.3 Surface water

3.3.1 Catchments, drainage and surface water features

The BP33 mine and existing Observation Hill Dam lie within the Charlotte River catchment (Figure 3-2). The Charlotte River drains into Bynoe Harbour. The BP33 mine site and surrounding areas are drained by minor (stream order 1), ephemeral watercourses that are broad and indistinctive in their upper reaches, forming into more defined channels lower down. These unnamed watercourses flow south and then west for a distance of around 3.5 km to where they meet the tidal, mangrove-lined lower reaches of the Charlotte River.

Observation Hill Dam is located around 1.5 km north-east of the BP33 mine. This dam was constructed to supply water for tin and tantalite mining and ore processing that occurred in the 1980's and 1990's (Frater 2005). It is situated in the upper reaches of a north-south trending drainage line, which (downstream of the dam wall) flows past the BP33 mine site.

Immediately downstream of Observation Hill Dam, there is a broad, open wet area with poorly defined drainage that supports wetland sedges and herbs during the wet season and early dry season, but mostly dries out later in the dry season (see EcOz 2018b). From here, the watercourse flows south and along the eastern side of the BP33 mine area. Starting at a point around 1 km downstream of the dam wall this watercourse has a well-defined channel (see surface water monitoring site BPUS SW1 photo in Figure 4-2). A late-dry season (October 2017) site inspection of this watercourse observed pools persisting but no visible flows starting from a point around 2 km downstream of the dam wall. The watercourse at this point has well-developed riparian vegetation (see surface water monitoring site BPDS SW2 photo in Figure 4-2). The ecological values of this watercourse are discussed further in section 3.3.2 below.

A number of historic mining pits that were mined in the 1980's and 1990's (now filled with water) are present, including the BP33 pit located where the proposed BP33 underground mine is to be located. The BP33 pit has a surface area of around 3,500 m². The depth of the pit is not known. The pit is located away from any surface water drainage lines, and water present in the pit is maintained by groundwater inflows, combined with incident rainfall and localised surface water runoff.

Figure 3-3 shows the BP33 catchment areas utilised in the water balance model.

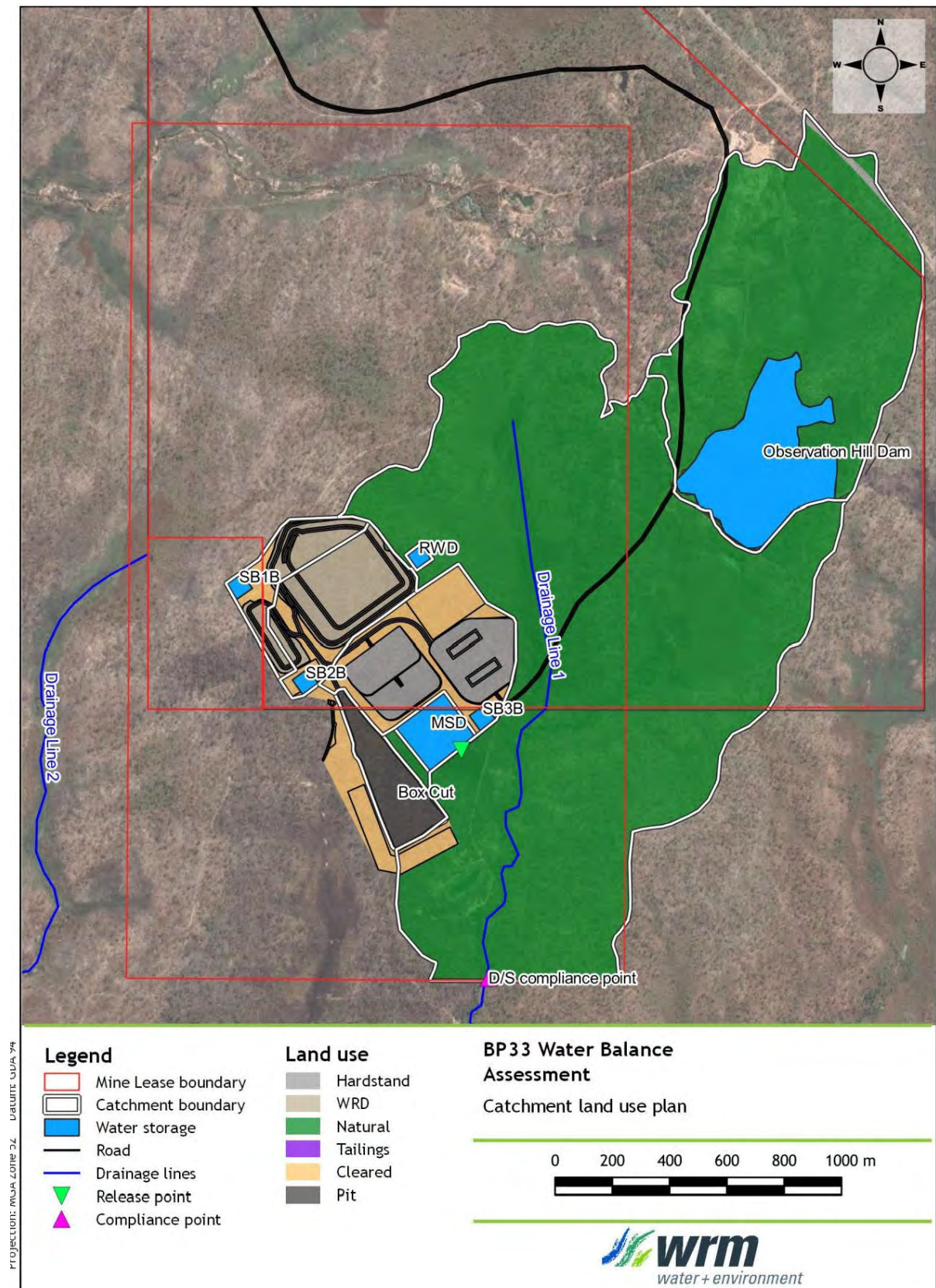


Figure 3-3. BP33 catchment areas and landuse mapping (Source: WRM, 2021)

3.3.2 Environmental and social values

Land use, beneficial uses and applicable water quality guidelines

The Bynoe Harbour catchment and surrounding areas are largely undeveloped vacant crown land, with only minor disturbances that include the sealed Cox Peninsula Road, unsealed access tracks, current mineral exploration activities, and historic mining pits and dams (see Frater 2005). Given this, waterways in the project area are largely intact (close to reference condition) and would be considered under the ANZECC (2000a) protection level classification as 'slightly disturbed'.

Berry Springs, a small township and rural residential area around 20 km east of BP33, is the closest area of intensive land-use; mainly horticulture and some cattle grazing.

There are no national parks or conservation areas within the catchment upstream or immediately downstream of the BP33 mine or Observation Hill Dam. The closest is Blackmore River Conservation Reserve, which is 16 km to the east, and well outside the mine area catchment.

The Bynoe Harbour catchment lies within the Fog Bay declared beneficial use area under the NT *Water Act*, which declares the beneficial uses of this area to be 'aquatic ecosystem protection and recreational water quality aesthetics'. The water quality guidelines specified for this beneficial use in the original declaration were the *Australian Water Quality Guidelines for Fresh and Marine Water Quality*, the latest version of which is now online as the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG 2018). As such, these are the water quality guidelines to be applied to waterways subject to potential impacts from the BP33 mine.

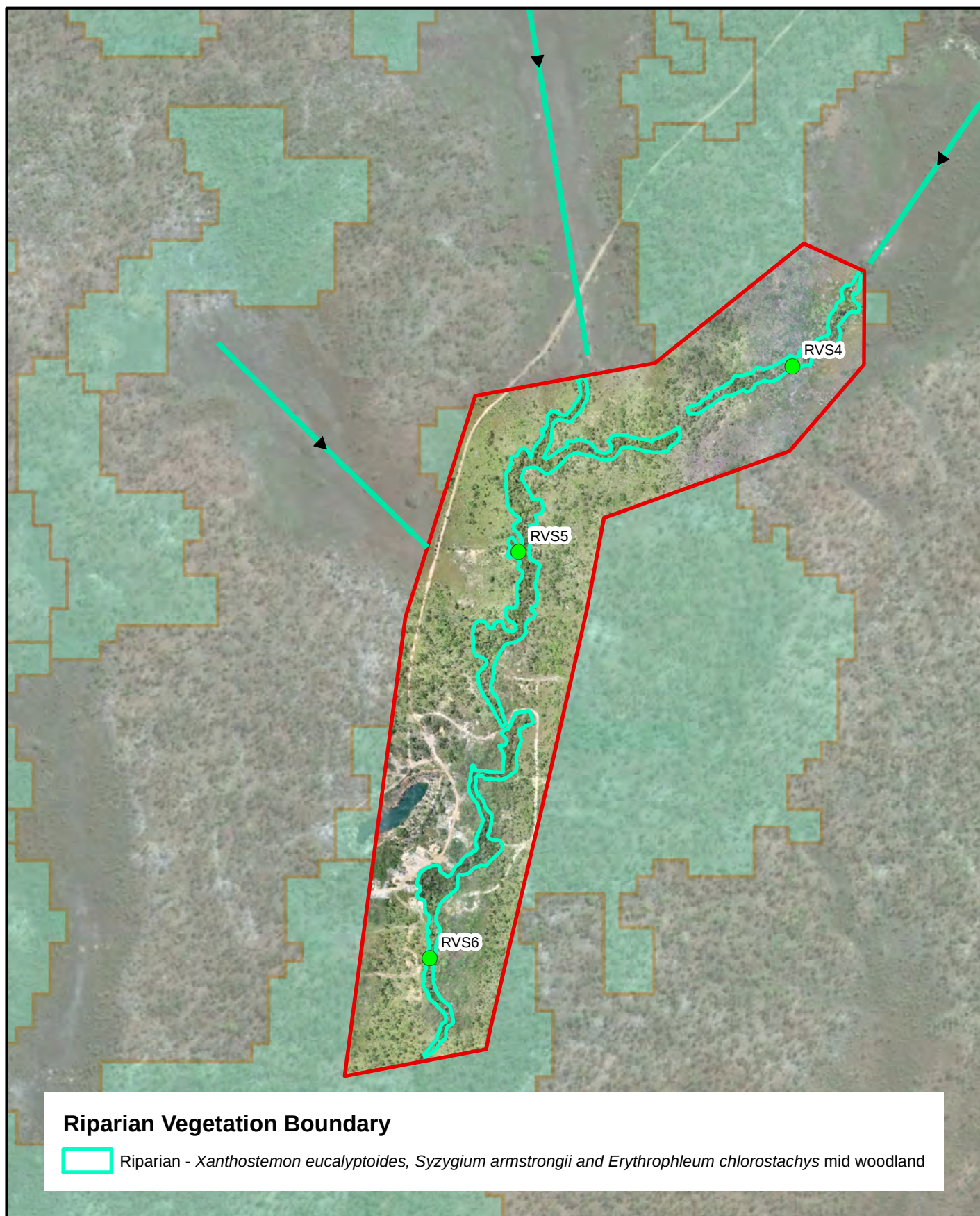
In relation to management and control of surface and groundwater extraction, the project area lies within the *Darwin Rural Water Control District* declared under the NT *Water Act*. Pursuant to Section 41 of the Act, a permit is required to construct a dam and pursuant to section 45, a licence is required to take surface water. Core submitted a surface water extraction licence application under the *Water Act* on 7 April 2021 (pending approval) for use of the existing Observation Hill Dam.

Ecological values of waterway east of the BP33 mine site

EcOz (2019) undertook an assessment of the riparian vegetation along the waterway downstream of Observation Hill Dam that flows along the eastern side of the BP33 mine. Riparian vegetation boundaries were mapped using drone imagery captured in March 2019. An on-ground survey describing the riparian vegetation community present and its condition was also undertaken in June 2019. The survey identified the riparian community as *Xanthostemon eucalyptoides*, *Syzygium armstrongii* and *Erythrophleum chlorostachys* mid woodland over *Pandanus spiralis*, *Helicia australasica* and *Carallia brachiata* mid shrubland over *Eriachne trisetata* mid tussock grassland. Figure 3-4 shows the mapped extent of the riparian vegetation community, which has a total area of 3.62 ha. The community was found to be in good condition with no major weed populations or fire impacts. The results of this pre-mining survey will be used as the baseline for assessing any changes and impacts to this riparian community from mining activities.

The presence of this riparian vegetation indicates this waterway receives a proportion of groundwater inputs to sustain this freshwater-dependant community during the dry season. This is also supported by the observation of pools (but not flowing water) persisting along this waterway during site visits by EcOz during the mid to late dry season. The area is also mapped as a 'moderate' potential groundwater dependant ecosystem (GDE) in the national GDE Atlas (BoM 2021). This is discussed further in Section 3.4.3 below.

Riparian vegetation communities are not rare as such, but they are considered to be significant vegetation communities as they are spatially restricted and provide habitat to a relatively large number of species (DENR 2020). A baseline aquatic survey undertaken at a site along this waterway by GHD (2017a) in May 2017, found the macroinvertebrate community to be in relatively natural (reference) condition in regards to the AUSRIVAS Model developed for the Darwin-Daly Region (Lamche 2007). This site also had the highest taxa richness and presence of pollution-sensitive species compared to three other sites surveyed at the same time for the Grants Lithium Project in the Darwin Harbour catchment.



MAP INFORMATION
 Name: Project location
 Projection: GDA 1994 MGA Zone 52
 Date Saved: 18-Oct-19
 Client: Core Lithium
 Author: D. vdHoek
 (reviewed by K. Welch)
DATA SOURCE
 Study site: EcOz
 Study site image: EcOz
 Background: ESRI imagery

Figure 3-4. Riparian vegetation boundary mapped by EcOz (2019)

3.4 Groundwater

The following groundwater information was summarised from the *Finniss Lithium Project BP33 Groundwater Modelling Report* (CloudGMS 2021). This study utilised information gained during a groundwater bore drilling program undertaken in September 2020 and subsequently detailed in *BP33 Groundwater Investigation Report* (Groundwater Enterprises 2020). Figure 4-1 shows the locations of the 13 groundwater monitoring bores installed during this drilling program, and Table 5-1 provides the depths, screened intervals and context of each of these bores.

3.4.1 Aquifer characteristics

The BCF forms the main aquifer beneath the BP33 site. It is a marginal fractured rock aquifer with typical bore yields of less than 0.5 L/s; largely due to the low primary porosity and lack of open fracturing within the formation. Higher yields (up to 3.5 L/s) have been recorded where drilling intersects fracture zones or bands of quartz veining. These fracture zones are discrete and commonly less than 1 m in thickness.

Groundwater is typically intersected at the base of the weathering zone/transition into fresh BCF. Groundwater drilling around the BP33 site indicates the main groundwater intersections occur at depths of 25 to 70 m, with most bores intersecting the groundwater at depths around 45 m. The BCF is largely fine grained and characteristically weathers to clay. Where heavily weathered, the formation is likely to be less permeable relative to fresh rock due to the higher likelihood of fractures staying open in the more competent, un-weathered rock.

There is limited information available on the groundwater characteristics of the pegmatite. Anecdotal information from mineral drilling and diamond coring at BP33 indicates the pegmatite is very competent and has limited potential to form an aquifer. The pegmatite is an igneous rock with negligible primary porosity and aquifer development is dependent on fracturing. Geotechnical logging at BP33 suggests the fracture density within the pegmatite is of a similar order to the surrounding BCF.

There is potential for minor aquifers in the Cenozoic deposits (sand, clay, gravel and laterite) in areas with thicker alluvial cover (i.e. along drainage lines) or where the laterite profile is more extensive. Investigation drilling undertaken at BP33 in September 2020 found that the alluvial sediments have limited spatial extent and thickness (<4.5 m). In the late dry season the alluvial sediments were unsaturated at the drilling sites between the BP33 mine site and the drainage line to the east. These results and subsequent groundwater monitoring indicate groundwater within the alluvial deposits is largely ephemeral or is restricted to small areas in very close proximity to the drainage lines.

Based on the known aquifer characteristics, four hydrostratigraphic units are identified for the BP33 mine site and surrounds. A hydrostratigraphic unit is a geological formation (or part of a geological formation) with similar hydrogeological properties. Table 3-1 outlines the properties of these hydrostratigraphic units.

Aquifer hydraulic conductivities were estimated by undertaking slug test on the 13 groundwater monitoring bores installed in September 2020. The test results revealed that the permeability of the BCF is dependent on secondary porosity (i.e., fracture and joint development). Fresh and weathered BCF with negligible fracturing displayed a hydraulic conductivity range of 0.003 – 0.08 m/day. Bore that intersected fractured BCF (fresh or weathered) showed a hydraulic conductivity two orders of magnitude higher, with a range from 0.27 – 2.6 m/day. The alluvial sediments (silty sand) tested with a hydraulic conductivity in the order of 0.4 m/day.

Maximum pumping rates for groundwater supply at BP33 were derived through pumping tests of monitoring bores BPG4d, BPG1, BPG5i and BPG6; see Groundwater Enterprises (2021). Maximum pumping rates ranged between 1.8 and 2 L/s, which are typical of the fractured BCF aquifer across the wider region. Of note is the question why groundwater bore yields are relatively low, but groundwater inflows into the BP33 box cut and underground are projected to intersect relatively large volumes of groundwater requiring dewatering (see Section 2.4.2 above). This is due to several factors including the size and depth of the workings. Individual bores are only open to a small area of the formation. The BCF aquifer has low transmissivity, so the amount

of water entering into the bores is relatively low. As the box cut/mine will be open to a much larger cross section of the aquifer, even with low transmissivity/storage there is potential to intercept reasonably large volumes of groundwater.

Table 3-1. Aquifer characteristics of the BP33 mine site area

Age	Name	Lithology	General depth/ thickness	Hydrogeology
Quaternary	Alluvial sediments	Silty sand and gravel	Present at surface, mostly confined to drainage lines, usually <4.5 m thick. Not a significant aquifer in the region	Permeable, but above the water table (unsaturated) most of the time
Proterozoic	Highly to moderately weathered BCF	Saprolite (phyllite). Mostly silt, clayey and minor sand	Weathered zone is on average 60 m thick, with the upper 30 m extensively weathered and the lower 30 m moderately to slightly weathered	Mostly low permeability
Proterozoic	Slightly weathered BCF	Saprock (phyllite) mostly clayey silt with rock fragments		Mostly low permeability. A few fractured aquifers, but yields typically less than 2 L/s
Proterozoic	Fresh BCF	Blue-grey fresh phyllite	Generally occurs at depths greater than 50 m	Low permeability, locally fractured rock

3.4.2 Groundwater levels, flows, recharge and discharge

Standing water levels (SWLs) in the 13 bores at the BP33 site have been measured continuously using loggers since their installation in September 2020. Figure 3-5 shows the SWLs measured in the deeper bores drilled to depths between 28 and 109 m in the fractured BCF. SWLs in these bores range from 4.5 to 9.8 metres below ground level (mBGL) in the late dry season (September-December). The bores respond uniformly to wet season recharge, and groundwater levels approach ground level by the mid wet season (January/February).

The seasonal change in water levels in the deep BCF bores ranges from 3.7 – 9.6 m. The seasonal range is greatest in BPG1 and BPG6. These bores are located on a ridge of outcropping BCF approximately 15 m higher in the landscape than the other bore sites. The larger water level range in these bores suggests that recharge rates may be higher in the elevated areas relative to the lower lying sites along the drainage lines.

Groundwater levels in the shallow bores (<8 m deep) constructed in the heavily weathered top of the BCF or alluvial sediments range from 4.4 – 6.6 mBGL in the late dry season. They rise steadily in response to wet season rainfall from December and plateau by mid-February at levels around the natural surface. The seasonal water level fluctuation in the shallow bores ranges from 3.1 – 5.5 m.

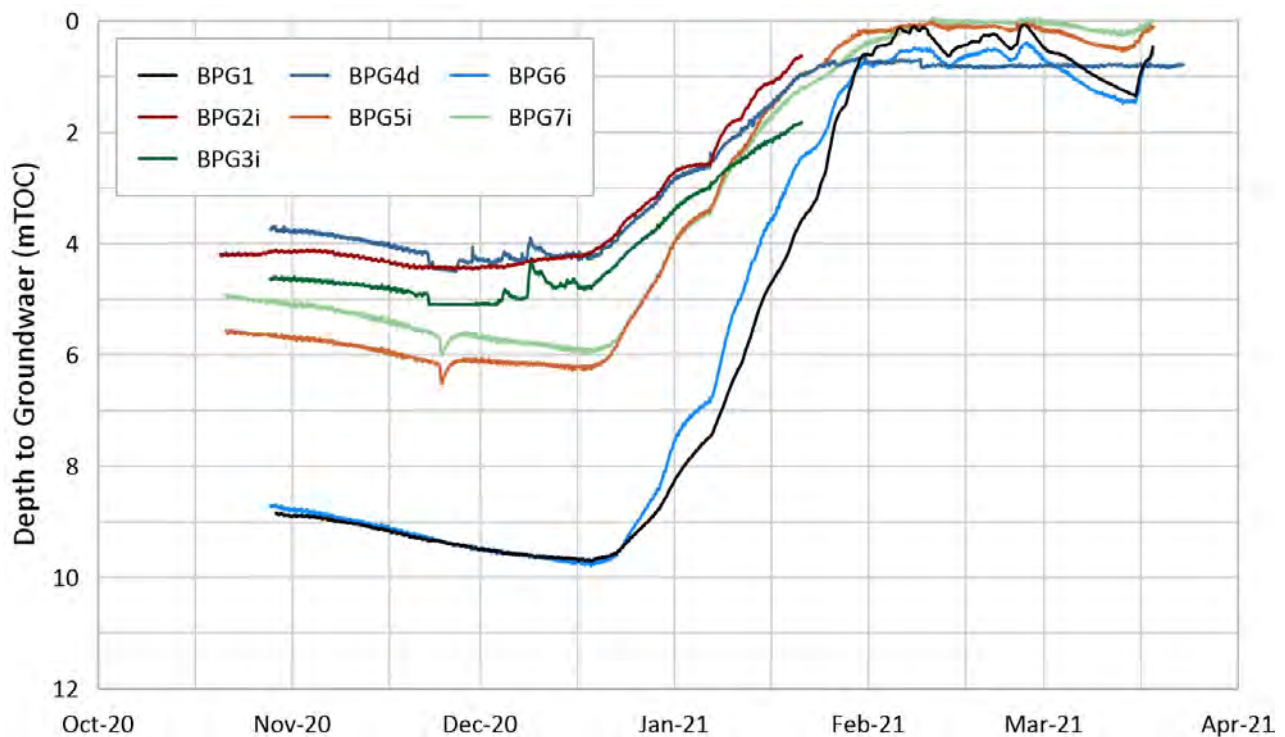


Figure 3-5. Hydrographs for deeper BP33 bores; excludes shallow bores <8 m deep (Source: CloudGMS 2021)

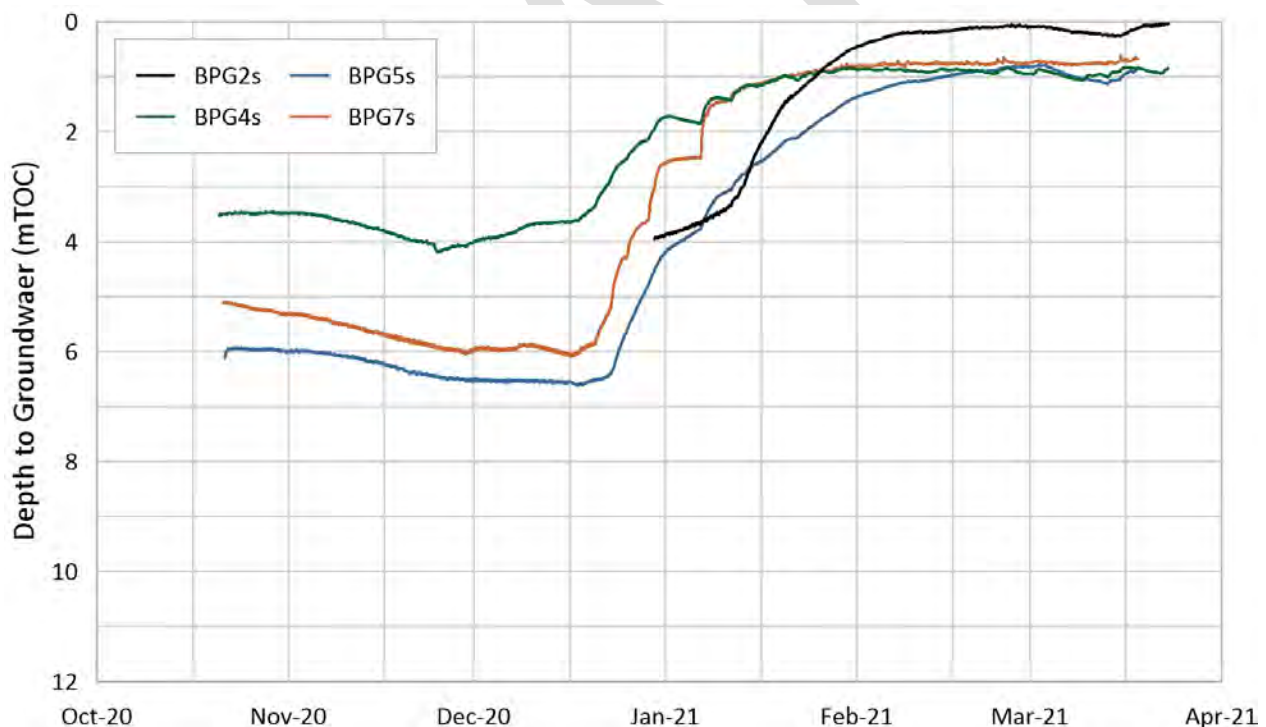


Figure 3-6. Hydrographs for shallow (<8 m deep) BP33 bores (Source: CloudGMS 2021)

The elevations of all 13 groundwater monitoring bores at BP33 have been accurately surveyed to a common datum: mAHD (metres Australian Height Datum). In order to determine groundwater flow direction, potentiometric surfaces were generated using the SWLs measured in the bores, converted to mAHD. Figure 3-7 shows the potentiometric surface representing the late dry season (December 2020) and Figure 3-8 the mid wet season (February 2021). Local flow direction is to the south-east across the BP33 site, with

groundwater moving from the more elevated areas in the north-west, to the lower lying areas along the drainage line in the south-east. The flow direction does not change between the dry and wet season surfaces, however the groundwater gradients become much steeper in the north-east of the site in the wet season. This is attributed preferential recharge occurring on the higher elevations. Water levels in the historic BP33 pit-lake are slightly elevated relative to the surrounding water table surface, suggesting that the pit-lake is operating as a local recharge feature.

Regionally, there is limited groundwater level and elevation data. However, the water table at the BP33 mine site and surrounding region is likely to broadly mirror the topography. The Darwin Harbour / Bynoe Harbour catchment boundary separates the groundwater system at BP33 from that of the Grants mine (Figure 3-2). Groundwater from the BP33 site generally moves in a south-easterly direction toward the Charlotte River.

Two mechanisms provide recharge to the aquifers of the BP33 area:

- Direct (or diffuse) recharge – this is defined as the water added to the groundwater in excess of soil moisture deficits and evapotranspiration, by direct vertical percolation of precipitation through the unsaturated zone and is typically distributed over large areas; and
- Indirect (or local) recharge – this results from the percolation of water to the water table following runoff as ponding in low-lying areas or through the beds of surface water courses and features (e.g. BP33 pit-lake).

Groundwater level monitoring data suggests that direct recharge is likely the dominant mechanism across the BP33 site. Recharge rates were estimated from the seasonal water table fluctuations measured in the monitoring bores across the site (see Figure 3-5 and Figure 3-6 above) using the method of Healy (2010). An annual water level variation of 9 m for the bores in elevated areas (BPG1 and BPG6) gives a recharge rate of between 90 and 180 mm/year. For the bores in lower lying areas, the annual variation in groundwater level is less (between 3 and 6 m), giving lower recharge rates of between 30 and 120 mm/year. The specific yield range of 0.01 – 0.02 was adopted in calculating these recharge estimates.

Natural mechanisms for groundwater leaving the aquifers in the study area are thought to be via:

- Evapotranspiration and diffuse discharge, where groundwater is relatively close to the surface (including from the surface of the BP33 pit-lake)
- Discharge to streams and creeks
- Throughflow to the south.

Evapotranspiration can be estimated from studies conducted in similar vegetation types and climatic conditions. Cook et al (1998) provided an annual estimate of evapotranspiration from the unsaturated zone of 1,110 mm for an annual rainfall of 1,720 mm. The volume and rate of groundwater discharge to surface features (streams and creeks) is expected to be relatively small as the aquifer has a low hydraulic conductivity.

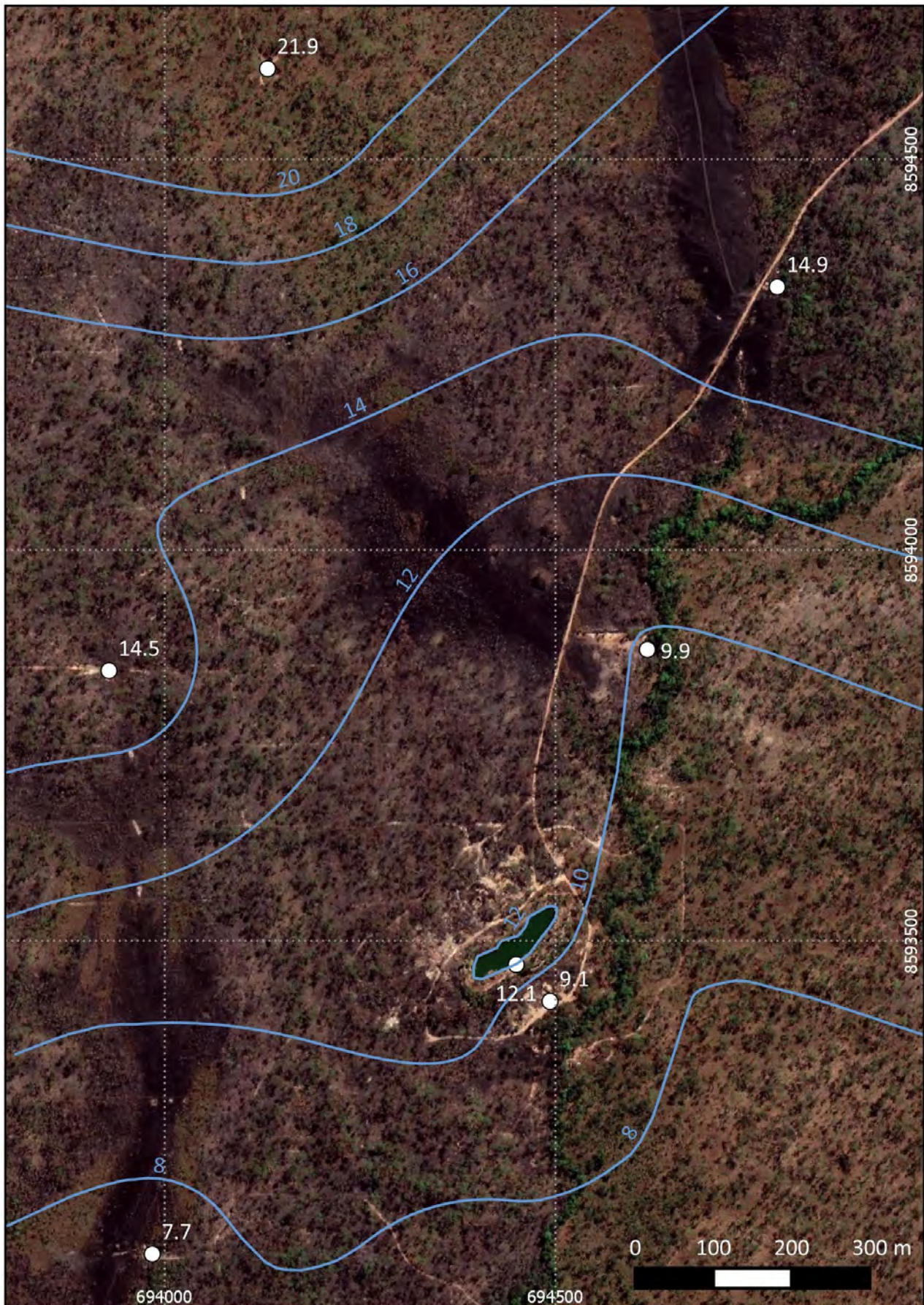


Figure 3-7. Late dry season (December 2020) potentiometric surface for the BCF aquifer (Source: CloudGMS 2021)

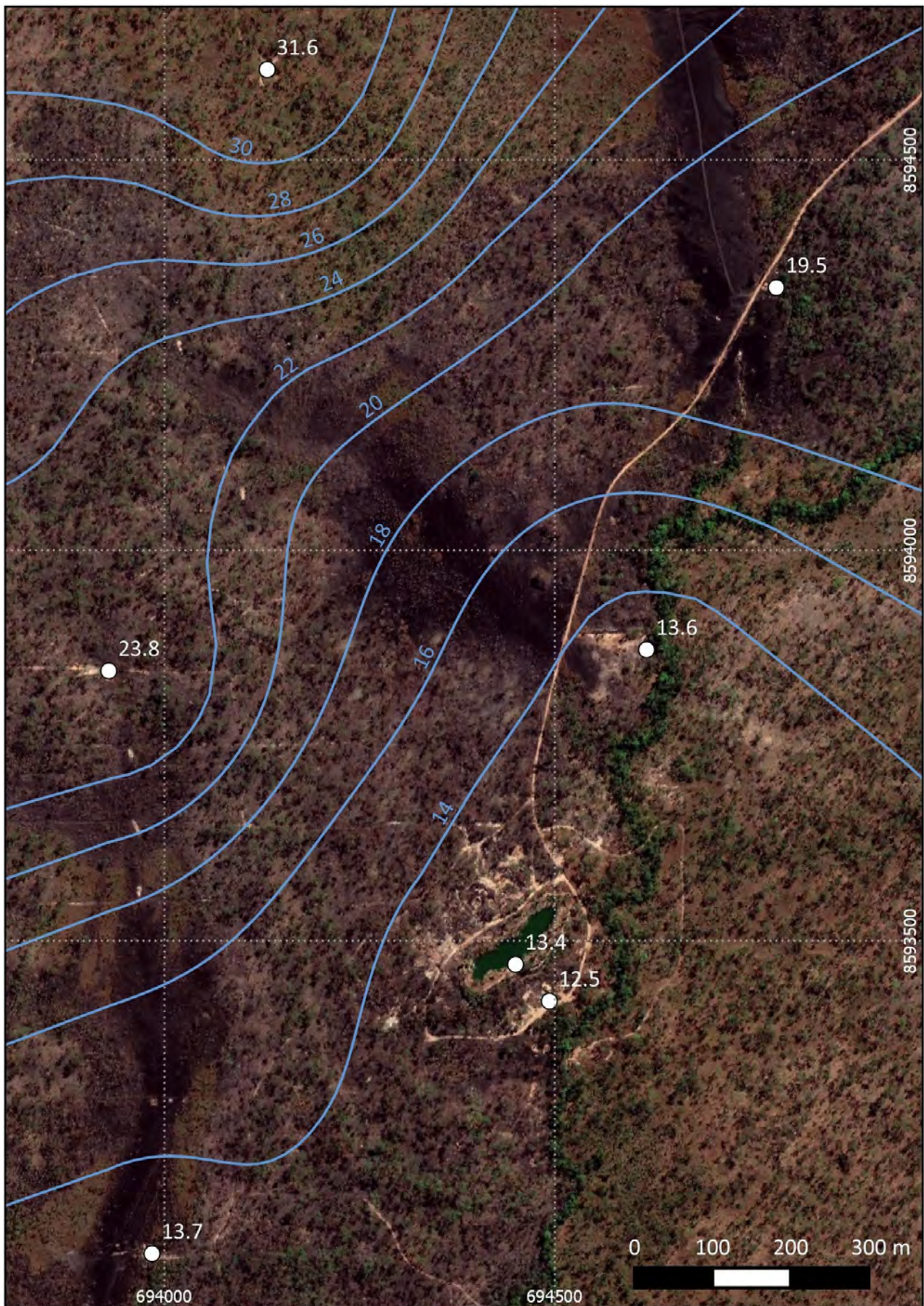


Figure 3-8. Mid-wet season (February 2021) potentiometric surface for the BCF aquifer (Source: CloudGMS 2021)

3.4.3 Environmental and social values

The BCF fractured and weathered rock aquifer beneath the BP33 mine site and surrounding areas is a poor groundwater resource, with bore yields typically less than 0.5 L/s and poor water quality with some areas with high arsenic levels. Given this, there is limited use of this aquifer for domestic, stock, or agricultural water supply.

Table 3-2 lists the registered bores within 10 km of the BP33 mine site identified using the NRMaps online tool. Six bores were identified excluding the monitoring bores drilled for the Grants and BP33 lithium project. The closest groundwater bore is RN023177, located 2.5 km north of BP33. RN023177 was drilled in 1984 and was constructed in the BCF as a potential water supply bore for Greenex mining operations at Observation Hill Dam. The bore is not currently in use. The next closest groundwater bore RN041993 is located 4.6 km south of BP33 on the Fog Bay Road. RN041993 was drilled in 2020 to provide a domestic water supply.

Table 3-2. Registered bores within 10 km of the BP33 mine site (Source: CloudGMS 2021)

Bore RN	Easting GDA94 Z52	Northing GDA94 Z52	Distance from BP33 mine (km)	Use	Comment
RN023177	695330	8595810	2.5	None	Abandoned Greenex mine bore
RN041993	694502	8588795	4.6	Production	Domestic supply
RN038217	688884	8586501	8.9	Production	Domestic supply
RN036421	688271	8586122	9.6	Production	Domestic Supply
RN024254	687130	8586960	9.8	Production	Dog Mine Bore
RN030887	703516	8589291	9.9	Production	Agriculture and domestic

All bores listed in Table 3-2 are well outside the modelled groundwater drawdown cone for the BP33 underground mine see Section 6.4.

The Berry Springs Dolostone aquifer is located around 20 km east of the BP33 area. There are concerns regarding over-extraction from this aquifer and water allocation is closely managed and subject to the *Berry Springs Water Allocation Plan 2016-2026* (DLRM 2016). The BCF fractured rock aquifer beneath the BP33 area has no connection to the Berry Springs Dolostone aquifer. The BCF aquifer has very poor hydraulic conductivity, and would have very poor connectivity over a distance of 20 km. Further, groundwater from the BP33 area flows south-west towards the Charlotte River, not the east where the dolostone aquifer is located.

The BP33 mine also lies within the *Darwin Rural Water Control District* declared under the *NT Water Act*. In relation to groundwater, this means a bore permit must be obtained prior to constructing a bore and a groundwater extraction licence granted prior to using the bore for water supply. A bore permit was obtained prior to installation of the 13 groundwater monitoring bores across the site. An groundwater extraction licence however is not required if the bores are only used for monitoring groundwater levels and water quality.

Groundwater dependent ecosystems (GDEs) are 'ecosystems which require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services' Richardson et al (2011). Types of potential GDEs include vegetation associated with springs or seeps, wetlands that persist throughout the dry season, riparian vegetation or monsoon rainforest patches reliant on groundwater remaining within the root zone for much of the year.

Potential GDE's are mapped at a national scale in the *Groundwater Dependent Ecosystems Atlas* available through the BoM website (<http://www.bom.gov.au/water/groundwater/gde/map.shtml>). Figure 3-9 shows the potential terrestrial GDEs around the BP33 site taken from the GDE's Atlas. A medium potential GDE is mapped along the waterway to the east of the mine site. Riparian vegetation delineated along this waterway by EcoZ (2019) indicates some level of groundwater input in order for this freshwater associated vegetation community to persist throughout each dry season (see Section 3.3.2 above).

No 'high' potential GDE's are mapped within the vicinity of the BP33 mine. The closest is a riparian vegetation community 3.8 km to the south-east near the intersection of Cox Peninsula Road and Fog Bay Road. This GDE is situated in the headwaters of a separate sub-catchment of the Charlotte River and well away from any potential impacts from the mine.

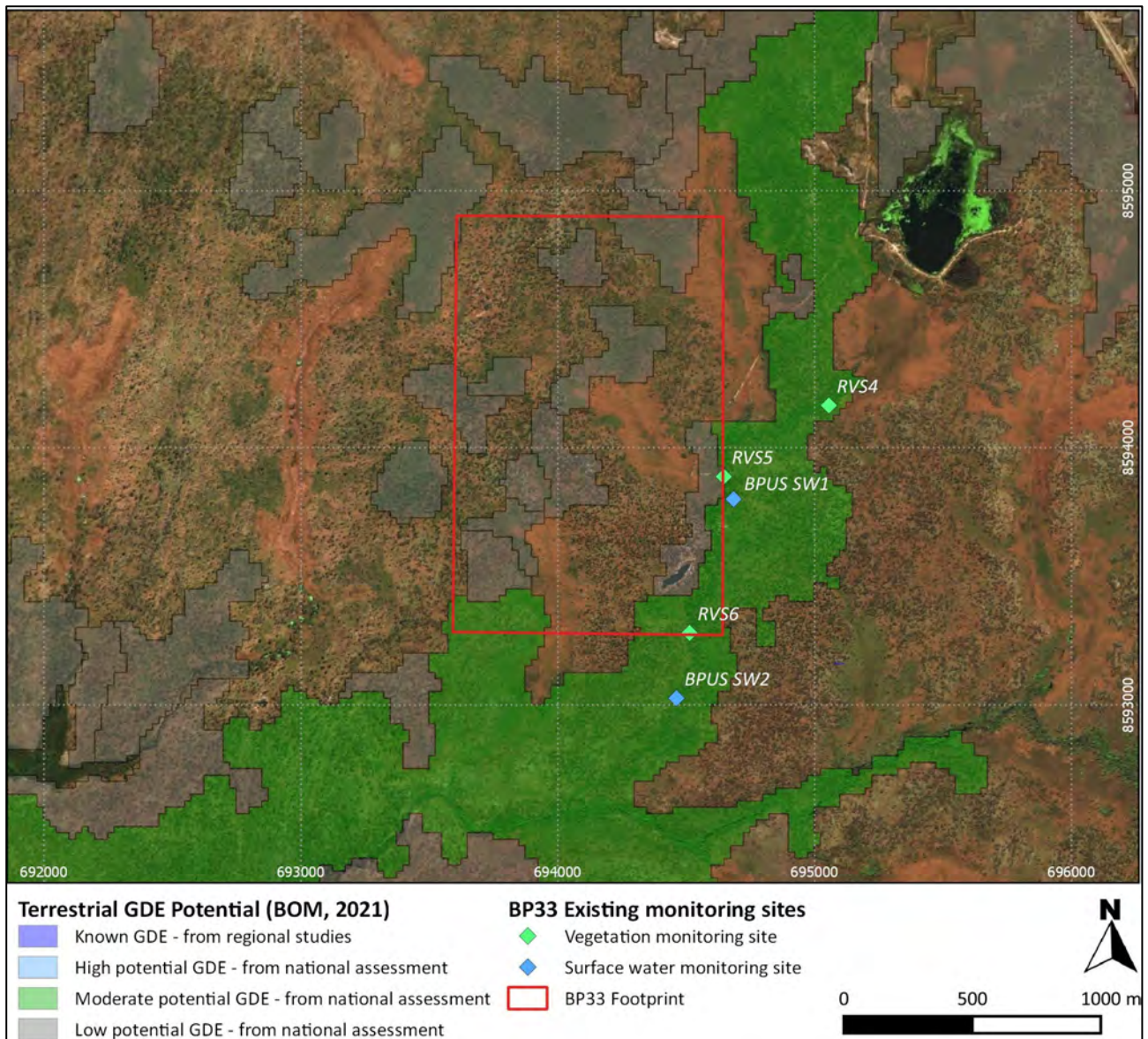


Figure 3-9. Potential terrestrial GDEs map (Source: CloudGMS 2021)

4 BASELINE SURFACE WATER QUALITY

Baseline surface water quality monitoring has been undertaken in the BP33 area since February 2017. The results of this monitoring are presented below. They provide a characterisation of pre-mining surface water quality and are used to develop initial site-specific guideline values (SSGV's) for detecting and assessing potential impacts once mining commences.

4.1 Monitoring sites

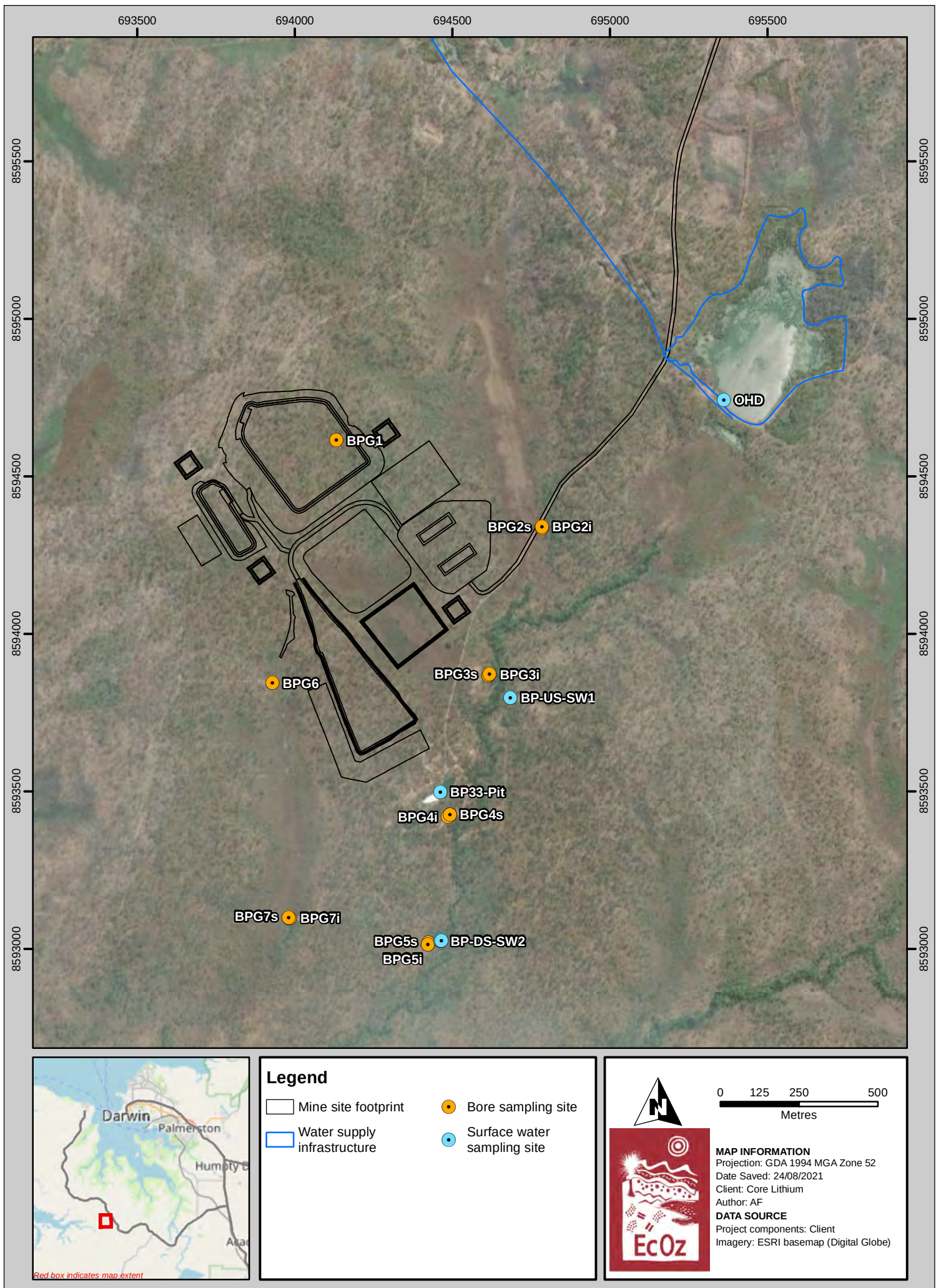
Table 4-1 outlines the location and purpose of surface water monitoring sites, and the date that monitoring started. See Figure 4-1 for a map of site locations.

Observation Hill Dam (OHD), is monitored to establish the quality of this water, which will be used to partially supply water to mining activities at both Grants and BP33. The historic BP33 open cut pit (now filled with water) is also monitored. This pit was mined between 1997 and 1999 to recover tin and tantalum ore from a pegmatite (Frater 2005).

Two monitoring sites are located along the drainage line directly east of the BP33 mine site (BPUS SW1 and BPDS SW2). This drainage line is well-defined by a channel and riparian vegetation, and typically flows throughout the wet season and early dry season (Figure 4-2). Flows stop during the dry season; however, pools persist in some seasons. These two sites aim to monitor any impacts from water extraction from OHD and any impacts from the BP33 mining operations.

Table 4-1. Baseline surface water quality monitoring sites.

Site ID	Site Name	Monitored since	Location	Purpose during mining
BPUS SW1	<i>BP33 Upstream Surface Water 1</i>	15 Feb 2017	Downstream of OHD but upstream of BP33 mine site	Monitor impacts from OHD water extraction and BP33 mining activities on downstream waterways.
BPDS SW2	<i>BP33 Downstream Surface Water 2</i>	15 Feb 2017	Downstream of OHD, BPUS SW1 and BP33 mine site	
OHD	<i>Observation Hill Dam</i>	12 Oct 2017	Surface water storage	Monitor water quality of water supply for mine site.
BP33 Pit	<i>BP33 historic mining pit</i>	15 Feb 2017	Inundated BP33 open cut mining pit located directly adjacent, 70-80 m west, of the ephemeral drainage line flowing from Observation Hill Dam	Representing potential groundwater quality.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ20208 - BP33 Supplementary Environmental Report\01 Project Files\Report maps\Figure 4.1. Map of baseline surface water and groundwater monitoring sites.mxd

Figure 4-1. Map of baseline surface water and groundwater monitoring sites

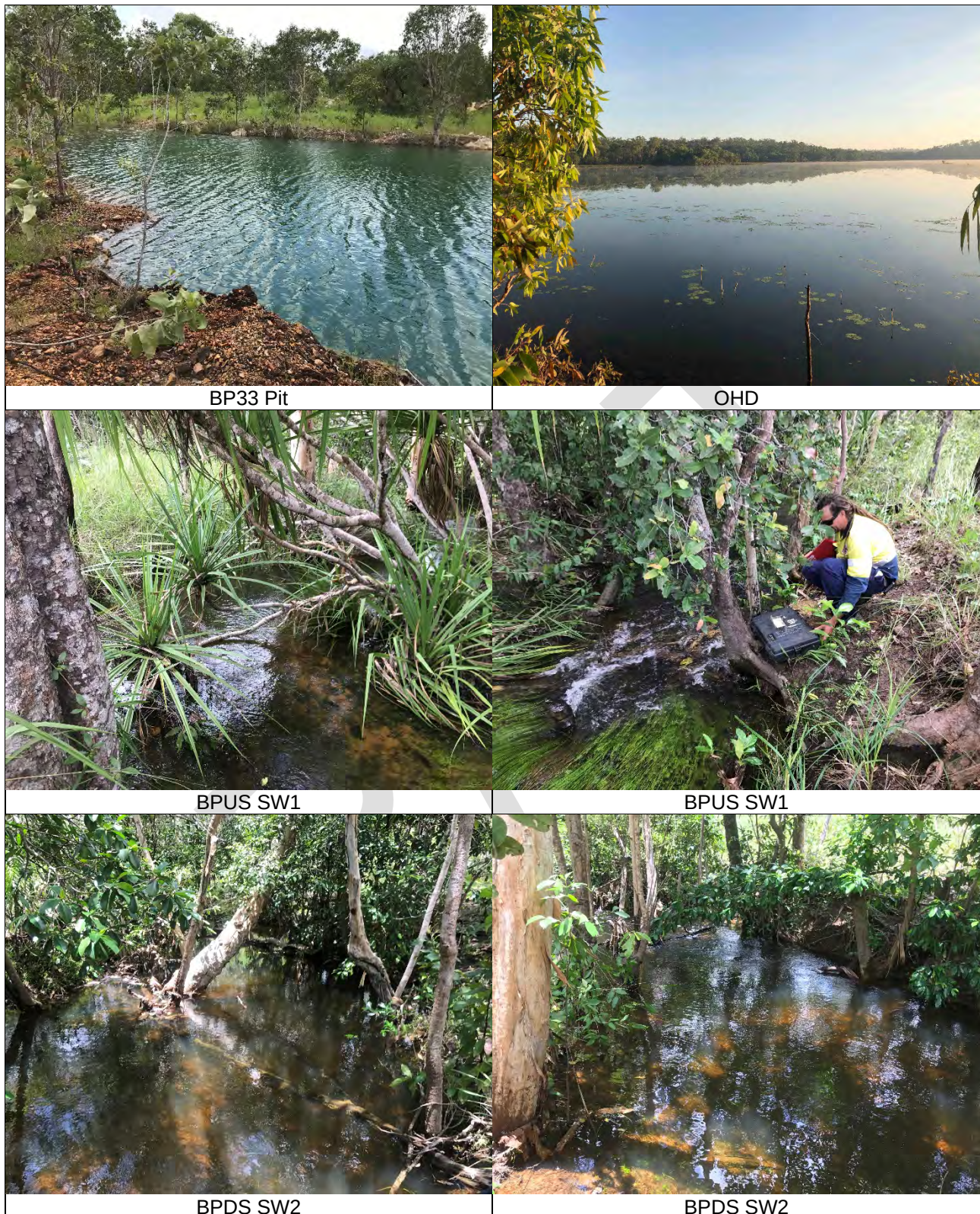


Figure 4-2. Photos of surface water monitoring sites taken 15 February 2017

4.2 Monitoring undertaken

Table 4-1 provides the date when monitoring commenced at each of the four monitoring sites. At BPUS SW1, BPDS SW2 and BP33 Pit, monitoring started in February 2017, and at OHD in October 2017.

BPUS SW1 and BPDS SW2 are sampled throughout the wet season, however they cease to flow during the early to mid-dry season. Sampling is not undertaken during the mid to late dry season as the stagnating pools that remain are not representative.

OHD and BP33 Pit can be sampled throughout the year.

BPUS SW1 and BPDS SW2 have each been sampled at least three times during each wet season i.e. the 2016/17, 2018/19, 2019/20 and 2020/21 wet seasons; totalling at least 13 sampling rounds. OHD and BP33 Pit have each been sampled at least 11 times over the 2017 to 2021 period, during both wet season and dry season conditions.

4.3 Rainfall

Wet season rainfall during the monitoring period between 2017 and 2021 was generally above average. The average annual rainfall for the site is 1,530 mm (see Section 3.1 above). The total 2016/17 wet season rainfall was 2,093 mm and total 2017/18 wet season rainfall was 2,061 mm (taken from Territory Wildlife Park BoM station No. 14264). The 2020/21 wet season was also above average (2,213 mm).

The 2018/19 wet season however, was well below average (1114 mm), and the 2019/20 wet season a little below average (1,533 mm).

4.4 Baseline surface water quality results

4.4.1 Physical parameters, nutrients, anions and cations

Table 4-2, Table 4-3 and Table 4-4 summarise the physical parameter, nutrient, anion and cation results. Median and 80th percentile concentrations have been calculated for each parameter. All data collected for the BPUS SW1 and BPDS SW2 were pooled given these sites are within close proximity, have similar catchments (i.e. undeveloped apart from exploration drilling and associated vehicle tracks), and have the same vegetation and flat topography.

Data from the OHD and BP33 Pit sites are treated separately given these water storages are man-made and have different historic purposes, depths and dimensions. Medians and 80th percentiles for the OHD and BP33 Pit sites were calculated using only data from each of these sites respectively.

All raw data collected and used in calculating median and 80th percentiles is provided in Appendix A.

When calculating medians and 80th percentiles, concentrations recorded as being below the laboratory limit of reporting (LOR) were replaced by a concentration equalling half the LOR e.g. if the concentration was recorded as <0.1 mg/L, the concentration was taken to be 0.05 mg/L.

The 20th percentile was also calculated for pH and dissolved oxygen (DO), given low concentrations of these parameters are also of concern.

The 80th percentile concentrations (and also 20th percentile in the case of pH and DO) are used in the Monitoring Plan in Section 8 to define SSGV's for assessing water quality monitoring data following the commencement of mining.

Table 4-2. Physical parameter, nutrient, anion and cation summary for BPUS SW1 and BPDS SW2

Parameter	Discussion	No data points	Median	80 th percentile *20 th percentile
Physical parameters				
Electrical Conductivity	Generally always low	26	18 µS/cm	26 µS/cm
pH	Generally always slightly acidic to neutral	26	5.5	Upper 7.3 Lower 5.2*
Dissolved Oxygen	Usually well oxygenated	26	75%sat	Upper 83%sat Lower 58%sat*
Turbidity	Generally always below 14 NTU, with the occasional spike above this	25	5 NTU	14 NTU
Nutrients				
Ammonia	Generally always well below 0.09 mg/L, with occasional concentration slightly above this	26	0.03 mg/L	0.09 mg/L
Nitrite	Almost always below the LOR of <0.01 mg/L	26	<0.01 mg/L	<0.01 mg/L
Nitrate	Usually below 0.03 mg/L. Occasional concentrations above this.	26	0.01 mg/L	0.03 mg/L
Total nitrogen	Generally always below 0.3 mg/L	26	0.2 mg/L	0.3 mg/L
Total phosphorus	Usually below 0.02 mg/L. Occasional concentrations above this.	26	<0.01 mg/L	0.02 mg/L
Anions and cations				
Alkalinity	Always low. Total alkalinity almost always remains less than 6 mg/L, comprising 100% bicarbonate alkalinity i.e. hydroxide and carbonate alkalinity are always below the LOR of <1 mg/L.	26	3 mg/L	6 mg/L
Sulfate	Always below LOR of <1 mg/L	26	<1 mg/L	<1 mg/L
Chloride	Always low and almost always less than 4 mg/L	26	2 mg/L	4 mg/L
Calcium, magnesium, potassium	All calcium, magnesium and potassium concentrations are below the LOR of <1 mg/L	26	<1 mg/L	<1 mg/L
Sodium	Always low and almost always less than 3 mg/L	26	2 mg/L	3 mg/l

Table 4-3. Physical parameter, nutrient, anion and cation summary for BP33 Pit

Parameter	Discussion	No data points	Median	80 th percentile *20 th percentile
Physical parameters				
Electrical Conductivity	Generally always low	13	24 µS/cm	27 µS/cm
pH	Generally always close to neutral	13	7.1	Upper 8.2 Lower 6.6*
Dissolved Oxygen	Generally always well oxygenated	13	85%sat	Upper 99%sat Lower 69%sat*
Turbidity	Generally always below 5 NTU	13	3 NTU	5 NTU
Nutrients				
Ammonia	Generally always below 0.06 mg/L	13	0.02 mg/L	0.06 mg/L
Nitrite	Always below the LOR of <0.01 mg/L	13	<0.01 mg/L	<0.01 mg/L
Nitrate	Usually below 0.03 mg/L. Occasional concentrations above this.	13	0.01 mg/L	0.03 mg/L
Total nitrogen	Generally always below 0.2 mg/L	13	0.2 mg/L	0.2 mg/L
Total phosphorus	Usually below the LOR of <0.01 mg/L. Occasional concentrations slightly above this.	13	<0.01 mg/L	<0.01 mg/L
Anions and cations				
Alkalinity	Always low. Total alkalinity almost always remains less than 7 mg/L, comprising 100% bicarbonate alkalinity i.e. hydroxide and carbonate alkalinity are always below the LOR of <1 mg/L.	13	6 mg/L	7 mg/L
Sulfate	Always below LOR of <1 mg/L	13	<1 mg/L	<1 mg/L
Chloride	Always low and almost always less than 3 mg/L	13	3 mg/L	3 mg/L
Calcium, magnesium, potassium	All calcium, magnesium and potassium concentrations are below the LOR of <1 mg/L	13	<1 mg/L	<1 mg/L
Sodium	Always low and almost always less than 3 mg/L	13	3 mg/L	3 mg/l

Table 4-4. Physical parameter, nutrient, anion and cation summary for OHD

Parameter	Discussion	No data points	Median	80th percentile *20th percentile
Physical parameters				
Electrical Conductivity	Generally always low	11	20 µS/cm	25 µS/cm
pH	Generally always close to neutral	11	6.7	Upper 7.0 Lower 6.0*
Dissolved Oxygen	Generally always moderately well oxygenated	11	79%sat	Upper 86%sat Lower 55%sat*
Turbidity	Generally always below 11 NTU	11	4 NTU	11 NTU
Nutrients				
Ammonia	Generally always well below 0.11 mg/L	11	0.03 mg/L	0.11 mg/L
Nitrite	Always below the LOR of <0.01 mg/L	11	<0.01 mg/L	<0.01 mg/L
Nitrate	Usually below 0.06 mg/L	11	0.02 mg/L	0.06 mg/L
Total nitrogen	Generally always below 0.5 mg/L	11	0.3 mg/L	0.5 mg/L
Total phosphorus	Usually below the LOR of <0.01 mg/L. Occasional concentrations slightly above this.	11	<0.01 mg/L	<0.01 mg/L
Anions and cations				
Alkalinity	Always low. Total alkalinity almost always remains less than 6 mg/L, comprising 100% bicarbonate alkalinity i.e. hydroxide and carbonate alkalinity are always below the LOR of <1 mg/L.	11	4 mg/L	6 mg/L
Sulfate	Always below LOR of <1 mg/L	11	<1 mg/L	<1 mg/L
Chloride	Always low and almost always less than 4 mg/L	11	3 mg/L	4 mg/L
Calcium, magnesium, potassium	All calcium, magnesium and potassium concentrations are below the LOR of <1 mg/L	11	<1 mg/L	<1 mg/L
Sodium	Always low and almost always less than 2 mg/L	11	2 mg/L	2 mg/l

4.4.2 *E. coli* and enterococci

Faecal contamination indicators *E. coli* and enterococci were included in the background pre-mining water quality monitoring program to establish whether these indicators were present prior to the installation of ablutions and associated wastewater treatment for the project. Table 4-5 provides a summary of the results, which show that concentrations are already present in the waterways draining from the BP33 area. The OHD proposed water source also records levels of these indicators.

Concentrations vary widely between sampling rounds and between sites. In general, the BPUS SW1 and BPDS SW2 recorded the highest concentrations. The OHD and BP33 Pit sites recorded relatively lower concentrations.

Table 4-5. Faecal contamination indicator summary for all sites.

Sites	<i>E. coli</i> (CFU/100mL)	Enterococci (CFU/100mL)
BPUS SW1 and BPDS SW2	No. data pts: 11 Median: 600 80 th percentile: 4,320 Maximum: 10,000 Minimum: 3	No. data pts: 11 Median: 300 80 th percentile: 1,060 Maximum: 4,800 Minimum: 17
BP33 Pit	No. data pts: 4 Median: 23 80 th percentile: 30 Maximum: 30 Minimum: 20	No. data pts: 4 Median: 15 80 th percentile: 30 Maximum: 30 Minimum: 2
OHD	No. data pts: 7 Median: 72 80 th percentile: 140 Maximum: 200 Minimum: 4	No. data pts: 7 Median: 32 80 th percentile: 59 Maximum: 60 Minimum: 4

4.4.3 Toxicants

Table 4-6, Table 4-7, and Table 4-8 summarise the toxicant results (i.e. dissolved metals and hydrocarbons) and include the calculated median and 80th percentile concentrations. Appendix A provides the raw data collected from all sites and used in these calculations.

- All data collected for the BPUS SW1 and BPDS SW2 sites were pooled given these sites are within close proximity, have similar catchments (i.e. undeveloped apart from exploration drilling and associated vehicle tracks), and have the same vegetation and flat topography.
- Medians and 80th percentiles for the OHD and BP33 Pit sites were calculated using only data from each of these sites respectively.
- When calculating medians and 80th percentiles, concentrations recorded as being below the LOR were replaced by a concentration equalling half the LOR e.g. if the concentration was recorded as <0.1 mg/L, the concentration was taken to be 0.05 mg/L.

Concentrations are compared to the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG 2018) toxicant default guideline values for 95% species protection in freshwater, where available. If for a particular parameter these pre-mining (reference) concentrations are all below the default guideline value, then this guideline value is acceptable to use for assessing potential surface water quality impacts once mining commences. If however, concentrations are above the default guideline, then SSGV's based on the 80th percentile of reference condition data would instead be used for assessing potential impacts – see the Monitoring Plan in Section 8 below.

Table 4-6. Toxicant summary for BPUS SW1 and BPDS SW2 sites.

Parameter	ANZG (2018) guideline ² (mg/L)	Discussion	No data points	Median (mg/L)	80 th percentile (mg/L)
Dissolved metals					
Aluminium	0.055 when pH >6.5 0.0008 when pH <6.5	Mostly above the ANZG (2018) guideline value. The pH at these sites is <6.5 most of the time.	26	0.05	0.10
Arsenic	0.013	Almost always below 0.002 mg/L and always below the guideline value	26	<0.001	0.002
Barium	NA	Always 0.003 mg/L	2	0.003	0.003
Beryllium	NA	Always below the LOR of <0.001 mg/L	2	<0.001	<0.001
Boron	0.37	Always below the LOR of <0.05 mg/L and as such always below the guideline value	2	<0.05	<0.05
Cadmium	0.0002	Always below the LOR of <0.0001 mg/L and as such always below the guideline value	26	<0.0001	<0.0001
Caesium	NA	Always below the LOR of <0.001 mg/L	2	<0.001	<0.001
Chromium	0.004	Always below the LOR of <0.001 mg/L and as such always below the guideline value	26	<0.001	<0.001
Cobalt	0.0014	Always below the LOR of <0.001 mg/L and as such always below the guideline value	2	<0.001	<0.001
Copper	0.0014	Always below the LOR of <0.001 mg/L and as such always below the guideline value	26	<0.001	<0.001
Iron	NA	Most concentrations less than 0.33 mg/L, with occasional concentrations above this	26	0.17	0.33
Lead	0.0034	Always below the LOR of <0.001 mg/L and as such always below the guideline value	26	<0.001	<0.001
Lithium	NA	Most concentrations less than 0.007 mg/L, with occasional concentrations above this	22	0.004	0.007
Mercury	0.0006	Always below the LOR of <0.0001 mg/L and as such always below the guideline value	26	<0.0001	<0.0001
Nickel	0.011	Always below the LOR of <0.001 mg/L and as such always below the guideline value	26	<0.001	<0.001
Selenium	0.011	Always below the LOR of <0.01 mg/L and as such always below the guideline value	20	<0.01	<0.01
Silver	0.00005	Always below the LOR of <0.001 mg/L. Unknown if this is below the guideline value.	2	<0.001	<0.001
Strontium	NA	Always below 0.002 mg/L	2	<0.001	0.002
Thorium	NA	Always below the LOR of <0.001 mg/L	2	<0.001	<0.001
Tin	NA	Always below the LOR of <0.001 mg/L	15	<0.001	<0.001
Titanium	NA	Always below the LOR of <0.01 mg/L	2	<0.01	<0.01
Uranium	0.0005	Always below the LOR of <0.001 mg/L. Unknown if this is below the guideline value.	2	<0.001	<0.001
Vanadium	0.006	Always below the LOR of <0.01 mg/L. Unknown if this is below the guideline value.	2	<0.01	<0.01

² Default guideline values for 95% species protection in freshwater. NA – no ANZG (2018) default guideline value available.

Parameter	ANZG (2018) guideline ² (mg/L)	Discussion	No data points	Median (mg/L)	80 th percentile (mg/L)
Zinc	0.008	Always below the LOR of <0.005 mg/L and as such always below the guideline value	26	<0.005	<0.005

Parameter	ANZG (2018) guideline ² (mg/L)	Discussion	No data points	Median (µg/L)	80 th percentile (µg/L)
Hydrocarbons					
TRH C6-C10	NA	Always below the LOR of <20 µg/L	14	<20	<20
>C10-C16	NA	Always below the LOR of <100 µg/L	14	<100	<100
>C16-C34	NA	Always below the LOR of <100 µg/L	14	<100	<100
>C34-C40	NA	Always below the LOR of <100 µg/L	14	<100	<100
Benzene	950	Always below the LOR of <1 µg/L and as such always below the guideline value	14	<1	<1
Toluene	180	Always below the LOR of <2 µg/L and as such always below the guideline value	14	<2	<2
Ethylbenzene	80	Always below the LOR of <2 µg/L and as such always below the guideline value	14	<2	<2
Meta & para-xylene	75	Always below the LOR of <2 µg/L and as such always below the guideline value	14	<2	<2
Ortho-xylene	350	Always below the LOR of <2 µg/L and as such always below the guideline value	14	<2	<2
Naphthalene	16	Always below the LOR of <5 µg/L and as such always below the guideline value	14	<5	<5

Table 4-7. Toxicant summary for BP33 Pit

Parameter	ANZG (2018) guideline ² (mg/L)	Discussion	No data points	Median (mg/L)	80 th percentile (mg/L)
Dissolved metals					
Aluminium	0.055 when pH >6.5 0.0008 when pH <6.5	Mostly below the ANZG (2018) guideline value. The pH at this site is >6.5 most of the time.	13	<0.01	<0.01
Arsenic	0.013	Occasionally above the guideline value	13	0.008	0.015
Barium	NA	Only analysed once and concentration was 0.004 mg/L	1	-	-
Beryllium	NA	Only analysed once and concentration was below the LOR of <0.001 mg/L	1	-	-
Boron	0.37	Only analysed once and concentration was below the LOR of <0.05 mg/L and as such below the guideline value	1	-	-
Cadmium	0.0002	Always below the LOR of <0.0001 mg/L and as such always below the guideline value	13	<0.0001	<0.0001
Caesium	NA	Only analysed once and concentration was 0.002 mg/L	1	-	-
Chromium	0.004	Always below the LOR of <0.001 mg/L and as such always below the guideline value.	13	<0.001	<0.001
Cobalt	0.0014	Only analysed once and concentration was below the LOR of <0.001 mg/L and as such below the guideline value	1	-	-
Copper	0.0014	Always below the LOR of <0.001 mg/L and as such always below the guideline value	13	<0.001	<0.001
Iron	NA	Always below the LOR of <0.05 mg/L	13	<0.05	<0.05
Lead	0.0034	Always below the LOR of <0.001 mg/L and as such always below the guideline value	13	<0.001	<0.001
Lithium	NA	Most concentrations less than 0.012 mg/L with occasional concentrations above this	11	0.009	0.012
Mercury	0.0006	Always below the LOR of <0.0001 mg/L and as such always below the guideline value	13	<0.0001	<0.0001
Nickel	0.011	Always below the LOR of <0.001 mg/L and as such always below the guideline value	13	<0.001	<0.001
Selenium	0.011	Always below the LOR of <0.01 mg/L and as such always below the guideline value	10	<0.01	<0.01
Silver	0.00005	Only analysed once and concentration was below the LOR of <0.001. Unknown if this is below the guideline value.	1	-	-
Strontium	NA	Only analysed once and concentration was 0.004 mg/L	1	-	-
Thorium	NA	Only analysed once and concentration was below the LOR of <0.001 mg/L	1	-	-
Tin	NA	Always below the LOR of <0.001 mg/L	9	<0.001	<0.001
Titanium	NA	Only analysed once and concentration was below the LOR of <0.01 mg/L	1	-	-

Parameter	ANZG (2018) guideline ² (mg/L)	Discussion	No data points	Median (mg/L)	80 th percentile (mg/L)
Uranium	0.0005	Only analysed once and concentration was below the LOR of <0.001 mg/L. Unknown if this is below the guideline value.	1	-	-
Vanadium	0.006	Only analysed once and concentration was below the LOR of <0.01 mg/L. Unknown if this is below the guideline value	1	-	-
Zinc	0.008	Always below the LOR of <0.005 mg/L and as such always below the guideline value	13	<0.005	<0.005

Parameter	ANZG (2018) guideline ² (mg/L)	Discussion	No data points	Median (µg/L)	80 th percentile (µg/L)
Hydrocarbons					
TRH C6-C10	NA	Always below the LOR of <20 µg/L	9	<20	<20
>C10-C16	NA	Always below the LOR of <100 µg/L	9	<100	<100
>C16-C34	NA	Always below the LOR of <100 µg/L	9	<100	<100
>C34-C40	NA	Always below the LOR of <100 µg/L	9	<100	<100
Benzene	950	Always below the LOR of <1 µg/L and as such always below the guideline value	9	<1	<1
Toluene	180	Always below the LOR of <2 µg/L and as such always below the guideline value	9	<2	<2
Ethylbenzene	80	Always below the LOR of <2 µg/L and as such always below the guideline value	9	<2	<2
Meta & para-xylene	75	Always below the LOR of <2 µg/L and as such always below the guideline value	9	<2	<2
Ortho-xylene	350	Always below the LOR of <2 µg/L and as such always below the guideline value	9	<2	<2
Naphthalene	16	Always below the LOR of <5 µg/L and as such always below the guideline value	9	<5	<5

Table 4-8. Toxicant summary for OHD

Parameter	ANZG (2018) guideline ² (mg/L)	Discussion	No data points	Median (mg/L)	80 th percentile (mg/L)
Dissolved metals					
Aluminium	0.055 when pH >6.5 0.0008 when pH <6.5	Mostly below the ANZG (2018) guideline value. The pH at this site is >6.5 most of the time.	11	<0.01	<0.01
Arsenic	0.013	Always below the guideline value	11	0.003	0.005
Barium	NA	Only analysed once and concentration was 0.001 mg/L	1	-	-
Beryllium	NA	Only analysed once and concentration was below the LOR of <0.001 mg/L	1	-	-
Boron	0.37	Only analysed once and concentration was below the LOR of <0.05 mg/L and as such below the guideline value	1	-	-
Cadmium	0.0002	Always below the LOR of <0.0001 mg/L and as such always below the guideline value	11	<0.0001	<0.0001
Caesium	NA	Only analysed once and concentration was below the LOR of <0.001 mg/L	1	-	-
Chromium	0.004	Always below the LOR of <0.001 mg/L and as such always below the guideline value	11	<0.001	<0.001
Cobalt	0.0014	Only analysed once and concentration was below the LOR of <0.001 mg/L and as such below the guideline value	1	-	-
Copper	0.0014	Always below the LOR of <0.001 mg/L and as such always below the guideline value	11	<0.001	<0.001
Iron	NA	Most concentrations less than 0.21 mg/L, with occasional concentrations above this	11	0.07	0.21
Lead	0.0034	Always below the LOR of <0.001 mg/L and as such always below the guideline value	11	<0.001	<0.001
Lithium	NA	Concentrations usually always less than 0.003 mg/L	11	0.001	0.003
Mercury	0.0006	Always below the LOR of <0.0001 mg/L and as such always below the guideline value	11	<0.0001	<0.0001
Nickel	0.011	Always below the LOR of <0.001 mg/L and as such always below the guideline value	11	<0.001	<0.001
Selenium	0.011	Always below the LOR of <0.01 mg/L and as such always below the guideline value	7	<0.01	<0.01
Silver	0.00005	Only analysed once and concentration was below the LOR of <0.001. Unknown if this is below the guideline value.	1	-	-
Strontium	NA	Only analysed once and concentration was 0.002 mg/L	1	-	-
Thorium	NA	Only analysed once and concentration was below the LOR of <0.001 mg/L	1	-	-
Tin	NA	Always below the LOR of <0.001 mg/L	5	<0.001	<0.001
Titanium	NA	Only analysed once and concentration was below the LOR of <0.01 mg/L	1	-	-
Uranium	0.0005	Only analysed once and concentration was below the LOR of <0.001 mg/L. Unknown if this is below the guideline value.	1	-	-

Parameter	ANZG (2018) guideline ² (mg/L)	Discussion	No data points	Median (mg/L)	80 th percentile (mg/L)
Vanadium	0.006	Only analysed once and concentration was below the LOR of <0.01 mg/L. Unknown if this is below the guideline value	1	-	-
Zinc	0.008	Always below the LOR of <0.005 mg/L and as such always below the guideline value	11	<0.005	<0.005
Parameter	ANZG (2018) guideline ² (mg/L)	Discussion	No data points	Median (µg/L)	80 th percentile (µg/L)
Hydrocarbons					
TRH C6-C10	NA	Always below the LOR of <20 µg/L	5	<20	<20
>C10-C16	NA	Always below the LOR of <100 µg/L	5	<100	<100
>C16-C34	NA	Always below the LOR of <100 µg/L	5	<100	<100
>C34-C40	NA	Always below the LOR of <100 µg/L	5	<100	<100
Benzene	950	Always below the LOR of <1 µg/L and as such always below the guideline value	5	<1	<1
Toluene	180	Always below the LOR of <2 µg/L and as such always below the guideline value	5	<2	<2
Ethylbenzene	80	Always below the LOR of <2 µg/L and as such always below the guideline value	5	<2	<2
Meta & para-xylene	75	Always below the LOR of <2 µg/L and as such always below the guideline value	5	<2	<2
Ortho-xylene	350	Always below the LOR of <2 µg/L and as such always below the guideline value	5	<2	<2
Naphthalene	16	Always below the LOR of <5 µg/L and as such always below the guideline value	5	<5	<5

4.5 Baseline surface water quality summary

4.5.1 BPUS SW1 and BPDS SW2

Water in the drainage line east of the BP33 mine site (sites BPUS SW1 and BPDS SW2) is characteristic of fresh rainwater and runoff, with a small component of groundwater seepage. Water quality characteristics are summarised as follows:

- EC is low (usually less than 26 $\mu\text{S}/\text{cm}$), but higher compared to the surface water monitoring sites at Grants, which are generally less than 18 $\mu\text{S}/\text{cm}$ (see [Grants WMP](#)).
- Turbidity measured at BPUS SW1 and BPDS SW2 is low (usually under 14 NTU).
- pH is slightly acidic to neutral (generally between 5.2 and 7.3)
- DO is moderate (generally between 58 and 83%sat).
- Nitrogen concentrations are moderate to low, with ammonia usually always less than 0.09 mg/L and TN less than 0.3 mg/L.
- TP is usually low and less than 0.02 mg/L.
- Anions, cations and alkalinity concentrations are low and generally always less than 6 mg/L. Similarly to EC however, concentrations are slightly higher compared to the Grants surface water sites, which are always less than 3 mg/L (see [Grants WMP](#)). This is indicating the BP33 drainage is receiving a small component of groundwater compared to the Grants drainages, which appear to only receive fresh rainwater and runoff.
- *E. coli* and enterococci are present at BPUS SW1 and BPDS SW2; concentrations vary widely between monitoring rounds, ranging from 3 CFU/100mL, up to 10,000 CFU/100mL.
- Dissolved metal concentrations are all below the ANZG (2018) default guideline value for arsenic, boron, cadmium, chromium, cobalt, copper, lead, nickel, selenium, zinc and mercury.
- All concentrations are below the LOR for the following dissolved metals, which do not have a default guideline value available: beryllium, caesium, thorium, tin and titanium.
- All silver, uranium, and vanadium concentrations are also below the LOR. These metals have guideline values available; however, the LOR is above the guideline value, so it cannot be determined if concentrations are above these guideline values.
- Barium does not have a guideline value; concentrations generally remain below 0.003 mg/L.
- Iron does not have a guideline value; concentrations generally remain below 0.33 mg/L.
- Lithium does not have a guideline value; concentrations generally remain below 0.007 mg/L.
- Strontium does not have a guideline value; concentrations generally remain below 0.002 mg/L.
- Aluminium is above the guideline value most of the time, with an 80th percentile concentration of 0.10 mg/L.
- TPH/TRH and BTEXN concentrations are always below detection limits.

4.5.2 Observation Hill Dam and BP33 Pit sites

Water in the man-made water storages (sites OHD and BP33 Pit) is characteristic of rainwater mixed with groundwater seepage. Water quality characteristics are summarised as follows:

- EC is low (generally less than 27 $\mu\text{S}/\text{cm}$) and very similar to the drainage line at BPUS SW1 and BPDS SW2.

- Turbidity is low (usually under 11 NTU)
- The pH is close to neutral (generally between 6.0 and 8.2)
- DO is moderate to high (generally between 55 and 99%sat).
- Nitrogen concentrations are moderate to low at BP33 Pit, with ammonia usually always less than 0.06 mg/L and TN less than 0.2 mg/L. Nitrogen concentrations are higher at OHD, with ammonia usually less than 0.11 mg/L and TN less than 0.5 mg/L.
- TP is usually low at both sites and less than 0.01 mg/L.
- Anions, cations and alkalinity concentrations are low and generally always less than 7 mg/L.
- *E. coli* and enterococci are present at these sites; concentrations are up to 30 CFU/100mL at BP33 Pit and up to 200 CFU/100mL at OHD.
- Dissolved metal concentrations are all below the ANZG (2018) default guideline value for aluminium, boron, cadmium, chromium, cobalt, copper, lead, nickel, selenium, zinc and mercury.
- All concentrations are below the LOR for the following dissolved metals, which do not have a default guideline value available: beryllium, caesium, thorium, tin and titanium.
- All silver, uranium, and vanadium concentrations are also below the LOR. These metals have guideline values available; however, the LOR is above the guideline value, so it cannot be determined if concentrations are above these guideline values.
- Iron does not have a guideline value; concentrations remain below the LOR of <0.05 mg/L at BP33 Pit and below 0.21 mg/L at OHD.
- Lithium does not have a guideline value; concentrations generally remain below 0.012 mg/L at BP33 Pit and below 0.003 mg/L at OHD.
- Arsenic is below the guideline value at OHD, but occasionally above the guideline value at BP33 Pit, with an 80th percentile concentration of 0.015 mg/L.
- TPH/TRH and BTEXN concentrations are always below detection limits.

5 BASELINE GROUNDWATER QUALITY

Baseline groundwater quality monitoring has been undertaken for the project since the installation of 13 groundwater monitoring bores across the BP33 mine site in September 2020 by Groundwater Enterprises (see Groundwater Enterprises 2020). The results of this monitoring are presented below. They provide a characterisation of pre-mining groundwater quality and are used to develop SSGV's for detecting and assessing potential impacts once mining commences. Establishing the levels of metals, nutrients and other constituents in the groundwater is also important for determining how to manage groundwater removed from the box-cut, decline and underground workings.

5.1 Monitoring bores

Table 5-1 details the 13 monitoring bores installed across the proposed mine site and Figure 4-1 shows their locations.

5.2 Monitoring undertaken

Sampling was undertaken monthly in all 13 bores over the wet season from October 2020 to March 2021, and then once during the dry season in June 2021; totalling seven monitoring rounds for each bore.

SWL fluctuations measured in these bores since their installation in September 2020 were graphed and described above in Section 3.4.2

Table 5-1. Groundwater monitoring bore details (Source Groundwater Enterprises 2020)

Bore ID	Site type	RN	Depth (mBGL)	Screened interval (mBGL)	Screened formation	Purpose
BPG1	single bore	041833	36	29-35	Fractured/weathered BCF with pegmatite	Assess groundwater conditions up-gradient of mine site
BPG2s	nested	041792	3.5	2.5-3.5	Alluvial sediments (silty sand with laterite band)	Assess groundwater conditions up-gradient between box-cut and OHD in the area of mapped GDE potential
BPG2i		041791	28.3	22.3-28.3	Fractured/weathered BCF with quartz veins	
BPG3s	nested	041794	4.5	3.5-4.5	Alluvial sediments	Assess groundwater conditions and establish a groundwater monitoring point at field-verified GDE and vegetation monitoring site RVS5
BPG3i		041793	48.75	41.75-47.75	Fresh BCF	
BPG4s	nested	041832	8.	5-8	Weathered BCF	Establish a nested monitoring site to investigate the degree of vertical connection between BCF aquifer, the weathered zone in the BCF and the alluvial aquifer in the immediate vicinity of the underground mine workings
BPG4i		041831	35.4	28.4-34.4	Weathered BCF	
BPG4d		041830	109	Open hole from 47	Fractured fresh BCF	
BPG5s	nested	041795	8	5-8	Weathered BCF	Assess groundwater conditions and establish monitoring at field-verified GDE and surface water monitoring site BPUS SW2
BPG5i		041796	57.3	49.3-55.3	Fractured fresh BCF	
BPG6	single bore	041799	73	66-72	Fractured fresh BCF	Assess conditions down-gradient of box-cut
BPG7s	nested	041797	7	4-7	Weathered BCF	Assess groundwater conditions down-gradient of mine site in area of mapped GDE potential
BPG7i		041798	53.2	46.2-52.2	Fractured fresh BCF	

5.3 Baseline groundwater quality results

Bores screened in the alluvial sediments and weathered BCF at shallow depths (to 8 mBGL) and also in the weathered BCF at intermediate depths (to 36 mBGL) all display similar water quality.

Bores screened in the deeper weathered and fresh BCF at depths greater than 36 mBGL display similar water quality to each other, and this water quality contrasts significantly to the shallower bores.

Table 5-1 outlines the two bore groupings and their water quality characteristics. Given the differences in water quality between these groupings, the baseline groundwater quality results for the bores screened to depths less than 36 mBGL (group 1) are discussed separately to the deeper bores screened at depths greater than 36 mBGL (group 2).

Table 5-2. Bore groupings based on groundwater quality

Bore Grouping	Screened aquifer	Screened depth	Bores	Water quality characteristics
1	Alluvial sediments and weathered BCF at shallow depth	Maximum 8 mBGL	BPG3s, BPG2s, BPG4s BPG5s and BPG7s	slightly acidic pH relatively low EC positive ORP relatively low alkalinity low arsenic relatively high zinc relatively low iron relatively low phosphorus
	Weathered BCF in elevated areas/recharge zones at intermediate depths	Maximum 36 mBGL	BPG1 and BPG2i	
2	Deeper weathered and fresh BCF	Depths greater than 36 mBGL	BPG4i, BPG4d, BPG5i, BPG6 and BPG7i	close to neutral pH relatively higher EC negative ORP relatively higher alkalinity high arsenic relatively low zinc relatively high iron relatively high phosphorus

5.3.1 Physical parameters, nutrients, anions and cations

Table 5-3 and Table 5-4 summarise the physical parameter and nutrient results for the shallow (<36 m deep) and deep (>36 m deep) bores respectively. Median and 80th percentile concentrations have been calculated for each parameter. All data collected for the shallow bores and deeper bores were pooled separately to derive separate median and 80th percentiles.

All raw data collected and used in calculating median and 80th percentiles is provided in Appendix B.

When calculating medians and 80th percentiles, concentrations recorded as being below the laboratory limit of reporting (LOR) were replaced by a concentration equalling half the LOR e.g. if the concentration was recorded as <0.1 mg/L, the concentration was taken to be 0.05 mg/L.

The 20th percentile was also calculated for pH and oxidation reduction potential (ORP), to provide an indication of the range in concentrations.

The 80th percentile concentrations (and also 20th percentile in the case of pH) are used in the Monitoring Plan in Section 8 to define SSGV's for assessing any changes in groundwater quality following the commencement of mining. The median and 80th percentile concentrations for groundwater are also compared to the baseline surface water concentrations to assess the potential impacts of discharging groundwater extracted from the mine workings into waterways at the site.

Table 5-3. Physical parameter, nutrient, anion and cation summary for all shallow (<36 m deep) groundwater monitoring bores combined

Parameter	Discussion	No data points	Median	80 th percentile *20 th percentile
Physical parameters				
Electrical Conductivity	Relatively low for groundwater, but higher than surface water concentrations presented in Section 4.4.1	36	66 µS/cm	90 µS/cm
pH	Always slightly acidic	36	5.32	Upper 5.56 Lower 4.84*
Oxidation Red. Pot.	Always well oxidised	36	126 mV	Upper 213 mV Lower 85 mV
Nutrients				
Ammonia	Generally always below 0.05 mg/L, with occasional concentrations above this	36	0.02 mg/L	0.05 mg/L
Nitrite	Almost always below the LOR of <0.01 mg/L	36	<0.01 mg/L	<0.01 mg/L
Nitrate	Usually below 0.16 mg/L. Occasional concentrations above this.	36	0.12 mg/L	0.16 mg/L
Total nitrogen	Usually below 0.3 mg/L. Occasional concentrations above this.	36	0.1 mg/L	0.3 mg/L
Total phosphorus	Usually below 0.07 mg/L. Occasional concentrations above this. Relatively high compared to surface water concentrations presented in Section 4.4.1	36	0.04 mg/L	0.07 mg/L
Anions and cations				
Alkalinity	Usually between 15 and 35 mg/L, comprising 100% bicarbonate alkalinity i.e. hydroxide and carbonate alkalinity are always below the LOR of <1 mg/L	36	21 mg/L	35 mg/L
Sulfate	Usually below LOR of <1 mg/L	36	<1 mg/L	<1 mg/L
Chloride	Usually less than 7 mg/L	36	6 mg/L	7 mg/L
Calcium, magnesium, potassium	All calcium, magnesium and potassium concentrations usually below the 4 mg/L	36	2 mg/L	4 mg/L
Sodium	Always low and less than 9 mg/L	36	7 mg/L	9 mg/l

Table 5-4. Physical parameter, nutrient, anion and cation summary for all deeper (>36 m deep) groundwater monitoring bores combined

Parameter	Discussion	No data points	Median	80 th percentile *20 th percentile
Physical parameters				
Electrical Conductivity	Relatively low for groundwater, but higher than shallow groundwater bores and also surface water concentrations presented in Section 4.4.1	40	251 µS/cm	275 µS/cm
pH	Close to neutral	40	6.70	Upper 6.84 Lower 6.42
Oxidation Red. Pot.	Always reduced	40	-46 mV	Upper -16 mV Lower -102*
Nutrients				
Ammonia	Generally always below 0.04 mg/L, with occasional concentrations above this	40	0.02 mg/L	0.04 mg/L
Nitrite	Always below the LOR of <0.01 mg/L	40	<0.01 mg/L	<0.01 mg/L
Nitrate	Usually always below 0.04 mg/L, with occasional concentrations above this	40	0.02 mg/L	0.04 mg/L
Total nitrogen	Usually always below LOR of <0.1 mg/L	40	<0.1 mg/L	<0.1 mg/L
Total phosphorus	Usually below 1.26 mg/L. Occasional concentrations above this. Relatively high compared to shallow groundwater bores and very high compared to surface water concentrations presented in Section 4.4.1	40	0.29 mg/L	1.26 mg/L
Anions and cations				
Alkalinity	Usually between 90 and 115 mg/L, comprising 100% bicarbonate alkalinity i.e. hydroxide and carbonate alkalinity are always below the LOR of <1 mg/L. High compared to shallow groundwater bores.	40	117 mg/L	124 mg/L
Sulfate	Usually below LOR of <1 mg/L	40	<1 mg/L	<1 mg/L
Chloride	Usually less than 8 mg/L	40	7 mg/L	8 mg/L
Calcium, magnesium, potassium	All calcium, magnesium and potassium concentrations are usually below the 10 mg/L	40	4 mg/L	10 mg/L
Sodium	Usually between 30 and 39 mg/L. High compared to shallow groundwater bores.	40	35 mg/L	39 mg/l

5.3.2 *E. coli* and enterococci

Faecal contamination indicators *E. coli* and enterococci were included in the background pre-mining groundwater quality monitoring program to establish whether these indicators were present prior to the installation of ablutions and associated wastewater treatment for the project.

Appendix A provides the raw *E. coli* and enterococci results measured in all bores during all monitoring rounds. In summary, almost all concentrations were below the LOR of <1 CFU/100 mL in both deep and shallow bores.

Rare low concentrations of up to 12 CFU/100 mL were detected, but these were isolated and the results for all bores indicated faecal contamination is generally not present. This was except for the shallow bores BPG2s and BPG3s, which recorded concentrations up to 1600 CFU/100 mL. These bores are screened in the shallow alluvial sediments of drainage lines and the concentrations derive from surface water infiltration. Surface water concentrations in these drainage lines are commonly above 1,000 CFU/100 mL.

5.3.3 Toxicants

Table 5-5 and Table 5-6 summarise the toxicant results (i.e. dissolved metals) and include the calculated median and 80th percentile concentrations. As above for physical parameters, nutrients, anions and cations, all data collected for the shallower bores screened at depths less than 36 mBGL was pooled for these calculations. Similarly, the data collected from the remaining deeper bores >36 mBGL was pooled when calculating median and 80th percentile concentrations. All raw data is provided in Appendix B.

When calculating medians and 80th percentiles, concentrations recorded as being below the LOR were replaced by a concentration equalling half the LOR e.g. if the concentration was recorded as <0.1 mg/L, the concentration was taken to be 0.05 mg/L.

The 80th percentile concentrations are used in the Monitoring Plan in Section 8 to define SSGV's for assessing any changes in groundwater quality following the commencement of mining.

The median and 80th percentile concentrations for groundwater are also compared to the (ANZG 2018) default guideline values for 95% species protection in freshwater (where available) and the baseline surface water concentrations to assess the potential impacts of discharging groundwater extracted from the mining workings into waterways at the site.

Table 5-5. Toxicant summary for all shallow (<36 m deep) groundwater monitoring bores combined

Parameter	ANZG (2018) guideline ² (mg/L)	Discussion	No data points	Median (mg/L)	80 th percentile (mg/L)
Dissolved metals					
Aluminium	0.055 when pH >6.5 0.0008 when pH <6.5	Mostly below the LOR of <0.01 mg/L but occasionally above the LOR and hence also at times above the ANZG (2018) guideline value. The pH in these bores is <6.5 most of the time.	36	<0.01	0.02
Arsenic	0.013	Mostly always below the ANZG (2018) guideline value	36	0.002	0.005
Barium	NA	The median concentration is around 10 times higher than surface water concentrations.	13	0.031	0.105
Beryllium	NA	Always below the LOR of <0.001 mg/L	13	<0.001	<0.001
Boron	0.37	Always below the LOR of <0.05 mg/L and as such always below the guideline value	13	<0.05	<0.05
Cadmium	0.0002	Always below the LOR of <0.0001 mg/L and as such always below the guideline value	36	<0.0001	<0.0001
Caesium	NA	Always below the LOR of <0.001 mg/L	13	<0.001	<0.001
Chromium	0.004	Always below the LOR of <0.001 mg/L and as such always below the guideline value	36	<0.001	<0.001
Cobalt	0.0014	Always below the LOR of <0.001 mg/L and as such always below the guideline value	13	<0.001	<0.001
Copper	0.0014	Usually below the LOR of <0.001 mg/L and as such usually below the guideline value. Occasional concentrations above the guideline value.	36	<0.001	0.002
Iron	NA	Most concentrations less than 0.06 mg/L, with occasional concentrations above this. Concentrations are low compared to surface water concentrations presented in Section 4.4.3	36	0.03	0.06
Lead	0.0034	Almost always below the LOR of <0.001 mg/L and as such below the guideline value	36	<0.001	<0.001
Lithium	NA	Most concentrations less than 0.090 mg/L. Concentrations are around 12 times higher than in surface water – see Section 4.4.3	36	0.049	0.090
Mercury	0.0006	Always below the LOR of <0.0001 mg/L and as such always below the guideline value.	36	<0.0001	<0.0001
Nickel	0.011	Most concentrations less than 0.006 mg/L and as such below the guideline value.	36	0.004	0.006
Selenium	0.011	Always below the LOR of <0.01 mg/L and as such always below the guideline value.	13	<0.01	<0.01
Silver	0.00005	Always below the LOR of <0.001. Unknown if this is below the guideline value.	13	<0.001	<0.001
Strontium	NA	Most concentrations below 0.031 mg/L, with occasional concentrations above this. Concentrations are high compared to surface water concentrations, which are always below 0.002 mg/L.	13	0.010	0.031
Thorium	NA	Always below the LOR of <0.01 mg/L	13	<0.01	<0.01
Tin	NA	Always below the LOR of <0.001 mg/L	13	<0.001	<0.001
Titanium	NA	Always below the LOR of <0.01 mg/L	13	<0.01	<0.01

Parameter	ANZG (2018) guideline ² (mg/L)	Discussion	No data points	Median (mg/L)	80 th percentile (mg/L)
Uranium	0.0005	Always below the LOR of <0.001. Unknown if this is below the guideline value.	13	<0.001	<0.001
Vanadium	0.006	Always below the LOR of <0.01. Unknown if this is below the guideline value.	13	<0.01	<0.01
Zinc	0.008	Most concentrations above the guideline value (median is around 2 times higher than guideline) and high compared to surface water concentrations, which are always below the LOR of <0.005 mg/L	36	0.017	0.031

Table 5-6. Toxicant summary for all deeper (>36 m deep) groundwater monitoring bores combined

Parameter	ANZG (2018) guideline ² (mg/L)	Discussion	No data points	Median (mg/L)	80 th percentile (mg/L)
Dissolved metals					
Aluminium	0.055 when pH >6.5 0.0008 when pH <6.5	Mostly below LOR of <0.01 mg/L and as such mostly below the ANZG (2018) guideline value. The pH at these sites is >6.5 most of the time.	40	0.05	0.10
Arsenic	0.013	Always well above the ANZG (2018) guideline value. The median concentration is over 12 times higher than the guideline value. Concentrations are also very high compared to surface water concentrations presented in Section 4.4.3, which are usually well below the guideline value. Note that the median concentration calculated for bores only within the mine footprint (BPG6, BPG4i and BPG4d) is higher (0.219 mg/L). This is around 17 times higher than the guideline value.	40	0.160	0.220
Barium	NA	Most concentrations below 0.052 mg/L. Concentrations are around 11 times higher than surface water concentrations.	12	0.034	0.052
Beryllium	NA	Always below the LOR of <0.001 mg/L	12	<0.001	<0.001
Boron	0.37	Always below the LOR of <0.05 mg/L and as such always below the guideline value	12	<0.05	<0.05
Cadmium	0.0002	Always below the LOR of <0.0001 mg/L and as such always below the guideline value	40	<0.0001	<0.0001
Caesium	NA	Concentrations detected just above the LOR of <0.001 mg/L	12	0.002	0.002
Chromium	0.004	Always below the LOR of <0.001 mg/L and as such always below the guideline value	40	<0.001	<0.001
Cobalt	0.0014	Always below the LOR of <0.001 mg/L and as such always below the guideline value	12	<0.001	<0.001
Copper	0.0014	Always below the LOR of <0.001 mg/L and as such always below the guideline value	40	<0.001	<0.001
Iron	NA	Most concentrations around 0.18 mg/L, which is similar to surface water concentrations. This is except for bores BPG5i and BPG4d, which have relatively higher concentrations and a median of 1.60 mg/L. This is more than 9 times higher than surface water concentrations.	40	0.18	1.59
Lead	0.0034	Always below the LOR of <0.001 mg/L and as such always below the guideline value	40	<0.001	<0.001
Lithium	NA	Most concentrations are around 0.146 mg/L, which is around 36 times higher than surface water concentrations. Concentrations are much higher in bores BPG4i and BG4d, with a median of 0.761 mg/L, which is 190 times higher than surface water concentrations.	40	0.146	0.699
Mercury	0.0006	Always below the LOR of <0.0001 mg/L and as such always below the guideline value	40	<0.0001	<0.0001
Nickel	0.011	Mostly below the LOR of <0.001 mg/L and always below the guideline value	40	<0.001	<0.001
Selenium	0.011	Always below the LOR of <0.01 mg/L and as such always below the guideline value	12	<0.01	<0.01
Silver	0.00005	Always below the LOR of <0.001. Unknown if this is below the guideline value.	12	<0.001	<0.001

Parameter	ANZG (2018) guideline ² (mg/L)	Discussion	No data points	Median (mg/L)	80 th percentile (mg/L)
Strontium	NA	Mostly below 0.109 mg/L. Concentrations are high compared to surface water concentrations, which are always below 0.002 mg/L.	12	0.083	0.109
Thorium	NA	Always below the LOR of <0.001 mg/L	12	<0.001	<0.001
Tin	NA	Always below the LOR of <0.001 mg/L	12	<0.001	<0.001
Titanium	NA	Always below the LOR of <0.01 mg/L	12	<0.01	<0.01
Uranium	0.0005	Always below the LOR of <0.001. Unknown if this is below the guideline value.	12	<0.001	<0.001
Vanadium	0.006	Always below the LOR of <0.01. Unknown if this is below the guideline value.	12	<0.01	<0.01
Zinc	0.008	Most concentrations below the guideline value, with occasional concentrations above the guideline value.	40	<0.005	0.010

5.4 Baseline groundwater quality summary

5.4.1 Shallow bores <36 m deep

Bores screened in the alluvial sediments and weathered BCF at shallow depths (to 8 mBGL), and also in the weathered BCF at intermediate depths (to 36 mBGL), display similar water quality (refer to Table 5-2 for bores included in this grouping).

- These bores have relatively low EC (median of 66 $\mu\text{S}/\text{cm}$) for groundwater, although this is still high compared to surface water concentrations in the BP33 area (see Section 4.4.1).
- The pH is slightly acidic, ranging between 4.8 and 5.6. This is slightly more acidic compared to surface water.
- The ORP is always oxidised (i.e. positive).
- Nitrogen concentrations are moderate to low and similar to surface water concentrations, with ammonia usually always less than 0.05 mg/L and TN less than 0.3 mg/L.
- TP concentrations have a median of 0.04 mg/L, which is high compared to surface water concentrations, which are generally below 0.02 mg/L.
- Alkalinity is higher than surface water, usually between 15 and 35 mg/L, and comprising 100% bicarbonate alkalinity.
- Major anion and cation concentrations are low, usually less than 9 mg/L, and are similar to surface water concentrations.
- Faecal contamination indicators *E. coli* and enterococci are mostly always below the LOR of <1 CFU/100mL. This was except for the shallow bores BPG2s and BPG3s, which recorded concentrations up to 1600 CFU/100 mL. These bores are screened in the shallow alluvial sediments of drainage lines and the concentrations derive from direct surface water infiltration
- Dissolved metal concentrations are all below the ANZG (2018) default guideline value for arsenic, boron, cadmium, chromium, cobalt, copper, lead, nickel, selenium and mercury.
- All concentrations are below the laboratory LOR for the following dissolved metals, which do not have a default guideline value available: beryllium, caesium, thorium, tin and titanium.
- All silver, uranium, and vanadium concentrations are also below the LOR. These metals have default guideline values available; however, the LOR is above the guideline value, so it cannot be determined if concentrations are above these guideline values.
- Barium does not have a guideline value. The median concentration for these bores of 0.031 mg/L is around 10 times the median surface water barium concentration.
- Iron does not have a guideline value. Most concentrations are below 0.06 mg/L, which is low compared to surface water iron concentrations.
- Strontium does not have a guideline value. The median concentration of 0.010 mg/L is high compared to surface water concentrations, which are always below 0.002 mg/L.
- Lithium does not have a guideline value. The median lithium concentration of 0.049 mg/L is high and around 12 times higher than the median surface water lithium concentration.
- Aluminium is mostly below the LOR of <0.01 mg/L but occasionally above the LOR and hence also at times above the guideline value. These concentrations are low compared to surface water concentrations, which are above the guideline value most of the time.
- Zinc concentrations are above the guideline value most of the time (median is around 2 times higher than guideline value), with an 80th percentile concentration of 0.031 mg/L. These concentrations are

also high compared to the deeper bores and surface water concentrations, which are mostly below the LOR of <0.005 mg/L. These elevated zinc concentrations are likely related to the interaction of the slightly acidic groundwater with the soil and weathered bedrock.

5.4.2 Deeper bores >36 m deep

Groundwater quality in the deeper bores screened in the weathered and fresh BCF at depths greater than 36 mBGL contrasts significantly to the shallower bores (refer to Table 5-2 for bores included in each grouping).

- Groundwater in these bores has moderate salinity for groundwater, with a median EC concentration of 251 $\mu\text{S}/\text{cm}$. This is high compared to the shallower bores and very high (14 times higher) compared to surface water in the BP33 area.
- Groundwater pH is close to neutral, ranging between 6.4 and 6.8.
- The ORP is always reduced (i.e. negative).
- TN concentrations in the deeper bores are generally always below 0.1 mg/L and low compared to surface water concentrations.
- TP concentrations have a median of 0.29 mg/L. This is around 15 times higher compared to surface water concentrations, which are generally below the 0.02 mg/L.
- Alkalinity is usually between 90 and 115 mg/L, comprising 100% bicarbonate alkalinity. This is high compared to the shallow groundwater bores and surface water.
- Major anion and cations are relatively low and usually less than 10 mg/L. This is except for sodium, with concentrations usually between 30 and 39 mg/L. This is high compared to the shallow groundwater bores and surface water.
- Faecal contamination indicators *E. coli* and enterococci are mostly always below the LOR of <1 CFU/100mL.
- Dissolved metal concentrations are all below the ANZG (2018) default guideline value for aluminium, boron, cadmium, chromium, cobalt, copper, lead, nickel, selenium, zinc and mercury.
- All concentrations are below the laboratory LOR for the following dissolved metals, which do not have a default guideline value available: beryllium, caesium, thorium, tin and titanium.
- All silver, uranium, and vanadium concentrations are also below the LOR. These metals have default guideline values available; however, the LOR is above the guideline value, so it cannot be determined if concentrations are above these guideline values.
- Barium does not have a guideline value. The median concentration of 0.034 mg/L is 11 times the median surface water barium concentration.
- Iron does not have a guideline value. The median concentration of 0.18 mg/L is similar to surface water iron concentrations. Two bores however (BPG5i and BPG4d) have relatively high iron concentrations, with a median of 1.60 mg/L. This is more than 9 times higher than surface water concentrations.
- Strontium does not have a guideline value. The median concentration of 0.083 mg/L is high compared to surface water concentrations, which are always below 0.002 mg/L.
- Lithium does not have a guideline value. The median lithium concentration of 0.146 mg/L is high and around 36 times higher than the median surface water lithium concentration. The two bores located where the BP33 underground mine is to be located (BPG4i and BPG4d) have even higher lithium concentrations, with a median of 0.761 mg/L. This is 190 times higher than surface water concentrations. These high concentrations are associated with lithium mineralisation i.e. the spodumene proposed to be mined.

- Arsenic concentrations have a median value of 0.160 mg/L, which is more than 12 times above the ANZG (2018) guideline value and very high compared to surface water concentrations, which are mostly below 0.002 mg/L. The median arsenic concentration is also over 16 times the *Australian Drinking Water Quality Guidelines* (NHMRC 2011) health guideline limit of 0.01 mg/L.

For bores located within the mine footprint (BPG6, BPG4i and BPG4d), arsenic concentrations are even higher, with a median concentration of 0.219 mg/L, which is 17 times the ANZG (2018) guideline value.

The BCF aquifer is a known 'high' risk aquifer for arsenic (see Karp 2008). The arsenic is from minerals of the BCF being mobilised into the groundwater through natural processes such as oxidation, weathering reactions, and/or biological activity.

5.5 Predicted water quality of water removed from mine workings

The mining operations intend to pump water dewatered from the box-cut and underground (comprising groundwater inflows and direct rainfall) to the MSD. This water will be treated through the filtration unit and re-used underground for dust suppression and operations, where possible. The water balance for mining operations (see Section 2.5.2 above), predicts that groundwater volumes requiring removal from the box-cut and underground workings will be well in excess of that used in mine operations and able to be stored on-site.

Options available for excess water disposal are described in section 2.5. Table 5-7 below aims to inform the options by comparing the water quality of the shallow and deep bores, with that of the surface water drainage east of the BP33 site (represented by surface water monitoring sites BPUS SW1 and BPDS SW2).

Table 5-7. Comparison of groundwater quality with surface water quality, and risks if water removed from mine workings was discharged to surface water

Parameter	Surface Water BPUS SW1 and BPDS SW2	Shallow bores	Deep bores	Risk
pH	Slightly acidic	Slightly to moderately acidic	Close to neutral	Low risk
EC	Very low	Relatively low for groundwater but moderately higher than surface water	Moderately high. Concentrations are high compared to surface water	Moderate risk. Dilution required would be up to 14 times
TN	Low	Low and similar to surface water	Lower than surface water	Low risk
TP	Low	High compared to surface water	High compared to surface water and also higher than shallow bores	Moderate risk. Dilution required would be around 15 times
Boron, Cadmium, Chromium, Cobalt, Copper, Lead, Nickel, Selenium, Mercury	Always below ANZG (2018) guideline value	Always below ANZG (2018) guideline value	Always below ANZG (2018) guideline value	Low risk
Beryllium, Caesium, Thorium, Tin, Titanium	Always below LOR – no ANZG (2018) guideline value available	Always below LOR – no ANZG (2018) guideline value available	Always below LOR – no ANZG (2018) guideline value available	Low risk
Silver, Uranium, Vanadium	Always below LOR, but noting that LOR is above ANZG (2018) guideline value	Always below LOR, but noting that LOR is above ANZG (2018) guideline value	Always below LOR, but noting that LOR is above ANZG (2018) guideline value	Low risk
Aluminium	Mostly above ANZG (2018) guideline value	Mostly below ANZG (2018) guideline value	Always below ANZG (2018) guideline value	Low risk
Lithium	Mostly less than 0.007 mg/L	Around 12 times higher than surface water concentrations Ecotox results in Grants WMP indicate these levels would not be toxic	Up to 190 times higher than surface water concentrations Ecotox results in Grants WMP indicate these levels would not be toxic	Low risk
Iron	Mostly less than 0.33 mg/L	Low compared to surface water	Up to 9 times higher than surface water concentrations in some bores, but most bores have concentrations similar to surface water	Low risk

Parameter	Surface Water BPUS SW1 and BPDS SW2	Shallow bores	Deep bores	Risk
Arsenic	Almost always below 0.002 mg/L and as such well below the ANZG (2018) guideline value of 0.13 mg/L	Mostly below 0.005 mg/L and as such well below the ANZG (2018) guideline value of 0.13 mg/L	Bores located within mine footprint very high concentrations, up to 17 times higher than ANZG (2018) guideline	Moderate risk. Dilution required could be up to 17 times, although mixing of deeper groundwater with shallow groundwater could reduce concentrations
Zinc	Always below ANZG (2018) guideline value	Concentrations are around 2 times higher than ANZG (2018) guideline value	Always below ANZG (2018) guideline value	Low risk Dilution ratio is not high and would be achieved by mixing of shallow and deep groundwater

6 RISK MANAGEMENT

A risk-based adaptive management framework will be adopted to identify and manage the risks of impacts to both surface water and groundwater over the operational life of mine and post-closure. A regular risk assessment process will be undertaken to identify and assess the risk of impacts to water associated with each phase of the mining activities. The risk assessment framework will be developed as part of the Mining Management Plan submitted under the *Mining Management Act*.

6.1 Potential impacts

The potentially significant impacts to water associated with the BP33 mining proposal have been identified and assessed through the environmental impact assessment (EIA) process undertaken to meet the requirements of the *Environment Protection Act 2019*. The EIA identified several potential impacts that require specific mitigation measures and/or further assessment in order to reduce the risk to an acceptable level, these are:

- Alteration of surface water flows into receiving environment from surface water diversion with mining infrastructure and uncontrolled release of MSD water
- Drawdown of groundwater in the underlying aquifers from dewatering of the underground workings.
- Contaminant source from mine site
- Turbidity in surface watercourses from mine run-off and discharges
- Metals in seepage and run-off from WRDs, ROM pad and underground mine post closure
- Metals in groundwater dewatered from the mine

The potential significance of these impacts and implications for ecological health, land uses, and the welfare and amenity of people is assessed in the sections below and provisional risk management measures are provided in Section 7.

6.1.1 Alteration of surface water flows

Hydrologic and hydraulic modelling prepared for the BP33 mine site submitted with the Referral information (SWES, 2020), indicates that there will be localised alteration of surface flow paths within the mine site footprint. Core has designed the box-cut to incorporate a contour drain on the western side, to divert surface water run-off from adjacent elevated areas towards a natural topographic low to the south-west, which will reduce the volumes of water requiring dewatering from the box cut. A drainage network system and sediment dams have been designed to manage internal stormwater flows. The contour drain and drainage system are shown on the site layout Figure 1-2. The modelling indicates the infrastructure will have a limited impact, on natural surface water flow regimes in comparison to pre-mining conditions, which is expected given the small portion of the catchment affected by the mine site infrastructure.

Surface water flows will be reduced in the drainage line downstream of the OHD when the dam is in use as a water source for the mining activities. The OHD, will be used as a water source for the Finnis Lithium Project Table 6-1 shows the modelled reduction in flows in the Charlotte River at a take rate of 2.02 ML/day from OHD, which is based on meeting the water demand for Grants Project as the modelling was prepared for the Grants Lithium Project EIS. The modelling is suitable for assessing potential impacts from changes to flows associated with the BP33 production phase because the modelled take rate from OHD is now predicted to be significantly less³ due to the groundwater model indicating the availability of significant inflow volumes that will be dewatered and reused on site. There are no other licenced consumptive uses on the Charlotte River catchment, and so it is assumed that extraction from the OHD is the only significant source of consumptive use in the catchment. On this basis, the percentage reduction across the wet season months does not exceed

³ The take-rate from OHD during the BP33 production phase is forecast as follows: BP33 supplementary demand (0.013 ML/day from the BP33 water balance); Grants processing demand 0.96 ML/day (from the Grants Lithium Project EIS); Total take-rate approximately 1 ML/day.

the threshold established in the *Territory Water Allocation Planning Framework*, which requires that extraction for consumptive uses will not exceed the threshold level equivalent to 20 per cent of flow at any time in any part of a river (DENR 2018).

Table 6-1. Modelled percent reduction in flows at Charlotte River outlet to Bynoe Harbour (Source: EnviroConsult 2019, pg.26)

November	December	January	February	March	April
12.6	9.4	3.7	2.9	1.4	3.9

Hydrological modelling was also used to assess how mine infrastructure will change flooding extent for a 1 in 100-year storm event i.e. 1% AEP (Annual Exceedance Probability). The model predicts that the mine infrastructure will have little effect on flood levels or flood hazard, and there would be no increased risk to people, livestock, or wildlife during flood events. The flood hazard downstream of the mine is slightly less as a result of the mine infrastructure. This is because there is a reduction in peak discharge downstream as more water is retained in the box-cut and other small water storages on site. Flood levels across the mine site were found to be very shallow and have low velocity, posing no risk to mining operations.

The response of riparian vegetation along the ephemeral watercourse downstream of the OHD and BP33 mine to the cumulative impact of reduced surface water flows and groundwater drawdown is uncertain. This is further discussed in Section 3.3.2 and a riparian monitoring program (section 8.4) has been developed to provide for quantification of impacts that occur during mining operations.

6.1.2 Groundwater drawdown

The modelled extent of groundwater drawdown around the BP33 mine (and Grants mine) due dewatering is shown in Figure 6-1. Predicted dewatering requirements of the box-cut, decline and underground workings are outlined above in section 2.4.2. At the end of the BP33 life of mine, there will be two separate drawdown cones in the surrounding BCF groundwater system. The BP33 drawdown cone extends approximately 2 km from the underground mine and the Grants drawdown cone approximately 1 km from the open pit. The Grants and BP33 drawdown cones do not interact, indicating that groundwater impacts are localised around each of the mine sites and do not contribute to cumulative impacts to the aquifer.

Modelling of groundwater drawdown was undertaken as a component of a broader modelling study with the objective of identifying potential impacts to the groundwater system and associated receptors from the Finnis Lithium Project (including Grants open cut mine and BP33 underground mine). The modelling addresses a range of climatic conditions using long term climate data sourced from the SILO⁴ data set and includes a predictive uncertainty assessment that adjusts the permeability and storage parameters of the aquifer to examine the potential upper and lower groundwater inflow volumes that could eventuate. The groundwater modelling technical report prepared by CloudGMS (2021), includes details of conceptual model development and calibration.

The modelling indicates that the groundwater will fully recover into the underground void within 3 years post-closure. During this period, there will be some impact to groundwater levels and availability within a 2 km zone of influence. Once mining ceases and the underground mine is backfilled to 65% filled, the groundwater table is predicted to recover to pre-mining levels within three years, as shown in Figure 6-2. The maximum extent of the drawdown cone extends outside of the ML and below ephemeral drainage lines to the east and south that are likely facultative Groundwater Dependent Ecosystems (GDE's) with an infrequent or partial dependence on groundwater (refer section 3.4.3). The drawdown cone extends to the west below an ephemeral drainage line, this is not modelled as a likely GDE. The depth to groundwater is likely to be below the depth accessible by the riparian vegetation for up to approximately five years, which is not expected to

⁴ SILO data drill (<https://www.longpaddock.qld.gov.au/silo>), a national scale database of climate records for Australia.

cause any long-term impact, but will need to be verified by monitoring riparian vegetation health (refer section 8.4). No impacts are predicted to existing groundwater users - the nearest of which is over 4 km from the site.

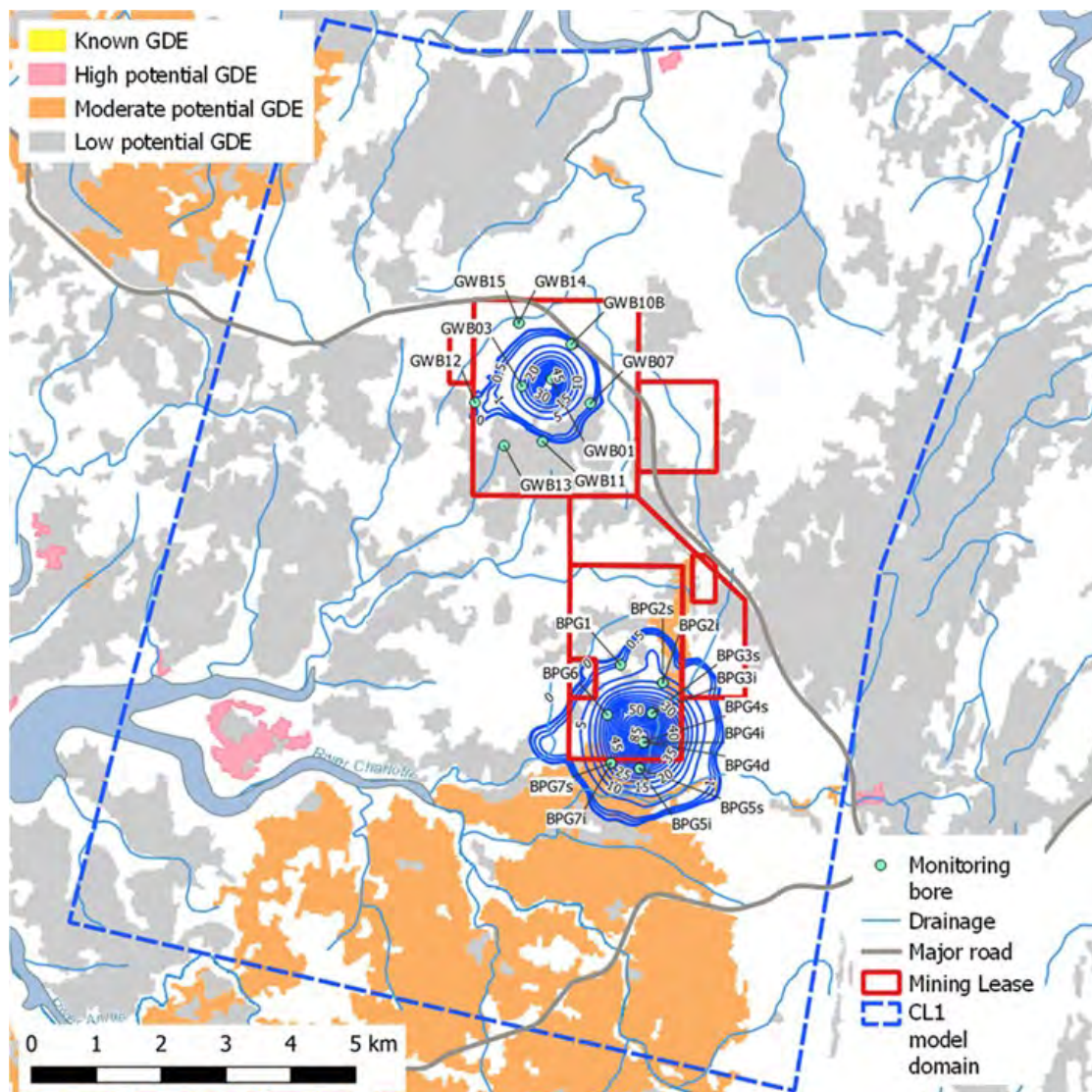


Figure 6-1. BP33 life of mine groundwater drawdown contours. (Source: CloudGMS 2021, pg.60)

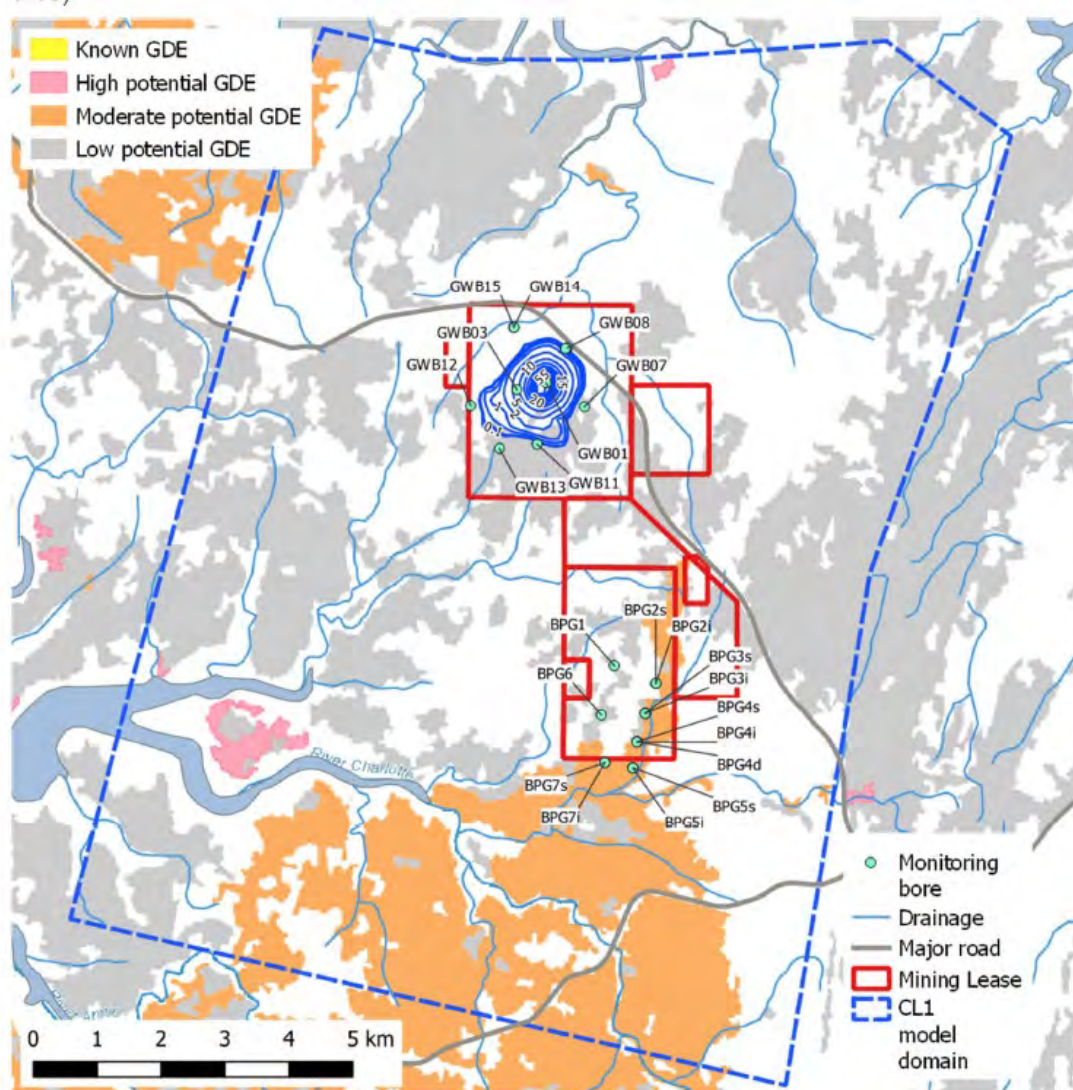


Figure 6-2. Post closure drawdown contours after 3 years of recovery (month 92) (Source: CloudGMS 2021, pg 65)

6.1.3 Contaminant sources

Table 6-2 summarises point and diffuse sources of discharges from the BP33 mine site that could have a significant impact to surface water and groundwater if not appropriately managed.

Table 6-2. Sources of point and diffuse discharges from the BP33 mine site

Discharge source/location	Quality	Quantity
Sediments present in run-off and discharges to watercourse	Water in sediment basins will be treated with flocculants to remove sediments prior to discharge off site as overland flow. The discharge standard adopted is the standard recommended for sediment basins in IECA (2008): 90th percentile NTU reading not exceeding 100, and 50th percentile NTU reading not exceeding 60.	Variable depending on wet season rainfall. Three sediment basins are located around the mine site as shown in Figure 1-2.

Discharge source/location	Quality	Quantity
Seepage from WRD's and ROM pad	Geochemical characterisation of waste rock and ore indicates potential for seepage to contain elevated metals and metalloids, primarily Al and As, but also Co, Cr, Cu, U and Zn.	Predicted to be low due to the WRD and ROM pad designs incorporating a low permeability base, and because the facilities will be in place for a short period of time (4 years). Kinetic testing is underway to improve certainty and inform detailed mine design and closure requirements.
Seepage from BP33 underground mine post-closure	As above	As above
Controlled discharge of surplus water to watercourse discharge point – refer Figure 8-1 for indicative location.	Groundwater inflows dewatered from the underground mine to the MSD are likely to contain hydrocarbons and suspended sediments. The water will be treated to remove these contaminants. The water is also naturally high in arsenic and phosphorous compared to local surface water characteristics. The water will be treated to reduce phosphorous concentrations (if required) and controlled release rate managed to address arsenic concentrations.	Maximum allowable controlled release rate has been determined based on the dilution factors required to meet the arsenic site-specific guideline value (SSGV) for surface water (0.013 mg/L). In very wet (1%ile) climatic conditions, the site could release up to 150 ML/month in the peak of the wet season. In median (50%ile) climatic conditions, the site could release up to 25 ML/month. Controlled release of water can only be undertaken in accordance with a Waste Discharge Licence under the <i>Water Act</i> , which Core will need to apply for prior to commencement of mining. Refer section 2.5.3 for details.
Controlled discharge of surplus water to a 20ha land irrigation area	As above Baseline water quality meets irrigation water quality trigger values as outlined in Chapter 4 Primary Industries of the ANZECC (2000b) guidelines.	The total volume of water requiring disposal during the 16 months start-up phase is estimated to be between 120 ML to 210 ML, depending on the climatic conditions experienced at the time. Refer section 2.5.3 for details.
Storage of surplus water in Grants open pit void	As above	Monthly volumes that would need to be transferred to keep the BP33 underground dry, range between approximately 60 ML/month to 180 ML/month over the life of mine. Refer section 2.5.3 for details.

Other sources of potential impacts to water quality, hydrocarbon and chemical storages and the onsite sewage system were considered in the EIA; however, these aspects were not considered potentially significant. Fuel and chemical storages being designed and operated in accordance with Australian Standards, they are unlikely to be a source of significant impact to water quality. The onsite sewage system will be designed and installed in accordance with the *Code of Practice for Wastewater Management* (Department of Health, 2020). These aspects will be managed through the adoption of design criteria and operational processes that are well-documented in the above-mentioned standards and guidelines, and therefore are unlikely to be a significant source of contaminants that could impact water quality.

6.1.4 Turbidity in surface watercourses from mine run-off and discharges

Mine affected water, including inflows dewatered from the box cut and underground and stormwater, will contain high levels of suspended sediments. This water will be captured and treated to remove sediments prior to being re-used or discharged off site. Dewatering will be directed to the MSD where sediments will be removed, and stormwater within the mine site will be captured in the internal drainage network and directed to one of three sediment basins for retention and/or treatment, prior to being released off site as overland flows. These systems will be designed and operated in accordance with the *Best Practice Erosion and Sediment*

Control Guidelines to provide sufficient retention time for the majority of sediments to fall out. Flocculants may be added to further reduce sediment loads. These forms of sediment removal align with best-practice guidance and are well-established in the mining industry, and so it is assumed they will be effective at reducing the sediment loads in discharges from the mine site.

6.1.5 Metals in seepage and run-off from WRDs, ROM pad and underground mine post-closure

The geochemical testing undertaken on materials that will be mined at the BP33 Project, described in section 2.6.3 of this document, indicates that elevated concentrations of metals/metalloids, primarily Al and As, but also Co, Cr, Cu, U and Zn, could occur beneath the WRD's and from the backfilled materials after the mine is closed. Run-off from the ROM pad could contain elevated concentrations of Al. The test results available to date, combined with the plan to backfill all WRD material to the underground mine and box cut, suggest a low risk of widespread and/or long-term impacts associated with metalliferous drainage. Further testing is underway to improve the certainty of this assessment and the results will inform detailed mine design and closure requirements.

If leaching from the WRD was to occur, it is expected to be low in volume as the WRD designs incorporate a low permeability base that will minimise seepage. The particle tracking work undertaken as part of the groundwater modelling study (CloudGMS, 2021, pg.67) indicates the extent of contaminant movement is likely to be limited to within the mine site footprint. The modelling results presented in Figure 6-3 indicate that the groundwater flows from the WRD's move to the east and terminate at the underground mine.

Post-closure when the mine void is backfilled to 65% filled, or if the mine were to close unexpectedly and the WRD's remain on the surface, then the particle tracking results shown in Figure 6-3 indicate that as the mine is no longer being dewatered and groundwater levels recover, contaminants could move towards the drainage lines to the east and west. The modelling predicts that any groundwater contamination that occurs will be localised and will not impact any groundwater users because the nearest licenced extraction bore is located 4 km away.

Run-off from the ROM pad will be captured and directed to the MSD where it can be managed with other mine-affected water. The surplus water management strategies provided in section 7 of this document include options for managing water with elevated metals concentrations, which include transfer to the Grants open pit void and irrigation to land. If the kinetic testing results predict Al concentrations greater than can be managed by these strategies, then alternative strategies would need to be investigated.

The ephemeral surface water courses to the east and west of the mine, which flow into the Charlotte River, would be the receiving environment in the event that uncontrolled discharge of water occurs from the mine site, including contaminated seepage or run-off from the WRD's and ROM pad. The extent to which aquatic ecosystems and other users of the ephemeral watercourses and Charlotte River could be affected by metalliferous drainage, depends on the metals/metalloids of concern, their toxicity and concentrations. The range of measures in place to minimise seepage and capture runoff are expected to effectively limit the release of large volumes of contaminated water.

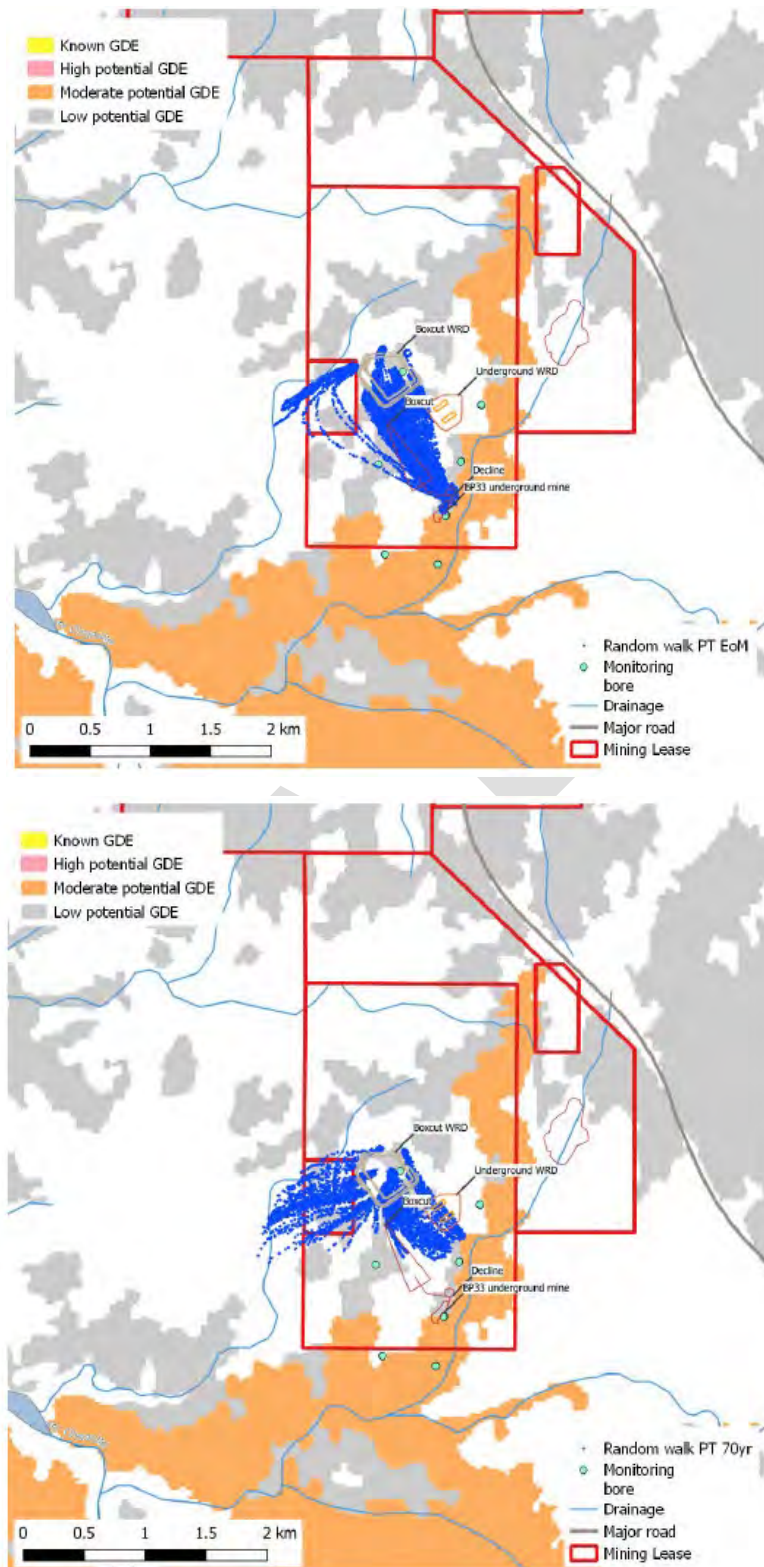


Figure 6-3. Random walk particle tracking results end of mine and 70 years post-closure (Source: CloudGSM 2021 pg. 68 & 69)

6.1.6 Metals in groundwater dewatered from the mine

Groundwater inflows dewatered from the box cut and underground mine are predicted to contain naturally elevated concentrations of arsenic and phosphorus, which exceed the surface water quality guideline values. To maintain the site water balance, most of this water will either be used for dust suppression or transferred Grants open pit void, and a small portion (approximately 12%) will be discharged to the watercourse east of the mine site or to a land irrigation area (refer section 7). If large volumes of water containing elevated concentrations of arsenic and/or phosphorous are discharged without adequate dilution or treatment, this could affect aquatic ecosystems either directly through arsenic exposure, or indirectly by phosphorous causing algal blooms.

Transfer of water to the Grants open pit void is the primary water management measure that will minimise potential for significant off-site impacts to surface water quality associated with surplus water management. The Grants Project groundwater model (submitted with the Grants Lithium Project EIS) indicates that the pit acts as a groundwater sink and so water stored in the pit is not predicted to pose a contamination risk to the surrounding aquifer. Further to this, the contaminants of concern are naturally occurring in the groundwater and so the concern relates only to their potential release to surface watercourses.

The use of the water for dust suppression and irrigation to land is not predicted to affect surface water or groundwater quality. The water quality results from baseline studies, summarised in section 4 above, indicates the water will meet the irrigation water quality trigger values outlined in *Chapter 4 Primary Industries* of the ANZECC (2000b) guidelines. To avoid run-off from land application areas, the water balance model assumes that dust suppression water will only be applied on days when rainfall is less than evaporation and the irrigation area requirements and rates were calculated using Food and Agricultural Organisation guidelines⁵.

Controlled release of water to the watercourse will only occur during the wet season and at times when there is sufficient rainfall and surface water flows in the watercourse to achieve the dilution factors required to meet the surface water SSGVs for arsenic and total phosphorous defined in section 8.2.6. Dewatering will be directed to the MSD where water quality will be tested and mine contaminants (hydrocarbons and sediments) removed so that the majority of water can be reused for dust suppression, irrigated to land or transferred to the Grants open pit void, without posing a risk to off-site surface water or groundwater quality. This strategy minimises discharge volumes and is expected to effectively limit release contaminants to the watercourse.

⁵ Crop evapotranspiration - Guidelines for computing crop water requirements - FAO Irrigation and drainage paper 56.

7 MANAGEMENT MEASURES

Table 7-1 documents the management measures using the environmental management hierarchy that will be implemented to reduce construction/operations phase risks to hydrological processes and water quality. A monitoring program for surface water and groundwater is detailed in section 8 below.

Table 7-1. Hydrological processes and water quality avoidance, mitigation, and monitoring measures

Potential impact	Avoidance	Mitigation	Monitoring
Alteration of surface water flows due to extraction and discharges	• Mine water management system designed to ensure all surplus water can be contained so that no releases occur to watercourses in the dry season. • A contour drain will be installed to divert overland flows away from the box cut, which will reduce dewatering and discharge requirements and maintain overland flows.	• Extraction from OHD will be minimised by reusing inflows dewatered from the mine as the primary water source. • Stormwater drainage and sediment dams will be designed to capture, treat and release clean water off site as overland flows. • Controlled discharge to the watercourse east of the mine site will be limited to periods of high flow due to the dilution factors required to meet site specific guideline values for water quality.	• Extraction from OHD will be metered and reported in accordance with the conditions of a Water Extraction Licence. • Water use on site will be metered and monitoring undertaken to assess water use efficiency. • A flow gauge will be installed to record surface flows on the drainage line downstream of OHD and mine site. • Discharges will be subject to a Waste Discharge Licence and volumes will be monitored and reported in accordance with the licence conditions.
Groundwater drawdown due to mine dewatering	• Not applicable	• Long-term impacts to groundwater will be limited by backfilling the mine allowing groundwater levels to recover to pre-mining conditions.	• Groundwater levels will be continuously monitored in all bores using Troll loggers – refer section 6.1.2 to verify extent of drawdown cone.
Elevated turbidity in surface water courses downstream due to releases and discharges.	• Mine design includes internal drainage network, storage dams and sediment dams that capture all mine-affected water and avoid uncontrolled release off-site.	• Sediment basins designed and operated according to <i>Best Practice Erosion and Sediment Control Guidelines</i>. • Mine-affected water reports to the MSD for removal of sediments and other contaminants prior to re-use or discharge.	• Monitoring as per section 8). • Internal storage dams and sediment dams monitored for turbidity, prior to any controlled release and weekly during the wet season.
Elevated metals concentrations in groundwater caused by seepage from WRD, ROM pad and/or underground mine post-closure	• WRD and ROM pads constructed of low permeability material. • Drains installed to capture run-off and divert to MSD if contaminants present. • The mine closure concept involves backfilling all waste rock, which when completed will eliminate the WRD's as a source of contamination.	• A risk-based approach consistent with the GARD Guide, will use the results of long-term kinetic testing to inform development of prevention and mitigation measures required in the detailed mine design to prevent metalliferous mine drainage.	• Monitoring as per section 8). • Weekly sampling of internal water storages. • Weekly sampling of downstream surface water in the wet season • Quarterly sampling of groundwater bores.

Potential impact	Avoidance	Mitigation	Monitoring
Elevated metals and phosphorous in surface water from controlled discharge of surplus water	• Surplus water volumes will be minimised by re-use of inflows dewatered from the mine for dust suppression. • Majority of surplus transferred to the Grants open pit void once mining ceases there. • Irrigation area used to dispose of excess water during periods when watercourses are under no or low flow conditions.	• All mine-affected water will report to onsite storages for water quality testing to confirm suitability for reuse or off-site discharge. • If SSGV's specified in the draft WMP (refer section 8.2.6) not met, the water will be contained and treated⁶ prior to reuse or discharge. • Dust suppression and irrigation will only occur when daily rainfall is less than evaporation. • Irrigation area/s will be delineated by land suitability assessment in accordance with the <i>NT Land Clearing Guidelines</i> and an irrigation management plan will be developed and implemented to ensure site soils and water balance are maintained. • Discharge to the watercourse east of the mine site will only occur when flows are sufficient to achieve dilution factors for arsenic. • A Waste Discharge Licence will be obtained under the <i>Water Act</i> and discharges will be managed to comply with the licence conditions.	• Monitoring as per section 8). • MSD sampled prior to any controlled release and weekly during the wet season. • Weekly sampling of downstream surface water in the wet season.

7.1.1 Measures to minimise water use and discharge

Water use and discharges will be minimised by re-use of water dewatered from the underground mine for dust suppression (underground and above ground) and as a water supply for the mining operations. Once mining ceases at the Grants open pit, any excess water from BP33 can be pumped to Grants for storage and reuse. Excess water that cannot feasibly be contained on site will be treated to remove sediments and other contaminants (if required), prior to discharge to a land irrigation area and/or watercourse (management options for excess water are discussed in subsequent sections below). Discharges will be authorised under the Mining Authorisation and a Waste Discharge Licence will be required for discharge to water during the wet season.

7.1.2 Management and treatment of mine site discharges

All mine-affected water will be contained in onsite storages, tested and treated (if required) to meet the SSGV's documented section 8) prior to re-use or disposal using the surplus water management strategies detailed in section 2.5.3. Mine-affected water transferred to the MSD will require treatment to remove sediment and hydrocarbons introduced by the mining activities, and potentially to reduce the naturally elevated Total Phosphorous concentrations present in the groundwater compared to surface water. Treatment to reduce naturally elevated arsenic concentrations is not required based on the current water balance model, because the majority of water can be managed using strategies that do not require release to surface water, but arsenic treatment may be investigated to provide a wider range of water management options. The adopted guideline

⁶ Treatment is expected to involve sediment and hydrocarbon removal at minimum. Phosphorous removal by flocculants may be required as indicated by the baseline water quality. Arsenic treatment is not required as part of the current water balance model, but may be investigated to increase water management options.

values for key contaminants of concern that will be adopted for water released to surface water, and water used for dust suppression/irrigation are provide in Table 8-4 below.

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8 MONITORING PLAN

8.1 Overview

This monitoring plan outlines the surface water, groundwater and riparian vegetation monitoring to be undertaken during and after mining. Monitoring aims to provide early warning and trigger management actions for mitigating impacts to surface waterways, groundwater aquifers and the ecosystems that depend on them.

Sections 4 and 5 presented the results of baseline (pre-mining) surface and groundwater quality monitoring undertaken since 2017 for surface water and 2020 for groundwater. Section 3.3.2 outlined the results of a baseline riparian vegetation survey. These baseline results are used to design the ongoing monitoring programs and to define assessment criteria and site-specific guideline values (SSGVs).

This monitoring plan will be updated regularly throughout operations to reflect on-ground activities as mining progresses. It will also support the project's Waste Discharge Licence (WDL) application to allow discharge from the MSD. Once the WDL is issued, this plan will be updated to reflect all WDL monitoring and reporting requirements.

8.2 Surface water monitoring program

Surface water monitoring aims to:

- Detect any contaminants, at an early stage, originating from mining operations entering drainage lines and waterways. Potential contaminant sources considered in the monitoring program include:
 - o WRD seepage
 - o Groundwater/direct rainfall dewatered from the mining operations
 - o Flocculants/chemicals used to treat water in sediment dams or MSD prior to discharge
 - o Sediment-laden runoff from the sediment dams or other areas of the mine site
 - o Fuel or chemical spills/leaks
 - o Seepage from sewage wastewater system (not relevant if a 'no release' system is adopted)
- Detect any secondary effects on waterways from physical stressors, such as alteration of surface water flows, excess nutrient and organic matter inputs from mine run-off/discharge causing eutrophication and algal blooms.
- Monitor contaminant levels in box-cut and underground water being pumped to MSD for guiding the need to treat this water, and the type of treatment required prior to its use in dust suppression or discharge to the environment.
- Verify the water quality in mine site storages e.g. MSD and sediment basins meets the discharge criteria prior to release or use in dust suppression. This includes verification sampling following any water treatment with flocculants/chemicals etc to ensure contaminant levels meet discharge criteria prior to release.

8.2.1 Surface water quality monitoring sites

Proposed surface water monitoring sites are shown in Figure 8-1 and detailed in Table 8-1. All existing baseline surface water monitoring sites will be retained except for BP33 Pit, as on-going water quality monitoring of this pit will not provide any further information for detecting or assessing impacts from the mine.

Internal mine monitoring sites that will be added to the program following construction of mine site infrastructure include sediment basins and MSD. Monitoring of these sites aims to ensure that water quality meets the required assessment criteria prior to discharge or use in dust suppression. Weekly sampling of the MSD and sediment basins during the wet season (November – April), even when not discharging, will also guide

implementation of any treatment measures or management actions needed to improve input water quality or contained water quality.

Monitoring of OHD and the two sites downstream of OHD (BPUS SW1 and BPDS SW2) will continue. Two additional site upstream sites will be added on the eastern side of the mine (BPUS SW4 and BPUS SW5) to provide upstream data for the BP33 mine site. BPUS SW5 will replace BPUS SW1 reference site which may be impacted by controlled release of mine affected waters from the MSD when operational. The indicative discharge point shown in Figure 8-1. The other additional site (BPUS SW4) will provide upstream water quality from the waterway feeding into the eastern stream will also be established as a reference site that is not directly impacted by OHD. The water quality of OHD is required to know the incoming water quality of water supplied to the mine. Monitoring of BPDS SW2 and BPUS SW5 aims to detect any downstream impacts from OHD water extraction. These two sites, and BPUS SW4 will also be used to determine any potential impacts to the waterway from BP33 mine operations. BPUS SW5 (replacing BPUS SW1) located upstream of the mine, and will be used as a reference site, and BPDS SW2 is downstream of the mine. Additional downstream site on the waterway on the western side of the mine (BPDS SW3) will also be established to monitor any potential impacts on this waterway from the western portion of the mine footprint.

8.2.2 Sampling frequency

Sampling frequency will be undertaken as per that outlined in Table 8-1.

8.2.3 Sampling methods

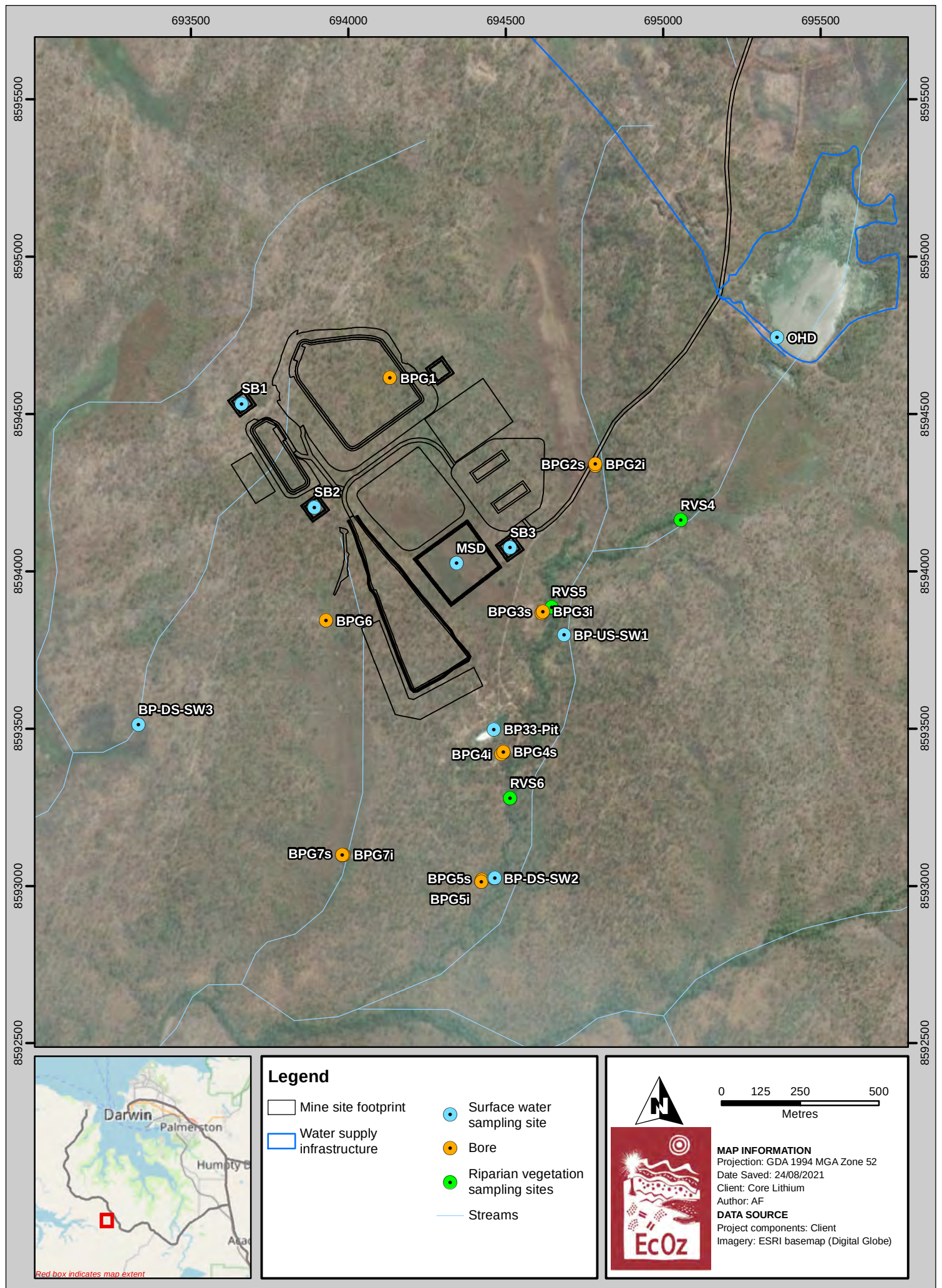
All surface water quality monitoring must be undertaken by qualified professionals in accordance with:

- ANZECC (2000a), *Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy Paper No 4*, Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), Canberra.
- ANZECC (2000b), *Australian Guidelines for Water Quality Monitoring and Reporting, National Water Quality Management Strategy Paper No 7*, Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), Canberra.
- AS/NZ Standards 5667:1998 - *Water Quality Sampling Parts 1, 4, 6, 10 and 11*.

All hand-held field parameter meters must be calibrated immediately prior to commencing sampling, and all sample collection for laboratory analysis must be into the appropriate laboratory-supplied bottles and handled in accordance with the standards listed above. Samples must be kept cool in eskies until delivered to the laboratory, and all samples delivered to laboratory within required holding times. All laboratory samples will be analysed by a NATA accredited laboratory.

Table 8-1. Surface water quality monitoring site details

Catchment	Site ID	Site Name	New/ Existing Site	Location	Purpose	Sampling Frequency
Eastern drainage	OHD	Observation Hill Dam	Existing	Surface water storage upstream of BPUS SW1	Monitor water quality of water supply for mine site.	Monthly
	BPUS SW1	BP33 Upstream Surface Water 1 (indicative future discharge monitoring point)	Existing	Downstream of OHD but upstream of BP33 mine site. Indicative future discharge point proposed for this location.	Previously was the reference site for upstream of any BP33 mine site impacts. Monitor impacts from controlled release from BP33 into drainage line.	Monthly: during wet season (Nov – Apr)
	BPDS SW2	BP33 Downstream Surface Water 2	Existing	Downstream of OHD, BPUS SW1 and BP33 mine site (eastern side).	Monitor impacts from OHD water extraction on downstream waterways. Is also located downstream of BP33 mine site operations and used to monitor potential impacts from MSD, ROM pad, box-cut, WRD's and contractor's area.	
	BPUS SW4	BP33 Upstream Surface Water 4	New	Upstream of BP33 mine site (not downstream of OHD).	New reference site for upstream of any BP33 mine site impacts.	
	BPUS SW5	BP33 Upstream Surface Water 5	New	Downstream of OHD but upstream of BP33 mine site	Monitor impacts from OHD water extraction on downstream waterways.	
Western drainage	BPDS SW3	BP33 Downstream Surface Water 3	New	Downstream of BP33 mine site (western side).	Located downstream of BP33 mine site operations and used to monitor potential impacts from WRDs.	
Mine footprint	MSD	Mine Settlement Dam	New	Eastern side of mine site. Receives water dewatered from box-cut and underground.	Monitor water quality in sediment basins/MSD to ensure they meet assessment criteria prior to release. For guiding any water quality treatment measures required prior to release or management actions to improve input water quality.	Prior to any controlled release field parameters are to be measured to confirm water quality meets discharge criteria <u>Weekly</u> field parameters during wet season (Nov – Apr) regardless of discharge <u>Weekly</u> lab parameters when discharging from either MWD1 and/or sediment basins. <u>Monthly</u> lab parameters during wet season (Nov – Apr) regardless of discharge
	SB1, SB2, SB3	Sediment Basins 1, 2 and 3	New	At end of stormwater drains across the site prior to discharge offsite		



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Figure 8-1. Map of ongoing groundwater, surface water and riparian vegetation monitoring sites

8.2.4 Parameters measured

Table 8-1 outlines the field and laboratory parameters measured at all sites during all sampling rounds. This is except for the extended metals suite (both total and dissolved) comprising 12+ metals (additional to the usual 11 metals suite) to be analysed annually.

These parameters aim to allow the detection of all identified surface water quality-related impacts discussed in the preceding sections of this WMP. Notes on field conditions must also be recorded whilst sampling at each site as listed in Table 8-2, and photos taken.

Table 8-2. Surface water and groundwater quality field and laboratory parameters and field notes

Field Parameters	Laboratory Parameters
- pH (pH units) - Electrical Conductivity (µS/cm) - Total Dissolved Solids (mg/L) - Turbidity (NTU) - Temperature (°C) - Oxidation Reduction Potential (mV) - Dissolved Oxygen (%saturation) - Standing water level (mBGL) for groundwater	- Nutrients (ammonia, NO_x (nitrate+nitrite), total nitrogen, total phosphorus, reactive phosphorus) - Dissolved and total metals (Al, As, Cd, Cr, Cu, Fe, Li, Hg, Pb, Ni, Zn) - Dissolved and total metals extended suite of 12+ metals in addition to the above (annually) - Major anions (sulfate, chloride, alkalinity), Major cations (calcium, magnesium, sodium, potassium) - Hydrocarbons (TPH/TRH, BTEXN) - Hydrogen sulphide (groundwater only) - Any constituents contained within the flocculants/chemicals used to treat water in the sediment basins, MWD1, ore processing or tailings thickening – to be identified and added to monitoring program in coming months.
Field Notes	
- Sampler Name/s - Date and Time - Weather conditions - Flow conditions, spillway flowing etc, note pumping rate for groundwater - Any visible pollutants, algae, water plants, fish, other biota - Water clarity - Any odour - Any dieback or visible impacts to riparian vegetation - Take photos	

8.2.5 Water volumes monitoring

The following list outlines the water volumes that will be measured continuously and recorded in a database to inform updates to the water balance, and assess if targets for water consumption minimisation are being met and where improvements can be made.

- Underground water removed through dewatering and pumped to MSD
- Water inflows from ROM Pad and WRD into sediment basins
- Water pumped from OHD to RWD
- Water pumped from RWD to mine office / workshops etc for domestic and ablutions
- Water used from RWD to standpipe for vehicle wash-down and onsite dust suppression
- Water used from MSD for dust suppression
- Rain gauge for recording daily rainfall on site

8.2.6 Surface water assessment criteria

Downstream surface water SSGVs

Table 8-3 lists the SSGVs to apply to the surface water sites downstream of the mine footprint i.e. BPDS SW2 and BPDS SW3. These SSGVs are based on the baseline surface water concentrations, as outlined in Section 4 above.

MSD discharge water quality criteria

Discharge water quality from the MSD will aim to meet the criteria in Table 8-3. Treatment will be undertaken of the water prior to release if initial water quality does not meet this criteria. Verification testing after treatment must be undertaken to ensure criteria is met prior to release. It is expected that for some parameters it may not be possible to meet the SSGV i.e. arsenic, TP and EC (see Section 5.5 above). A water management strategy is currently being developed to manage these risks (see Section 9 below).

Dust suppression and irrigation water quality criteria

The quality of water used from the MSD for dust suppression and irrigation must meet the irrigation water quality trigger values as outlined in Chapter 4 *Primary Industries* of the ANZECC (2000a) guidelines. This includes for metals the 'short-term trigger values' in Table 4.2.10 of ANZECC (2000a), for salinity and sodicity the approach outlined in section 4.2.4 of ANZECC (2000a), and the 'short-term trigger values' for nitrogen and phosphorus in Table 4.2.11 in ANZECC (2000a); noting the requirement for site-specific assessment as outlined in Volume 3, Section 9.2.6, ANZECC (2000c).

Sediment basin discharge water quality criteria

As outlined above in Section 2.7, turbidity in the sediment basins will be reduced as much as possible, but final discharge from the sediment basins is not always expected to achieve the very low turbidity levels in the receiving drainage lines. As such, the discharge standard recommended for sediment basins in IECA (2008) is adopted:

90th percentile NTU reading not exceeding 100, and 50th percentile NTU reading not exceeding 60

Once discharged, the turbidity of water from the sediment basins is expected to reduce rapidly with dilution in the receiving drainage lines, combined with the filtering effect of the vegetation growing within the drainage lines. The assessment criteria outlined in Table 8-3, applying to all routine surface water monitoring sites downstream of the mine will still apply for turbidity.

Table 8-3. Surface water site-specific guideline values

Parameter	SSGV	Source
pH	5.2 – 7.3	20 th percentile and 80 th percentile of background data
EC	26 µS/cm	80 th percentile of background data
Turbidity	14 NTU	80 th percentile of background data
DO	50 – 100%sat	20 th percentile and 80 th percentile of background data
TN	0.3 mg/L	80 th percentile of background data
TP	0.02 mg/L	80 th percentile of background data
<i>E. Coli</i>	4,320 CFU/100mL	80 th percentile of background data
Enterococci	1060 CFU/100mL	80 th percentile of background data
Aluminium	0.10 mg/L	80 th percentile of background data
Arsenic	0.013 mg/L	ANZG (2018) 95% species protection, freshwater
Cadmium	0.0002 mg/L	ANZG (2018) 95% species protection, freshwater
Chromium	0.004 mg/L	ANZG (2018) 95% species protection, freshwater

Parameter	SSGV	Source
Copper	0.0014 mg/L	ANZG (2018) 95% species protection, freshwater
Iron	0.33 mg/L	80 th percentile of background data
Lead	0.0034 mg/L	ANZG (2018) 95% species protection, freshwater
Lithium	0.43 mg/L	Ecotoxicity Assessment, see Grants WMP
Mercury	0.0006 mg/L	ANZG (2018) 95% species protection, freshwater
Nickel	0.011 mg/L	ANZG (2018) 95% species protection, freshwater
Zinc	0.008 mg/L	ANZG (2018) 95% species protection, freshwater
Hydrocarbons	Remain below detection limits	Background data

Table 8-4 summarises the assessment criteria and corrective actions that will be implemented to protect water quality and flows in the downstream watercourses. Assessment criteria and SSGV's that will protect the downstream ecosystems were derived from pre-mining baseline results from surface and groundwater quality monitoring.

Table 8-4. Summary of assessment criteria and corrective actions for surface water quality and flows

Monitoring	Assessment criteria/SSTV's	Response
Observation Hill Dam (OHD)	Australian Drinking Water Guidelines	• Treatment through Reverse Osmosis plant
Raw Water Dam (RWD)	Australian Drinking Water Guidelines	• Investigate issues with treatment system. • Import potable water until treatment issues resolved.
Sediment basins	IECA (2008) discharge standard - 90th percentile NTU reading not exceeding 100, and 50th percentile NTU reading not exceeding 60	• Increase retention time, addition of flocculants or physical filtering • Identify sources of sediment loads and rectify. Install sediment controls in internal drainage network. • Clean out sediment basins • Transfer water to alternative storages – i.e. MSD or Grants open pit void.
Mine Settling Dam (MSD)	As per surface water below. Irrigation water quality trigger values Chapter 4 Primary Industries of the ANZECC (2000b) Compliance with WDL conditions	• Treatment to remove sediments, hydrocarbons and phosphorous. • Review release criteria to ensure dilution factors achieved in watercourse. • Send to irrigation area or Grants open pit void if surface water criteria not met.
Surface water	Toxicants = ANZG (2018) 95% species protection guideline values Physical, bacteriological and metals with no GV = 80 th percentile of baseline data Lithium = 0.43 mg/L based on ecotoxicological testing Hydrocarbons = below detection limits Sediments = as per above	• Decrease discharge volumes • Check flow gauge station is providing accurate reading of flow volumes in watercourse • Review release criteria and procedures • Visually inspect mine site to identify diffuse contamination sources. • Sample sites further downstream to record extent of contamination. • Report to regulators in accordance with approval and licence conditions. • Increase sampling frequency to weekly until issue resolved.
Monitoring of water extraction volumes from OHD	Volumes greater than predicted in water balance model (i.e. 4ML/month during the BP33 production phase)	• Review site water use efficiency. • Check that water reuse is being maximised.
Monitoring of downstream surface flows by automatic gauging station	Not applicable. Data to inform causation assessment if impacts to riparian vegetation are detected.	• Review site water use efficiency. • Check that water reuse is being maximised.

Monitoring	Assessment criteria/SSTV's	Response
Monitoring of water use across the mine site (refer draft WMP Appendix C section 7.2.5)	Water use greater than forecast in the site water balance model (i.e. 2.6ML/day for BP33)	- The risks to the environment and other water users will be re-assessed and mitigation measures identified as part of the annual Mine Management Plan reporting and review process. - Annual riparian vegetation condition monitoring to assess ecosystem response to reduced groundwater availability. - If monitoring identifies an impact to riparian vegetation, then the Mine Closure Plan will include post-mining reinstatement of habitat values in the affected areas and monitoring of ecosystem recovery.

8.3 Groundwater monitoring program

8.3.1 Groundwater monitoring bores

The groundwater monitoring bores used for baseline monitoring (as detailed in Table 5-1 and shown in Figure 4-1) will remain in place and continue to be monitoring during and after mining.

8.3.2 Sampling frequency

All bores will be sampled quarterly until the commencement of mining to improve understanding of baseline groundwater quality. This monitoring frequency will continue throughout the life of the mine and also afterwards for a period of time yet to be determined.

Sampling will then be undertaken quarterly throughout operations and post-closure until all rehabilitation criteria specified in the *Mine Closure Plan* is achieved.

Continuous SWL measurement is currently undertaken in all bores using Troll loggers. This will continue throughout operations and post-closure until all rehabilitation criteria specified in the *Mine Closure Plan* is achieved.

8.3.3 Parameters measured

Table 8-1 outlines the field and laboratory parameters measured in all bores during all sampling rounds. This is except for the extended metals suite (both total and dissolved) comprising 12+ metals (additional to the usual 11 metals suite) to be analysed annually.

These parameters aim to allow the detection of all identified groundwater quality-related impacts discussed in the preceding sections of this WMP. The continuous measurement of groundwater levels using Troll loggers in all bores will also allow detection of any groundwater mounding associated with the WRD, MSD or any other water storages on site; also any potential reduction in groundwater inflows to ephemeral streams from groundwater drawdown around the underground mine.

8.3.4 Sampling methods

All groundwater quality monitoring must be undertaken by qualified professionals in accordance with the standards:

- ANZECC (2000a), *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, National Water Quality Management Strategy Paper No 4, Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), Canberra.

- ANZECC (2000b), *Australian Guidelines for Water Quality Monitoring and Reporting, National Water Quality Management Strategy Paper No 7*, Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), Canberra.
- AS/NZ Standards 5667:1998 - *Water Quality Sampling Parts 1, 4, 6, 10 and 11*.

Bore pumping to obtain samples must ensure representative aquifer samples are obtained i.e. low-flow pumping, or purging to remove all stagnant water within the bore prior to sampling.

All hand-held field parameter meters must be calibrated immediately prior to commencing sampling, and all sample collection for laboratory analysis must be into the appropriate laboratory-supplied bottles and handled in accordance with the standards e.g. samples kept cool in eskies until delivered to laboratory, and all samples delivered to laboratory within required holding times. All laboratory samples will be analysed by a NATA accredited laboratory.

8.3.5 Assessment criteria

Table 8-5 lists the SSGV's for assessing ongoing groundwater monitoring results during and after mining. The aim of monitoring is for groundwater quality to remain unchanged from pre-mining condition. As such, all SSTV's are derived from the 80th percentile of background data (and also 20th percentile in the case of pH).

Separate SSGV's are specified for the shallow bore (screened at depths less than 36 mBGL) and deeper bores, given the differing water quality of these systems.

Table 8-5. Groundwater site-specific guideline values

Parameter	SSGV shallow bores	SSGV deeper bores
pH	4.8 – 5.6	6.4 – 6.8
EC	90 µS/cm	275 µS/cm
TN	0.3 mg/L	<0.1 mg/L
TP	0.07 mg/L	1.26 mg/L
<i>E. Coli</i>	<1 CFU/100mL	<1 CFU/100mL
Enterococci	<1 CFU/100mL	<1 CFU/100mL
Aluminium	0.02 mg/L	0.10 mg/L
Arsenic	0.005 mg/L	0.220 mg/L
Cadmium	<0.0001 mg/L	<0.0001 mg/L
Chromium	<0.001 mg/L	<0.001 mg/L
Copper	0.002 mg/L	<0.001 mg/L
Iron	0.06 mg/L	1.59 mg/L
Lead	<0.001 mg/L	<0.001 mg/L
Lithium	0.090 mg/L	0.699mg/L
Mercury	<0.0001 mg/L	<0.0001 mg/L
Nickel	<0.006 mg/L	<0.001 mg/L
Zinc	0.031 mg/L	0.010 mg/L
Hydrocarbons	Remain below detection limits	Remain below detection limits

Table 8-6 summarises the assessment criteria and corrective actions that will be implemented to minimise impacts to groundwater quality and levels as far as is practicable. Assessment criteria and SSGV's that will protect the aquifer and downstream ecosystems were derived from pre-mining baseline results from groundwater quality and levels monitoring.

Table 8-6. Summary of assessment criteria and corrective actions for groundwater quality and levels

Monitoring	Assessment criteria/SSTV's	Response
Groundwater bores	Derived from the 80th percentile of background data. Separate SSTV's derived for shallow and deep bores.	• Investigate source of contamination based on contaminants of concern and bore location. • Implement mitigation measures at source if possible. • Assessment of plume extent and fate by qualified hydrogeologist. • Implement controls at receptors if modelling indicates potential impact. • Report to regulators in accordance with approval and licence conditions.
Continuous water level logging and quarterly sampling of water levels in 13 groundwater monitoring bores	Drawdown in bores closest to the riparian zone (i.e. BPG3, BPG5) greater than predicted by groundwater model.	• The risks to the environment and other water users will be re-assessed and mitigation measures identified as part of the annual Mine Management Plan reporting and review process.

8.4 Riparian vegetation monitoring

Riparian vegetation monitoring will be undertaken annually at the same time of the year that baseline surveys were conducted i.e. March for drone surveys and June for the vegetation plot survey. Drone imagery will define the boundary and total area of the riparian vegetation community and compare the extent to that found in EcOz (2019). Vegetation plot surveys will also be undertaken at each of the baseline survey sites RVS4, RVS5 and RVS6. Based on modelling of groundwater drawdown, it is expected that groundwater will be below the depth accessible by the riparian vegetation to the east and south of the mineral leases for up to approximately five years.

When analysing the results of future drone surveys against the baseline dataset, any significant retraction in riparian vegetation patch boundaries should trigger further assessment to determine the extent and potential cause of impact i.e. is the change confined to the impacted watercourse or occurring more broadly. This may require re-survey of vegetation plots to determine if there has been a change in vegetation structure and composition in response to vegetation boundary impacts.

Changes in vegetation structure and composition along the landward edge may indicate changes in surface and or groundwater flows entering those communities. However, further contextual assessment will be required as these changes could also occur because of bushfire and weed invasion unrelated to the project activities.

The monitoring program for riparian vegetation will be undertaken throughout the mining operations and post closure.

8.5 Monitoring results recording and reporting

All results from surface water and groundwater quality monitoring will be entered into the *Core Lithium Surface Water and Groundwater Quality Monitoring Database* (Excel spreadsheet), which has already been established and is populated with the baseline monitoring results collected to date.

Similarly, riparian vegetation monitoring results will be recorded into a database already set up with the baseline survey results.

Reporting requirements will align with those required for annual MMP reporting and the reporting required for the WDL once established.

9 INFORMATION/KNOWLEDGE GAPS

This draft WMP has been prepared based on the preliminary mine site design and operational assumptions, consistent with the current stage of mine planning. Throughout the document, information and knowledge gaps have been identified that require further work to inform the development of risk management strategies. Information and knowledge gaps and actions proposed to address these are summarised in Table 9-1 below.

Table 9-1. Information/knowledge gaps, how and when they will be addressed

Information/knowledge gap	Work required	Timing
Toxicant (metal) concentrations in seepage from temporary WRDs	Long-term kinetic testing results to determine if specific design controls required on WRDs and/or ROM to capture and treat contaminated water. Provide detailed WRD and ROM designs in MMP. Provide details of water treatment in MMP. Incorporate contaminants of concern and monitoring locations into surface water monitoring program (if required).	Testing commenced in July 2021 and will be complete July 2022.
Water management system	Detailed feasibility assessment of the water storage, treatment and disposal options identified in the site water balance study – refer Table 9-2 below. Detailed design of site water management system and update the draft Water Management Plan.	Prior to submission of MMP.
Forecast v actual water use	Install automated flow gauges to monitor extraction from OHD and MSD.	Prior to extraction of water – forecast TBC.
	Install automated flow gauges to record water use across the mine site for mining operations and dust suppression (surface and underground).	Progressively as mine site is constructed.
	Review forecast versus actual water use	End of each year of operations as part of annual reporting.
	Establish water use targets and actions	End of year 1. Review annually.

9.1 Water management system – options under consideration

Large volumes of water will need to be dewatered from the box-cut and underground workings to allow mining operations to occur. Section 2.5 of this WMP provides details of water management strategies and forecast surplus water volumes. Water will be pumped to the MSD storage and used as a water supply for the mine operations, which will minimise the need to extract water from OHD and will account for most of the site water inflows. However, there will still be water surplus to the mine requirements. Table 9-2 lists the options identified for managing this water and provides details of the further work required to inform detailed design of the site water management system.

Table 9-2. Management of surplus water strategies

Water management system options	Information considered	Uncertainties / information gaps
Transfer of MSD water via a pipeline to Grants pit	• BP33 start up mining schedule commencement May 2023. • Grants mining schedule ceases October 2024. • 16-months overlap of BP33 start up with Grants mining schedule. • No water will be pumped into the Grants pit until Grants mining ceases after October 2024. • Modelling predicts the Grants pit void has capacity to store the excess groundwater inflow from the MSD. • Reuse of water in processing facility. • Estimated volumes of 60-180ML/month will require pumping to the pit to fully dewater the underground (base case).	• Investigate feasibility of daily pumping rate to Grants pit
Irrigation to woodland environment and/or suitable infrastructure (i.e. temporary WRDs) during start-up phase of BP33 (prior to completion of Grants pit mining)	• Irrigation used during 16-month mining schedule overlap between BP33 and Grants operations. • Modelling proposed an excess of 120 ML to 210 ML to be managed over of the 16-month period (May 2023 to October 2024). • Irrigation area of 20ha would be sufficient to manage surplus water (base case) during medium climatic conditions.	• Investigate the suitability of this water management system is for the proposal.
Controlled discharge of water from MSD during the wet season	• Arsenic concentration in groundwater is naturally high. • A target dilution ratio for discharge into receiving waters is expected between 1:17 to 1:12, part MSD water and part receiving water, based on the median arsenic groundwater concentration at the BP33 underground location. • Modelling predicts up to 25ML/month could be released during median wet season climatic conditions, and up to 105ML/month during very wet climatic conditions. • Treatment options (for arsenic) of water can be applied if dilution ratio cannot be attained.	• If dilution ratio cannot be achieved in stream, investigate treatment options of water, to discharge water.
Additional internal water storage capacity	• 16-months overlap of BP33 start up with Grants mining schedule. • Base case groundwater inflows with wet climatic conditions identified an additional 120ML of storage in the MSD would be required if irrigation was not sufficient due to increased non-irrigation days. • If combination groundwater inflows follow the predicted upper bound groundwater case up to 320ML will be required for storage.	• Investigate if increase on internal water storages is possible in the current footprint. • Investigate if pumping rate to Grants pit can be increased.
Evaporator fans at Grants pit	• Increase water disposal opportunities in the Grants pit.	• Practicality of setting up evaporator fans in pit.

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APPENDIX A BASELINE SURFACE WATER AND GROUNDWATER QUALITY RAW DATA

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Site	Date Sampled DD/MM/YY	Time								
			pH	Temp	ORP	EC	TDS	Salinity	DO	Turbidity
			pH unit	°C	mV	µS/cm	mg/L	ppt	%sat	NTU
Water Quality Objectives Darwin Harbour Reg			6.0-7.5			200			50-100	20
BP33 PIT	15/02/2017	12:50	6.91	31.2	288	23.9	15.6	0.00	96	3.4
BP33 PIT	19/04/2017	10:25	6.65	30.7	272	18.8	10.0	0.01	98	0.6
BP33 PIT	12/10/2017	11:30	7.33	32.3	210	22.6	15.0	0.01	82	3.2
BP33 PIT	1/02/2018	13:35	8.90	29.9	131	26.2	17.3	0.01	100	8.4
BP33 PIT	14/03/2018	11:40	8.27	32.7	159	17.1	11.1	0.00	69	1.8
BP33 PIT	3/05/2018	10:07	7.64	30.8	117	20.7	13.7	0.01	35	1.9
BP33 PIT	8/08/2018	12:43	8.18	26.5	-15	22.1	14.3	0.01	94	1.9
BP33 PIT	18/12/2018	9:00	7.84	34.0	279	20.6	13.3	0.01	110	0.0
BP33 PIT	14/02/2019	11:15	6.65	34.1	175	24.1	14.6	0.01	85	2.4
BP33 PIT	17/12/2020	11:15	7.10	31.6	39	30.3	19.5	0.01	91	7.7
BP33 PIT	21/01/2021	9:30	6.03	32.0	80	28.4	18.2	0.01	83	2.7
BP33 PIT	9/02/2021	9:30	6.78	29.3	53	24.9	16.3	0.01	78	4.6
BP33 PIT	23/03/2021	9:00	6.29	31.3	51	27.2	17.6	0.01	69	2.9
BP33 PIT	24/06/2021	10:00	6.45	27.6	106	27.1	17.5	0.01	66	8.2
BP33 PIT	22/07/2021	7:25	7.11	26.3	246.5	28.5	18	0.01	93	1.4
BPDS SW2	15/02/2017	12:25	5.06	27.9	437	15.3	10.0	0.00	82	3.2
BPDS SW2	19/04/2017	10:00	5.49	27.5	306	17.7	10.0	0.01	70	2.2
BPDS SW2	12/10/2017	Dry								
BPDS SW2	1/02/2018	13:54	7.84	28.0	243	16.6	10.3	0.01	85	5.6
BPDS SW2	14/03/2018	12:00	7.26	25.0	169	16.6	10.8	0.00	54	3.7
BPDS SW2	3/05/2018	10:28	6.67	26.6	145	24.4	15.6	0.01	41	2.1
BPDS SW2	14/02/2019	10:45	5.52	29.3	209	49.5	31.9	0.02	12	12.7
BPDS SW2	28/03/2019	10:35	5.54	27.2	378	31.9	21.0	0.01	66	13.9
BPDS SW2	21/01/2020	11:34	5.41	26.4	237	16.2	11.0	0.01	83	23.6
BPDS SW2	26/03/2020	9:26	5.47	27.5	264	22.1	14.0	0.01	78	4.6
BPDS SW2	23/12/2020		5.47	26.7	375	21.1	14.0	0.01	82	24.8
BPDS SW2	13/01/2021	12:00	7.30	29.3	218	20.0	13.1	0.00	92	20.4
BPDS SW2	10/02/2021	9:30	5.58	28.2	100	15.9	10.4	0.01	75	7.6
BPDS SW2	17/03/2021	11:55	4.54	28.2	133	15.8	10.4	0.01	73	5.4
BPUS SW1	15/02/2017	13:25	6.46	27.7	324	14.6	9.5	0.00	84	3.3
BPUS SW1	19/04/2017	10:55	5.45	27.5	308	18.2	10.0	0.01	72	2.0
BPUS SW1	12/10/2017	Dry								
BPUS SW1	1/02/2018	13:02	7.78	27.6	270	14.0	9.1	0.00	85	4.6
BPUS SW1	14/03/2018	12:25	7.24	25.1	173	15.7	10.2	0.00	73	3.9
BPUS SW1	3/05/2018	9:53	7.42	26.4	118	26.4	16.9	0.01	34	5.0
BPUS SW1	14/02/2019	10:00	5.42	29.0	186	47.4	30.7	0.02	12	
BPUS SW1	28/03/2019	10:03	5.52	27.2	358	27.5	18.0	0.01	66	12.1
BPUS SW1	21/01/2020	11:19	5.40	27.0	231	14.4	9.0	0.01	84	17.2
BPUS SW1	26/03/2020	9:00	5.61	27.6	264	22.1	14.0	0.01	78	4.6
BPUS SW1	23/12/2020		6.72	26.5	32	20.2	13.0	0.01	79	11.7
BPUS SW1	21/01/2021	8:30	5.09	28.9	108	23.2	15.0	0.01	75	6.8
BPUS SW1	16/02/2021	10:50	5.01	28.1	105	15.0	9.8	0.01	70	4.8
BPUS SW1	17/03/2021	10:10	4.88	27.5	110	14.8	9.7	0.01	78	4.6
OHD	12/10/2017	10:30	6.59	31.7	80	19.1	12.4	0.01	80	3.7
OHD	9/08/2018	12:15	9.31	26.5	-10	34.7	25.4	0.02	79	8.9
OHD	18/12/2018	8:30	6.78	33.2	287	20.8	13.7	0.01	97	0.0
OHD	14/02/2019	12:00	7.19	34.0	191	22.4	14.3	0.01	77	1.9
OHD	28/03/2019	9:20	6.20	30.4	336	19.5	13.0	0.01	90	1.4
OHD	21/01/2020	11:04	5.47	28.3	249	27.3	18.0	0.01	53	140
OHD	26/03/2020	8:33	6.78	30.4	243	18.8	12.0	0.01	80	2.7
OHD	17/12/2020	11:45	6.59	31.1	75	21.4	13.7	0.01	54	13.0
OHD	21/01/2021	8:00	6.67	30.5	90	19.4	12.4	0.01	80	5.1
OHD	16/02/2021	10:50	6.67	30.9	31	20.0	13.1	0.00	61	4.5
OHD	17/03/2021	8:20	5.88	29.8	54	13.5	9.1	0.00	57	2.8
OHD	22/06/2021	12:30	5.81	26.0	117	14.5	9.1	0.01	73	5.4
OHD	22/07/2021	7:54	6.46	25.8	259.6	15.1	10	0.01	90	5.2

Site	Date Sampled DD/MM/YY	Time	Major Anions							Major Cations			
			Total Hardness as CaCO ₃	Hydroxide Alkalinity as CaCO ₃	Carbonate Alkalinity as CaCO ₃	Bicarbonate Alkalinity as CaCO ₃	Total Alkalinity as CaCO ₃	Sulfate as SO ₄	Chloride	Calcium	Magnesium	Sodium	Potassium
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Water Quality Objectives Darwin Harbour Region (freshwater rivers & streams)													
BP33 PIT	15/02/2017	12:50	<1	<1	<1	3	3	<1	3	<1	<1	2	<1
BP33 PIT	19/04/2017	10:25	<1	<1	<1	4	4	<1	2	<1	<1	2	<1
BP33 PIT	12/10/2017	11:30	<1	<1	<1	8	8	<1	3	<1	<1	3	<1
BP33 PIT	1/02/2018	13:35	<1	<1	<1	6	6	<1	2	<1	<1	2	<1
BP33 PIT	14/03/2018	11:40	<1	<1	<1	5	5	<1	<1	<1	<1	2	<1
BP33 PIT	3/05/2018	10:07	<1	<1	<1	6	6	<1	1	<1	<1	2	<1
BP33 PIT	8/08/2018	12:43	<1	<1	<1	4	4	<1	2	<1	<1	2	<1
BP33 PIT	18/12/2018	9:00	<1	<1	<1	7	7	<1	3	<1	<1	3	<1
BP33 PIT	14/02/2019	11:15	<1	<1	<1	5	5	<1	2	<1	<1	3	<1
BP33 PIT	17/12/2020	11:15		<1	<1	9	9	<1	3	<1	1	3	<1
BP33 PIT	21/01/2021	9:30		<1	<1	7	7	<1	3	<1	<1	3	<1
BP33 PIT	9/02/2021	9:30		<1	<1	7	7	<1	3	<1	<1	3	<1
BP33 PIT	23/03/2021	9:00		<1	<1	6	6	<1	3	<1	<1	3	<1
BP33 PIT	24/06/2021	10:00		<1	<1	6	6	<1	3	<1	<1	3	<1
BP33 PIT	22/07/2021	7:25		<1	<1	6	6	<1	3	<1	<1	3	<1
BPDS SW2	15/02/2017	12:25	<1	<1	<1	2	2	<1	1	<1	<1	2	<1
BPDS SW2	19/04/2017	10:00	<1	<1	<1	2	2	<1	2	<1	<1	2	<1
BPDS SW2	12/10/2017	Dry											
BPDS SW2	1/02/2018	13:54	<1	<1	<1	2	2	<1	2	<1	<1	1	<1
BPDS SW2	14/03/2018	12:00	<1	<1	<1	4	4	<1	<1	<1	<1	2	<1
BPDS SW2	3/05/2018	10:28	<1	<1	<1	4	4	<1	3	<1	<1	2	<1
BPDS SW2	14/02/2019	10:45	8	<1	<1	8	8	<1	7	<1	2	4	2
BPDS SW2	28/03/2019	10:35	<1	<1	<1	<1	<1	<1	8	<1	<1	4	1
BPDS SW2	21/01/2020	11:34		<1	<1	3	3	<1	2	<1	<1	2	<1
BPDS SW2	26/03/2020	9:26		<1	<1	5	5	<1	3	<1	<1	2	<1
BPDS SW2	23/12/2020			<1	<1	4	4	<1	4	<1	<1	2	<1
BPDS SW2	13/01/2021	12:00		<1	<1	8	8	<1	3	<1	<1	2	<1
BPDS SW2	10/02/2021	9:30		<1	<1	3	3	<1	2	<1	<1	2	<1
BPDS SW2	17/03/2021	11:55		<1	<1	<1	<1	<1	2	<1	<1	2	<1
BPUS SW1	15/02/2017	13:25	<1	<1	<1	2	2	<1	1	<1	<1	2	<1
BPUS SW1	19/04/2017	10:55	<1	<1	<1	2	2	<1	2	<1	<1	2	<1
BPUS SW1	12/10/2017	Dry											
BPUS SW1	1/02/2018	13:02	<1	<1	<1	2	2	<1	1	<1	<1	1	<1
BPUS SW1	14/03/2018	12:25	<1	<1	<1	4	4	<1	<1	<1	<1	1	<1
BPUS SW1	3/05/2018	9:53	<1	<1	<1	5	5	<1	3	<1	<1	2	<1
BPUS SW1	14/02/2019	10:00	8	<1	<1	6	6	<5	7	<1	2	4	2
BPUS SW1	28/03/2019	10:03	<1	<1	<1	3	3	<1	6	<1	<1	4	<1
BPUS SW1	21/01/2020	11:19		<1	<1	2	2	<1	2	<1	<1	2	<1
BPUS SW1	26/03/2020	9:00		<1	<1	6	6	<1	3	<1	<1	2	<1
BPUS SW1	23/12/2020			<1	<1	6	6	<1	4	<1	<1	2	<1
BPUS SW1	21/01/2021	8:30		<1	<1	3	3	<1	3	<1	<1	3	<1
BPUS SW1	16/02/2021	10:50		<1	<1	3	3	<1	2	<1	<1	2	<1
BPUS SW1	17/03/2021	10:10		<1	<1	<1	<1	<1	2	<1	<1	2	<1
OHD	12/10/2017	10:30	<1	<2	<3	4	4	<1	3	<1	<1	2	<1
OHD	9/08/2018	12:15	<1	<1	<1	5	5	<1	2	<1	<1	1	<1
OHD	18/12/2018	8:30	<1	<1	<1	7	7	<1	3	<1	<1	3	<1
OHD	14/02/2019	12:00	<1	<1	<1	4	4	<1	3	<1	<1	2	<1
OHD	28/03/2019	9:20	<1	<1	<1	<1	<1	<1	4	<1	<1	2	<1
OHD	21/01/2020	11:04		<1	<1	2	2	<1	4	<1	<1	2	<1
OHD	26/03/2020	8:33		<1	<1	7	7	<1	2	<1	<1	2	<1
OHD	17/12/2020	11:45		<1	<1	4	4	<1	3	<1	<1	2	<1
OHD	21/01/2021	8:00		<1	<1	2	2	<1	2	<1	<1	2	<1
OHD	16/02/2021	10:50		<1	<1	4	4	<1	2	<1	<1	2	<1
OHD	17/03/2021	8:20		<1	<1	<1	<1	<1	2	<1	<1	1	<1
OHD	22/06/2021	12:30		<1	<1	7	7	<1	2	<1	<1	1	<1
OHD	22/07/2021	7:54		<1	<1	3	3	<1	2	<1	<1	2	<1

Site	Date Sampled DD/MM/YY	Time	Dissolved Metals																								
			Aluminium	Arsenic	Beryllium	Barium	Cadmium	Caesium	Chromium	Cobalt	Copper	Lead	Lithium	Nickel	Selenium	Silver	Strontium	Thorium	Tin	Titanium	Uranium	Vanadium	Zinc	Boron	Iron	Mercury	
			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	mg/L	mg/L	
Water Quality Objectives Darwin Harbour Reg			pH >6.5 pH <6.5 0.0008	0.013			0.0002		0.004		0.0014	0.0034		0.011	0.011								0.008			0.0006	
BP33 PIT	15/02/2017	12:50	0.02	0.008			<0.0001		<0.001		<0.001	<0.001	-	<0.001	<0.01				<0.001					<0.005		<0.05	<0.0001
BP33 PIT	19/04/2017	10:25	<0.01	0.007			<0.0001		<0.001		<0.001	<0.001	-	<0.001	<0.01				<0.001					<0.005		<0.05	<0.0001
BP33 PIT	12/10/2017	11:30	<0.01	0.015			<0.0001		<0.001		<0.001	<0.001	0.006	<0.001	<0.01				<0.001					<0.005		<0.05	<0.0001
BP33 PIT	1/02/2018	13:35	0.05	0.006			<0.0001		<0.001		<0.001	<0.001	0.006	<0.001	<0.01				<0.001					<0.005		<0.05	<0.0001
BP33 PIT	14/03/2018	11:40	0.01	0.007			<0.0001		<0.001		<0.001	<0.001	0.006	<0.001	<0.01				<0.001					<0.005		<0.05	<0.0001
BP33 PIT	3/05/2018	10:07	<0.01	0.010			<0.0001		<0.001		<0.001	<0.001	0.008	<0.001	<0.01				<0.001					<0.005		<0.05	<0.0001
BP33 PIT	8/08/2018	12:43	<0.01	0.008			<0.0001		<0.001		<0.001	<0.001	0.008	<0.001	<0.01				<0.001					<0.005		<0.05	<0.0001
BP33 PIT	18/12/2018	9:00	<0.01	0.019			<0.0001		<0.001		0.001	<0.001	0.009	<0.001	<0.01				<0.001					<0.005		<0.05	<0.0001
BP33 PIT	14/02/2019	11:15	0.04	0.016			<0.0001		<0.001		<0.001	<0.001	0.010	<0.001	<0.01				<0.001					<0.005		<0.05	<0.0001
BP33 PIT	17/12/2020	11:15	<0.01	0.014			<0.0001		<0.001		<0.001	<0.001	0.016	<0.001					<0.001					<0.005		<0.05	<0.0001
BP33 PIT	21/01/2021	9:30	<0.01	0.012			<0.0001		<0.001		<0.001	<0.001	0.012	<0.001										<0.005		<0.05	<0.0001
BP33 PIT	9/02/2021	9:30	<0.01	0.007			<0.0001		<0.001		<0.001	<0.001	0.012	<0.001										<0.005		<0.05	<0.0001
BP33 PIT	23/03/2021	9:00	<0.01	0.008	<0.001	0.004	<0.0001	0.002	<0.001	<0.001	<0.001	<0.001	0.010	<0.001	<0.01	<0.001	0.004	<0.001	<0.001	<0.01	<0.001	<0.01	<0.005	<0.05	<0.05	<0.0001	
BP33 PIT	24/06/2021	10:00	<0.01	0.008	<0.001	0.005	<0.0001	0.002	<0.001	<0.001	<0.001	<0.001	0.009	<0.001	<0.01	<0.001	0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.005	<0.05	<0.05	<0.0001	
BP33 PIT	22/07/2021	7:25																									
BPDS SW2	15/02/2017	12:25	0.03	0.002			<0.0001		<0.001		<0.001	<0.001	-	<0.001	<0.01				<0.001					<0.005		0.16	<0.0001
BPDS SW2	19/04/2017	10:00	0.02	<0.001			<0.0001		<0.001		<0.001	<0.001	-	<0.001	<0.01				<0.001					<0.005		0.10	<0.0001
BPDS SW2	12/10/2017	Dry																									
BPDS SW2	1/02/2018	13:54	0.04	<0.001			<0.0001		<0.001		<0.001	<0.001	0.002	<0.001	<0.01				<0.001					<0.005		0.07	<0.0001
BPDS SW2	14/03/2018	12:00	0.01	0.001			<0.0001		<0.001		<0.001	<0.001	0.003	<0.001	<0.01				<0.001					<0.005		0.06	<0.0001
BPDS SW2	3/05/2018	10:28	0.02	0.002			<0.0001		<0.001		<0.001	<0.001	0.006	<0.001	<0.01				<0.001					<0.005		0.38	<0.0001
BPDS SW2	14/02/2019	10:45	0.26	0.024			<0.0001		<0.001		<0.001	<0.001	0.012	0.002	<0.01				<0.001					<0.005		1.46	<0.0001
BPDS SW2	28/03/2019	10:35	0.08	0.003			<0.0001		<0.001		<0.001	<0.001	0.010	<0.001	<0.01				<0.001					<0.005		0.62	<0.0001
BPDS SW2	21/01/2020	11:34	0.37	<0.001			<0.0001		<0.001		<0.001	<0.001	0.004	<0.001	<0.01									<0.005		0.24	<0.0001
BPDS SW2	26/03/2020	9:26	0.07	0.002			<0.0001		<0.001		<0.001	<0.001	0.006	<0.001	<0.01									<0.005		0.19	<0.0001
BPDS SW2	23/12/2020		0.08	<0.001			<0.0001		<0.001		0.001	<0.001	0.004	<0.001										<0.005		0.16	<0.0001
BPDS SW2	13/01/2021	12:00	0.05	<0.001			<0.0001		<0.001		<0.001	<0.001	0.003	<0.001										<0.005		0.12	<0.0001
BPDS SW2	10/02/2021	9:30	0.04	0.001			<0.0001		<0.001		<0.001	<0.001	0.001	<0.001										<0.005		0.15	<0.0001
BPDS SW2	17/03/2021	11:55	0.04	0.001	<0.001	0.003	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.005	<0.05	0.26	<0.0001	
BPUS SW1	15/02/2017	13:25	0.04	0.002			<0.0001		<0.001		<0.001	<0.001	-	<0.001	<0.01				<0.001					<0.005		0.17	<0.0001
BPUS SW1	19/04/2017	10:55	0.01	0.001			<0.0001		<0.001		<0.001	<0.001	-	<0.001	<0.01				<0.001					<0.005		0.09	<0.0001
BPUS SW1	12/10/2017	Dry																									
BPUS SW1	1/02/2018	13:02	0.04	0.001			<0.0001		<0.001		<0.001	<0.001	0.002	<0.001	<0.01				<0.001					<0.005		0.09	<0.0001
BPUS SW1	14/03/2018	12:25	0.02	0.001			<0.0001		<0.001		<0.001	<0.001	0.003	<0.001	<0.01				<0.001					<0.005		0.06	<0.0001
BPUS SW1	3/05/2018	9:53	0.02	0.002			<0.0001		<0.001		<0.001	<0.001	0.007	<0.001	<0.01				<0.001					<0.005		0.25	<0.0001
BPUS SW1	14/02/2019	10:00	0.25	0.012			<0.0001		<0.001		<0.001	<0.001	0.014	<0.001	<0.01				<0.001					<0.005		1.04	<0.0001
BPUS SW1	28/03/2019	10:03	0.12	0.002			<0.0001		<0.001		<0.001	<0.001	0.008	<0.001	<0.01				<0.001					<0.005		0.53	<0.0001
BPUS SW1	21/01/2020	11:19	0.30	<0.001			<0.0001		<0.001		<0.001	<0.001	0.003	<0.001	<0.01									<0.005		0.18	<0.0001
BPUS SW1	26/03/2020	9:00	0.07	0.001			<0.0001		<0.001		<0.001	<0.001	0.006	<0.001	<0.01									<0.005		0.19	<0.0001
BPUS SW1	23/12/2020		0.07	<0.001			<0.0001		<0.001		<0.001	<0.001	0.003	<0.001										<0.005		0.14	<0.0001
BPUS SW1	21/01/2021	8:30	0.06	0.001			<0.0001		<0.001		<0.001	<0.001	0.004	<0.001										<0.005		0.17	<0.0001
BPUS SW1	16/02/2021	10:50	0.06	0.001			<0.0001		<0.001		<0.001	<0.001	0.003	<0.001										<0.005		0.21	<0.0001
BPUS SW1	17/03/2021	10:10	0.03	0.001	<0.001	0.003	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.01	<0.001	0.002	<0.001	<0.001	<0.01	<0.001	<0.01	<0.005	<0.05	0.14	<0.0001	
OHD	12/10/2017	10:30	<0.01	0.002			<0.0001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.01				<0.001					<0.005		<0.05	<0.0001
OHD	9/08/2018	12:15	<0.01	0.002			<0.0001		<0.001		<0.001	<0.001	0.001	<0.001	<0.01				<0.001					<0.005		0.06	<0.0001
OHD	18/12/2018	8:30	<0.01	0.002			<0.0001		<0.001		<0.001	<0.001	0.001	<0.001	<0.01				<0.001					<0.005		0.06	<0.0001
OHD	14/02/2019	12:00	<0.01	0.002			<0.0001		<0.001		<0.001	<0.001	0.001	<0.001	<0.01				<0.001					<0.005		0.07	<0.0001
OHD	28/03/2019	9:20	<0.01	0.003			<0.0001		<0.001		<0.001	<0.001	0.001	<0.001	<0.01									<0.005		0.10	<0.0001
OHD	21/01/2020	11:04	0.17	0.004			<0.0001		<0.001		<0.001	<0.001	0.004	<0.001	<0.01									<0.005		0.10	<0.0001
OHD	26/03/2020	8:33	0.02	0.009			<0.0001		<0.001		<0.001	<0.001	0.003	<0.001	<0.01									<0.005		0.51	<0.0001
OHD	17/12/2020	11:45	<0.01	0.00																							

[illegible]

Site	Date Sampled DD/MM/YY	Time	Nutrients							
			Ammonia as N	Nitrite as N	Nitrate as N	Nitrite + Nitrate as N	TKN as N	Total Nitrogen as N	Total Phosphorus as P	Reactive Phosphorus as P
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Water Quality Objectives Darwin Harbour Region (freshwater rivers & streams)						0.008		0.23	0.01	0.005
BP33 PIT	15/02/2017	12:50	0.08	<0.01	0.02	0.02	<0.1	<0.1	<0.01	<0.01
BP33 PIT	19/04/2017	10:25	0.03	<0.01	<0.01	<0.01	<0.1	<0.1	<0.01	<0.01
BP33 PIT	12/10/2017	11:30	<0.01	<0.01	0.03	0.03	0.2	0.2	<0.01	<0.01
BP33 PIT	1/02/2018	13:35	<0.01	<0.01	0.03	0.03	0.1	0.1	<0.01	0.006
BP33 PIT	14/03/2018	11:40	0.06	<0.01	<0.01	<0.01	0.2	0.2	<0.01	<0.001
BP33 PIT	3/05/2018	10:07	<0.01	<0.01	0.01	0.01	0.2	0.2	1.18	<0.001
BP33 PIT	8/08/2018	12:43	0.06	<0.01	<0.01	<0.01	0.1	0.1	<0.01	0.002
BP33 PIT	18/12/2018	9:00	0.02	<0.01	<0.01	<0.01	0.1	0.1	0.01	0.012
BP33 PIT	14/02/2019	11:15	<0.01	<0.01	0.02	0.02	0.2	0.2	<0.01	0.010
BP33 PIT	17/12/2020	11:15	0.06	<0.01	0.1	0.1	0.3	0.4	0.02	0.005
BP33 PIT	21/01/2021	9:30	0.02	<0.01	0.04	0.04	0.2	0.2	<0.01	<0.001
BP33 PIT	9/02/2021	9:30	0.02	<0.01	<0.01	<0.01	0.2	0.2	<0.01	0.004
BP33 PIT	23/03/2021	9:00	0.03	<0.01	<0.01	<0.01	0.1	0.1	<0.01	0.006
BP33 PIT	24/06/2021	10:00	<0.01	<0.01	0.01	0.01	0.2	0.2	0.01	0.002
BP33 PIT	22/07/2021	7:25	<0.01	<0.01	<0.01	<0.01	0.2	0.2	0.01	
BPDS SW2	15/02/2017	12:25	0.12	<0.01	0.03	0.03	0.2	0.2	<0.01	<0.01
BPDS SW2	19/04/2017	10:00	0.06	<0.01	<0.01	<0.01	<0.1	<0.1	0.02	<0.01
BPDS SW2	12/10/2017	Dry								
BPDS SW2	1/02/2018	13:54	<0.01	<0.01	0.02	0.02	0.1	0.1	<0.01	0.004
BPDS SW2	14/03/2018	12:00	<0.01	<0.01	<0.01	<0.01	0.1	0.1	<0.01	<0.001
BPDS SW2	3/05/2018	10:28	0.02	<0.01	0.03	0.03	0.2	0.2	<0.01	<0.001
BPDS SW2	14/02/2019	10:45	<0.01	<0.01	0.02	0.02	0.7	0.7	0.06	0.012
BPDS SW2	28/03/2019	10:35	<0.01	<0.01	<0.01	<0.01	0.3	0.3	0.01	<0.01
BPDS SW2	21/01/2020	11:34	0.09	<0.01	<0.01	<0.01	0.3	0.3	<0.01	0.007
BPDS SW2	26/03/2020	9:26	<0.01	<0.01	<0.01	<0.01	0.2	0.2	<0.01	0.003
BPDS SW2	23/12/2020		0.09	0.02	<0.01	<0.01	0.3	0.3	<0.01	0.003
BPDS SW2	13/01/2021	12:00	0.22	<0.01	0.09	0.09	0.4	0.5	0.03	0.003
BPDS SW2	10/02/2021	9:30	<0.01	<0.01	0.02	0.02	<0.1	<0.1	<0.01	0.003
BPDS SW2	17/03/2021	11:55	0.03	<0.01	<0.01	<0.01	0.1	0.1	<0.01	<0.001
BPUS SW1	15/02/2017	13:25	0.04	<0.01	0.04	0.04	0.1	0.1	<0.01	<0.01
BPUS SW1	19/04/2017	10:55	0.03	<0.01	<0.01	<0.01	<0.1	<0.1	<0.01	<0.01
BPUS SW1	12/10/2017	Dry								
BPUS SW1	1/02/2018	13:02	<0.01	<0.01	0.02	0.02	0.2	0.2	0.72	0.003
BPUS SW1	14/03/2018	12:25	0.07	<0.01	<0.01	<0.01	0.1	0.1	<0.01	<0.001
BPUS SW1	3/05/2018	9:53	0.12	<0.01	0.03	0.03	0.2	0.2	<0.01	<0.001
BPUS SW1	14/02/2019	10:00	<0.01	<0.01	<0.01	<0.01	0.7	0.7	0.04	0.012
BPUS SW1	28/03/2019	10:03	0.04	<0.01	<0.01	<0.01	0.3	0.3	<0.01	<0.01
BPUS SW1	21/01/2020	11:19	0.02	<0.01	<0.01	<0.01	0.2	0.2	<0.01	0.006
BPUS SW1	26/03/2020	9:00	0.03	<0.01	<0.01	<0.01	0.2	0.2	0.01	0.002
BPUS SW1	23/12/2020		0.01	0.02	<0.01	<0.01	0.2	0.2	<0.01	0.003
BPUS SW1	21/01/2021	8:30	<0.01	<0.01	0.03	0.03	0.2	0.2	<0.01	0.002
BPUS SW1	16/02/2021	10:50	<0.01	<0.01	0.02	0.02	0.1	0.1	<0.01	0.003
BPUS SW1	17/03/2021	10:10	0.09	<0.01	<0.01	<0.01	0.2	0.2	<0.01	<0.001
OHD	12/10/2017	10:30	0.03	<0.01	0.03	0.03	0.2	0.2	<0.01	<0.01
OHD	9/08/2018	12:15	0.01	<0.01	<0.01	<0.01	0.3	0.3	<0.01	0.002
OHD	18/12/2018	8:30	0.02	<0.01	0.02	0.02	0.2	0.2	0.02	0.002
OHD	14/02/2019	12:00	0.03	<0.01	0.02	0.02	0.2	0.2	<0.01	0.003
OHD	28/03/2019	9:20	0.03	<0.01	<0.01	<0.01	0.4	0.4	<0.01	<0.01
OHD	21/01/2020	11:04	0.49	<0.01	0.16	0.16	0.8	1.0	<0.01	0.003
OHD	26/03/2020	8:33	0.05	<0.01	<0.01	<0.01	0.5	0.5	0.02	0.002
OHD	17/12/2020	11:45	0.15	<0.01	0.02	0.02	0.5	0.5	<0.01	<0.001
OHD	21/01/2021	8:00	0.02	<0.01	0.03	0.03	0.2	0.2	<0.01	<0.001
OHD	16/02/2021	10:50	0.02	<0.01	0.08	0.08	0.2	0.3	0.04	0.004
OHD	17/03/2021	8:20	0.02	<0.01	<0.01	<0.01	0.2	0.2	<0.01	<0.001
OHD	22/06/2021	12:30	<0.01	<0.01	0.02	0.02	0.2	0.2	<0.01	<0.001
OHD	22/07/2021	7:54	<0.01	<0.01	0.01	0.01	0.3	0.3	0.01	

Site	Date Sampled DD/MM/YY	Time	Total Petroleum Hydrocarbons - NEPM 1999					Total Recoverable Hydrocarbons - NEPM 2013								BTEXN							
			C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)	C6 - C10 Fraction	C6 - C10 Fraction minus BTEX (F1)	>C10 - C16 Fraction	>C16 - C34 Fraction	>C34 - C40 Fraction	>C10 - C40 Fraction (sum)	>C10 - C16 Fraction minus Naphthalene (F2)	Benzene	Toluene	Ethylbenzene	meta- & para-Xylene	ortho-Xylene	Total Xylenes	Sum of BTEX	Naphthalene	
			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
Water Quality Objectives Darwin Harbour Region (freshwater rivers & streams)															950				350				
BP33 PIT	15/02/2017	12:50	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BP33 PIT	19/04/2017	10:25	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BP33 PIT	12/10/2017	11:30	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BP33 PIT	1/02/2018	13:35	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BP33 PIT	14/03/2018	11:40	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BP33 PIT	3/05/2018	10:07	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BP33 PIT	8/08/2018	12:43	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BP33 PIT	18/12/2018	9:00	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BP33 PIT	14/02/2019	11:15	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BP33 PIT	17/12/2020	11:15																					
BP33 PIT	21/01/2021	9:30																					
BP33 PIT	9/02/2021	9:30																					
BP33 PIT	23/03/2021	9:00																					
BP33 PIT	24/06/2021	10:00																					
BP33 PIT	22/07/2021	7:25	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BPDS SW2	15/02/2017	12:25	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BPDS SW2	19/04/2017	10:00	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BPDS SW2	12/10/2017	Dry																					
BPDS SW2	1/02/2018	13:54	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BPDS SW2	14/03/2018	12:00	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BPDS SW2	3/05/2018	10:28	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BPDS SW2	14/02/2019	10:45	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BPDS SW2	28/03/2019	10:35	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BPDS SW2	21/01/2020	11:34																					
BPDS SW2	26/03/2020	9:26																					
BPDS SW2	23/12/2020																						
BPDS SW2	13/01/2021	12:00																					
BPDS SW2	10/02/2021	9:30																					
BPDS SW2	17/03/2021	11:55																					
BPUS SW1	15/02/2017	13:25	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BPUS SW1	19/04/2017	10:55	<20	320	1450	<50	1770	<20	<20	800	840	<100	1640	800	<1	<2	<2	<2	<2	<2	<1	<5	
BPUS SW1	12/10/2017	Dry																					
BPUS SW1	1/02/2018	13:02	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BPUS SW1	14/03/2018	12:25	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BPUS SW1	3/05/2018	9:53	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BPUS SW1	14/02/2019	10:00	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BPUS SW1	28/03/2019	10:03	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
BPUS SW1	21/01/2020	11:19																					
BPUS SW1	26/03/2020	9:00																					
BPUS SW1	23/12/2020																						
BPUS SW1	21/01/2021	8:30																					
BPUS SW1	16/02/2021	10:50																					
BPUS SW1	17/03/2021	10:10																					
OHD	12/10/2017	10:30	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
OHD	9/08/2018	12:15	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
OHD	18/12/2018	8:30	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
OHD	14/02/2019	12:00	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
OHD	28/03/2019	9:20	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	
OHD	21/01/2020	11:04																					
OHD	26/03/2020	8:33																					
OHD	17/12/2020	11:45																					
OHD	21/01/2021	8:00																					
OHD	16/02/2021	10:50																					
OHD	17/03/2021	8:20																					
OHD	22/06/2021	12:30																					
OHD	22/07/2021	7:54	<20	<50	<100	<50	<50	<20	<20	<100	<100	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<5	

Site	Date Sampled DD/MM/YY	Time	Microbiological		
			Faecal Coliforms	E. Coli	Enterococci
			CFU/100mL	CFU/100mL	CFU/100mL
Water Quality Objectives Darwin Harbour Region (freshwater rivers & streams)					
BP33 PIT	15/02/2017	12:50			
BP33 PIT	19/04/2017	10:25			
BP33 PIT	12/10/2017	11:30			
BP33 PIT	1/02/2018	13:35			
BP33 PIT	14/03/2018	11:40			
BP33 PIT	3/05/2018	10:07			
BP33 PIT	8/08/2018	12:43			
BP33 PIT	18/12/2018	9:00			
BP33 PIT	14/02/2019	11:15			
BP33 PIT	17/12/2020	11:15	~20	~20	30
BP33 PIT	21/01/2021	9:30	26	26	~2
BP33 PIT	9/02/2021	9:30		~20	15
BP33 PIT	23/03/2021	9:00		~30	14
BP33 PIT	24/06/2021	10:00		14	65
BP33 PIT	22/07/2021	7:25		~3	
BPDS SW2	15/02/2017	12:25			
BPDS SW2	19/04/2017	10:00			
BPDS SW2	12/10/2017	Dry			
BPDS SW2	1/02/2018	13:54			
BPDS SW2	14/03/2018	12:00			
BPDS SW2	3/05/2018	10:28			
BPDS SW2	14/02/2019	10:45			
BPDS SW2	28/03/2019	10:35			
BPDS SW2	21/01/2020	11:34	6000	6000	4800
BPDS SW2	26/03/2020	9:26	660	660	530
BPDS SW2	23/12/2020		10000	10000	640
BPDS SW2	13/01/2021	12:00	~600	~600	1300
BPDS SW2	10/02/2021	9:30		~3	110
BPDS SW2	17/03/2021	11:55		~66	75
BPUS SW1	15/02/2017	13:25			
BPUS SW1	19/04/2017	10:55			
BPUS SW1	12/10/2017	Dry			
BPUS SW1	1/02/2018	13:02			
BPUS SW1	14/03/2018	12:25			
BPUS SW1	3/05/2018	9:53			
BPUS SW1	14/02/2019	10:00			
BPUS SW1	28/03/2019	10:03			
BPUS SW1	21/01/2020	11:19			
BPUS SW1	26/03/2020	9:00	1800	1800	700
BPUS SW1	23/12/2020		1400	1400	300
BPUS SW1	21/01/2021	8:30	~50	~50	17
BPUS SW1	16/02/2021	10:50		100	67
BPUS SW1	17/03/2021	10:10		~71	110
OHD	12/10/2017	10:30			
OHD	9/08/2018	12:15			
OHD	18/12/2018	8:30			
OHD	14/02/2019	12:00			
OHD	28/03/2019	9:20	35	35	58
OHD	21/01/2020	11:04	~200	~200	~40
OHD	26/03/2020	8:33	84	67	~8
OHD	17/12/2020	11:45	~4	~4	~4
OHD	21/01/2021	8:00	~90	~90	16
OHD	16/02/2021	10:50		~72	32
OHD	17/03/2021	8:20		100	~60
OHD	22/06/2021	12:30		~17	68
OHD	22/07/2021	7:54		~9	

Site	Date Sampled DD/MM/YY	Physical Parameters								
		SWL	pH	Temp	ORP	EC	TDS	Salinity	DO	Turbidity
		mBTOC	pH unit	°C	mV	µS/cm	mg/L	ppt	%sat	NTU
ANZECC 95% Aquatic Ecosystem Protec		6.0-7.5				250				
BPG1	26/10/2020	8.81	5.48	36.7	213	77	50	0.03	14	6.51
BPG1	23/11/2020	9.34	5.28	30.7	154	65	42	0.03	26	14.90
BPG1	16/12/2020	9.65	4.98	30.5	114	55	36	0.02	27	4.55
BPG1	20/01/2021	3.74	4.84	30.9	148	51	34	0.02	24	1.54
BPG1	10/02/2021	0.04	4.80	31.1	147	55	36	0.02	23	2.10
BPG1	18/03/2021	0.48	4.44	30.5	192	57	37	0.03	31	2.24
BPG1	23/06/2021	4.61	4.71	30.7	133	55	36	0.02	26	8.26
BPG2i	21/10/2020	4.20	5.55	33.1	281	75	49	0.00	16	16.40
BPG2i	19/11/2020	5.18	5.49	29.8	123	90	59	0.04	7	0.30
BPG2i	15/12/2020	4.18	5.24	30.5	92	71	47	0.03	7	36.70
BPG2i	13/01/2021	1.35	5.02	29.3	274	70	45	0.00	36	1.77
BPG2i	9/02/2021	TOC	5.27	29.2	126	64	42	0.03	16	1.75
BPG2i	17/03/2021	TOC	4.98	29.2	86	66	43	0.03	19	1.08
BPG2i	24/06/2021	1.77	4.98	29.5	126	67	44	0.03	2	2.01
BPG2s	20/10/2020	DRY								
BPG2s	19/11/2020	DRY								
BPG2s	15/12/2020	DRY								
BPG2s	13/01/2021	2.92								
BPG2s	9/02/2021	0.07	5.47	30.2	85	107	70	0.05	6	12.40
BPG2s	17/03/2021	0.10	5.45	29.3	52	112	73	0.05	14	9.36
BPG2s	24/06/2021	1.87	5.55	28.6	86	86	55	0.04	59	55.70
BPG3i	27/10/2020	4.59	6.75	30.9	-82	312	203	0.15	2	4.55
BPG3i	19/11/2020	4.82	6.74	30.6	-49	323	210	0.15	2	2.28
BPG3i	15/12/2020	4.62	6.84	30.1	-110	330	215	0.16	2	4.79
BPG3i	20/01/2021	1.81	6.76	29.3	-62	307	199	0.14	4	1.22
BPG3i	10/02/2021	1.08	6.67	30.2	-34	287	186	0.13	2	4.15
BPG3i	18/03/2021	1.10	6.57	29.8	-37	307	198	0.14	12	1.14
BPG3i	24/06/2021	1.80	6.52	29.7	-69	287	187	0.13	2	3.69
BPG3s	20/10/2020	DRY								
BPG3s	19/11/2020	DRY								
BPG3s	15/12/2020	DRY								
BPG3s	20/01/2021	4.63								
BPG3s	10/02/2021	DRY								
BPG3s	17/03/2021	4.35	5.64	31.0	65	126	82	0.06	25	305.00
BPG4d	17/12/2020	4.15	6.59	29.8	-81	269	174	0.13	1	6.45
BPG4d	13/01/2021	1.62	6.27	29.7	-114	265	172	0.10	12	14.70
BPG4d	9/02/2021	0.52	6.68	29.6	-140	253	164	0.12	2	2.81
BPG4d	23/03/2021	0.57	6.54	29.6	-96	258	168	0.12	4	8.57
BPG4d	24/06/2021	1.63	6.57	29.6	-106	278	179	0.13	4	2.01
BPG4i	21/10/2020	3.77	10.06	31.1	60	428	278	0.20	22	93.10
BPG4i	23/11/2020	4.31	7.06	31.7	63	262	170	0.12	8	324.00
BPG4i	17/12/2020	4.05	6.71	30.3	58	222	144	0.10	8	330.00
BPG4i	13/01/2021	1.41	6.54	31.9	84	232	150	0.10	11	139.00
BPG4i	9/02/2021	0.62	6.76	29.7	20	216	140	0.10	5	377.00
BPG4i	23/03/2021	0.62	6.61	30.3	13	222	141	0.10	9	131.00
BPG4i	24/06/2021	2.10	6.45	30.2	44	201	131	0.09	13	110.00
BPG4s	20/10/2020	3.53	5.70	33.3	381	63	41	0.00	29	OR
BPG4s	24/11/2020	DRY								
BPG4s	17/12/2020	3.59	5.45	29.0	102	65	42	0.03	32	
BPG4s	13/01/2021	1.17	5.14	31.2	173	67	44	0.00	51	134.00
BPG4s	9/02/2021	0.82	5.73	28.2	347	67	43	0.00	37	1000+
BPG4s	17/03/2021	0.83	5.35	32.9	71	61	42	0.03	18	1000+
BPG4s	24/06/2021	2.42	5.20	29.6	108	63	41	0.03	35	1000+
BPG5i	27/10/2020	5.63	6.37	30.3	-35	200	130	0.09	1	37.70
BPG5i	19/11/2020	6.00	6.35	30.9	-40	207	135	0.10	1	17.60
BPG5i	16/12/2020	6.15	6.22	30.4	-63	196	127	0.09	2	9.50
BPG5i	13/01/2021	1.99	5.96	30.6	-195	197	128	0.10	6	1.69
BPG5i	10/02/2021	0.07	6.36	30.0	-87	189	122	0.09	3	3.42
BPG5i	18/03/2021	TOC	6.06	30.5	-29	195	127	0.09	1	0.97
BPG5i	23/06/2021	2.80	6.30	30.0	-62	216	140	0.10	5	1.52
BPG5s	21/10/2020	6.11	5.79	31.6	190	94	61	0.10	8	35.30
BPG5s	19/11/2020	DRY								
BPG5s	16/12/2020	6.70	5.53	30.9	4	80	53	0.04	20	54.40
BPG5s	13/01/2021	2.91	5.79	34.3	133	109	70	0.10	4	4.96
BPG5s	10/02/2021	1.27	6.08	29.9	268	112	72	0.10	37	10.70
BPG5s	17/03/2021	1.02	5.70	33.1	59	102	66	0.05	19	7.60
BPG5s	23/06/2021	3.16	5.56	28.4	77	78	51	0.04	31	6.55
BPG6	26/10/2020	8.67	6.85	31.5	-18	242	157	0.11	5	-
BPG6	19/11/2020	9.17	6.87	30.8	-45	252	164	0.12	2	4.44
BPG6	16/12/2020	9.68	6.84	30.5	-129	239	155	0.11	2	6.24
BPG6	13/01/2021	4.22	6.96	30.8	-273	246	160	0.10	5	1.87
BPG6	10/02/2021	0.35	6.71	30.5	-127	227	148	0.11	1	2.26
BPG6	18/03/2021	0.40	6.70	30.4	-99	231	150	0.11	2	0.58
BPG6	23/06/2021	4.52	6.55	30.5	-101	237	154	0.11	3	1.82
BPG7i	27/10/2020	5.01	7.04	29.4	-29	262	170	0.12	2	4.07
BPG7i	19/11/2020	5.48	7.03	30.1	-46	273	177	0.13	2	3.02
BPG7i	16/12/2020	5.83	6.79	29.7	-41	256	167	0.12	3	5.07
BPG7i	20/01/2021	1.23	6.80	29.5	-11	248	161	0.12	4	1.08
BPG7i	10/02/2021	TOC	7.03	29.7	-41	251	163	0.12	2	4.93
BPG7i	18/03/2021	TOC	6.74	29.6	-32	255	166	0.12	2	1.12
BPG7i	23/06/2021	2.23	6.72	29.4	-33	262	170	0.12	0	1.39
BPG7s	21/10/2020	5.12	4.84	30.3	405	21	13	0.00	34	16.00
BPG7s	19/11/2020	DRY								
BPG7s	16/12/2020	6.04	4.68	30.3	115	24	15	0.01	20	46.40
BPG7s	20/01/2021	1.02	4.90	29.8	106	32	21	0.00	76	18.40
BPG7s	10/02/2021	0.76	5.52	30.8	426	52	34	0.00	50	12.60
BPG7s	17/03/2021	0.73	4.84	31.9	2	54	35	0.02	43	19.70
BPG7s	23/06/2021	2.96	4.70	29.0	145	36	23	0.02	58	18.90

Site	Date Sampled DD/MM/YY	Major Anions								Major Cations			
		Total Hardness as CaCO ₃	Hydroxide Alkalinity as CaCO ₃	Carbonate Alkalinity as CaCO ₃	Bicarbonate Alkalinity as CaCO ₃	Total Alkalinity as CaCO ₃	Sulfate as SO ₄	Chloride	Total Anions	Calcium	Magnesium	Sodium	Potassium
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ANZECC 95% Aquatic Ecosystem Protection (freshwater)													
BPG1	26/10/2020		<1	<1	27	27	<1	8		2	1	7	4
BPG1	23/11/2020		<1	<1	20	20	<1	7		2	1	5	3
BPG1	16/12/2020		<1	<1	12	12	<1	7		<1	1	4	2
BPG1	20/01/2021		<1	<1	12	12	<1	7	0.44	<1	1	4	3
BPG1	10/02/2021		<1	<1	15	15	<1	7	0.5	<1	1	5	3
BPG1	18/03/2021		<1	<1	14	14	<1	7	0.48	<1	1	4	2
BPG1	23/06/2021		<1	<1	16	16	<1	8	0.54	<1	1	5	3
BPG2i	21/10/2020		<1	<1	32	32	<1	7		2	3	6	4
BPG2i	19/11/2020		<1	<1	42	42	<1	6		5	3	7	3
BPG2i	15/12/2020		<1	<1	23	23	<1	7		1	2	5	4
BPG2i	13/01/2021		<1	<1	21	21	<1	7	0.62	<1	1	5	3
BPG2i	9/02/2021		<1	<1	16	16	<1	7	0.52	1	2	5	4
BPG2i	17/03/2021		<1	<1	12	12	<1	7	0.44	1	2	4	3
BPG2i	24/06/2021		<1	<1	16	16	<1	7	0.52	<1	2	5	4
BPG2s	20/10/2020												
BPG2s	19/11/2020												
BPG2s	15/12/2020												
BPG2s	13/01/2021												
BPG2s	9/02/2021		<1	<1	38	38	<1	11	1.07	1	4	9	5
BPG2s	17/03/2021		<1	<1	35	35	<1	9	0.95	2	4	8	5
BPG2s	24/06/2021		<1	<1	28	28	<1	8	0.78	<1	3	8	3
BPG3i	27/10/2020		<1	<1	146	146	<1	10		12	4	43	7
BPG3i	19/11/2020		<1	<1	145	145	<1	9		10	4	40	5
BPG3i	15/12/2020		<1	<1	145	145	<1	10		10	4	41	9
BPG3i	20/01/2021		<1	<1	147	147	<1	10	3.22	12	4	42	6
BPG3i	10/02/2021		<1	<1	165	165	<1	8	3.52	12	4	43	5
BPG3i	18/03/2021		<1	<1	140	140	<1	8	3.02	12	4	42	6
BPG3i	24/06/2021		<1	<1	130	130	<1	8	2.82	10	4	40	4
BPG3s	20/10/2020												
BPG3s	19/11/2020												
BPG3s	15/12/2020												
BPG3s	20/01/2021												
BPG3s	10/02/2021												
BPG3s	17/03/2021		<1	<1	46	46	2	5	1.1	7	2	14	2
BPG4d	17/12/2020		<1	<1	118	118	2	8		4	3	41	4
BPG4d	13/01/2021		<1	<1	119	119	<1	8	2.6	4	2	36	4
BPG4d	9/02/2021		<1	<1	119	119	<1	8	2.6	5	3	39	4
BPG4d	23/03/2021		<1	<1	117	117	2	8	2.6	5	3	36	4
BPG4d	24/06/2021		<1	<1	114	114	<1	8	2.5	5	3	38	4
BPG4i	21/10/2020		<1	134	53	187	6	6		6	2	71	24
BPG4i	23/11/2020		<1	<1	118	118	3	7		5	1	38	7
BPG4i	17/12/2020		<1	<1	96	96	2	6		4	2	35	4
BPG4i	13/01/2021		<1	<1	107	107	<1	6	2.31	4	1	31	4
BPG4i	9/02/2021		<1	<1	103	103	1	6	2.25	6	3	36	4
BPG4i	23/03/2021		<1	<1	92	92	<1	6	2.01	3	2	32	3
BPG4i	24/06/2021		<1	<1	82	82	<1	6	1.81	2	2	31	3
BPG4s	20/10/2020		<1	<1	18	18	<1	6		<1	1	11	2
BPG4s	24/11/2020												
BPG4s	17/12/2020		<1	<1	16	16	<1	6		<1	<1	9	1
BPG4s	13/01/2021		<1	<1	24	24	<1	6	0.65	<1	<1	10	<1
BPG4s	9/02/2021		<1	<1	24	24	<1	6	0.65	<1	1	10	2
BPG4s	17/03/2021		<1	<1	15	15	<1	6	0.47	<1	<1	10	1
BPG4s	24/06/2021		<1	<1	21	21	<1	5	0.56	<1	<1	9	1
BPG5i	27/10/2020		<1	<1	86	86	<1	7		7	4	22	5
BPG5i	19/11/2020		<1	<1	94	94	<1	6		8	4	21	5
BPG5i	16/12/2020		<1	<1	85	85	<1	7		7	4	22	5
BPG5i	13/01/2021		<1	<1	91	91	<1	8	2.04	7	3	20	4
BPG5i	10/02/2021		<1	<1	92	92	<1	7	2.04	7	4	22	5
BPG5i	18/03/2021		<1	<1	89	89	<1	7	1.98	7	4	22	6
BPG5i	23/06/2021		<1	<1	94	94	<1	7	2.08	7	4	23	5
BPG5s	21/10/2020		<1	<1	28	28	4	6		3	3	9	3
BPG5s	19/11/2020												
BPG5s	16/12/2020		<1	<1	27	27	7	5		1	2	7	2
BPG5s	13/01/2021		<1	<1	43	43	<1	5	1	<1	2	12	5
BPG5s	10/02/2021		<1	<1	48	48	<1	5	1.1	6	2	9	4
BPG5s	17/03/2021		<1	<1	35	35	<1	5	0.84	6	2	7	3
BPG5s	23/06/2021		<1	<1	40	40	<1	4	0.91	3	3	6	2
BPG6	26/10/2020		<1	<1	108	108	3	6		11	3	29	5
BPG6	19/11/2020		<1	<1	116	116	3	6		10	3	29	4
BPG6	16/12/2020		<1	<1	104	104	2	6		9	3	26	4
BPG6	13/01/2021		<1	<1	117	117	<1	8	2.56	10	2	29	4
BPG6	10/02/2021		<1	<1	118	118	<1	6	2.53	10	3	30	4
BPG6	18/03/2021		<1	<1	102	102	<1	6	2.21	10	4	29	5
BPG6	23/06/2021		<1	<1	108	108	<1	6	2.33	10	3	28	4
BPG7i	27/10/2020		<1	<1	117	117	<1	7		10	3	36	4
BPG7i	19/11/2020		<1	<1	123	123	<1	6		10	3	35	3
BPG7i	16/12/2020		<1	<1	121	121	<1	7		10	3	35	4
BPG7i	20/01/2021		<1	<1	122	122	<1	7	2.64	10	3	38	3
BPG7i	10/02/2021		<1	<1	126	126	<1	7	2.71	10	3	36	3
BPG7i	18/03/2021		<1	<1	118	118	<1	7	2.56	10	3	37	4
BPG7i	23/06/2021		<1	<1	120	120	<1	7	2.6	9	3	36	3
BPG7s	21/10/2020		<1	<1	1	1	<1	2		<1	<1	2	<1
BPG7s	19/11/2020												
BPG7s	16/12/2020		<1	<1	6	6	<1	2		<1	<1	2	<1
BPG7s	20/01/2021		<1	<1	11	11	<1	3	0.3	<1	<1	3	<1
BPG7s	10/02/2021		<1	<1	17	17	<1	4	0.45	2	<1	7	<1
BPG7s	17/03/2021		<1	<1	11	11	<1	5	0.36	<1	<1	9	<1
BPG7s	23/06/2021		<1	<1	13	13	<1	4	0.37	<1	<1	6	<1

Site	Date Sampled DD/MM/YY	Dissolved Metals														
		Aluminium	Arsenic	Beryllium	Barium	Cadmium	Caesium	Chromium	Cobalt	Copper	Lead	Lithium	Nickel	Selenium	Silver	Strontium
		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
ANZECC 95% Aquatic Ecos		pH >6.5	0.013			0.0002		0.004		0.0014	0.0034		0.011	0.011		
BPG1	26/10/2020	0.04	0.004			<0.0001		<0.001		0.002	0.001	0.046	0.003			
BPG1	23/11/2020	0.03	0.004			<0.0001		<0.001		0.006	<0.001	0.042	0.002			
BPG1	16/12/2020	0.02	0.004			<0.0001		<0.001		0.002	<0.001	0.042	0.003			
BPG1	20/01/2021	0.02	0.003			<0.0001		<0.001		0.006	<0.001	0.042	0.004			
BPG1	10/02/2021	0.01	0.004			<0.0001		<0.001		0.004	<0.001	0.047	0.002			
BPG1	18/03/2021	0.01	0.006	<0.001	0.025	<0.0001	<0.001	<0.001	<0.001	0.008	<0.001	0.046	0.002	<0.01	<0.001	0.007
BPG1	23/06/2021	0.01	0.005	0.002	0.032	<0.0001	<0.001	<0.001	<0.001	0.002	<0.001	0.051	0.004	<0.01	<0.001	0.01
BPG2i	21/10/2020	0.02	0.001			<0.0001		<0.001		<0.001	<0.001	0.061	0.008			
BPG2i	19/11/2020	0.02	0.002			<0.0001		<0.001		0.005	<0.001	0.066	0.003			
BPG2i	15/12/2020	0.02	0.002			<0.0001		<0.001		<0.001	<0.001	0.065	0.003			
BPG2i	13/01/2021	0.02	0.002			<0.0001		<0.001		0.006	<0.001	0.069	0.002			
BPG2i	9/02/2021	0.01	0.002			<0.0001		<0.001		<0.001	<0.001	0.062	0.002			
BPG2i	17/03/2021	<0.01	0.002	0.002	0.022	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	0.062	<0.001	<0.01	<0.001	0.009
BPG2i	24/06/2021	<0.01	0.003	0.002	0.031	<0.0001	<0.001	<0.001	<0.001	0.002	<0.001	0.059	0.003	<0.01	<0.001	0.011
BPG2s	20/10/2020															
BPG2s	19/11/2020															
BPG2s	15/12/2020															
BPG2s	13/01/2021															
BPG2s	9/02/2021	0.02	0.001			<0.0001		<0.001		<0.001	<0.001	0.09	0.005			
BPG2s	17/03/2021	0.02	0.003	<0.001	0.126	<0.0001	<0.001	<0.001	0.002	<0.001	<0.001	0.096	0.005	<0.01	<0.001	0.018
BPG2s	24/06/2021	<0.01	0.002	0.004	0.092	0.0008	<0.001	0.001	0.005	0.003	<0.001	0.076	0.006	<0.01	<0.001	0.006
BPG3i	27/10/2020	<0.01	0.160			<0.0001		<0.001		<0.001	<0.001	0.112	<0.001			
BPG3i	19/11/2020	<0.01	0.162			<0.0001		<0.001		<0.001	<0.001	0.111	<0.001			
BPG3i	15/12/2020	0.01	0.157			<0.0001		<0.001		<0.001	<0.001	0.111	<0.001			
BPG3i	20/01/2021	<0.01	0.149			<0.0001		<0.001		<0.001	<0.001	0.102	<0.001			
BPG3i	10/02/2021	<0.01	0.13			<0.0001		<0.001		<0.001	<0.001	0.098	<0.001			
BPG3i	18/03/2021	0.01	0.144	<0.001	0.056	<0.0001	0.001	<0.001	<0.001	0.001	<0.001	0.111	<0.001	<0.01	<0.001	0.143
BPG3i	24/06/2021	<0.01	0.136	<0.001	0.042	<0.0001	0.001	<0.001	<0.001	<0.001	<0.001	0.089	<0.001	<0.01	<0.001	0.077
BPG3s	20/10/2020															
BPG3s	19/11/2020															
BPG3s	15/12/2020															
BPG3s	20/01/2021															
BPG3s	10/02/2021															
BPG3s	17/03/2021	0.02	0.001	<0.001	0.096	<0.0001	<0.001	<0.001	0.002	0.001	<0.001	0.033	0.009	<0.01	<0.001	0.038
BPG4d	17/12/2020	<0.01	0.191			<0.0001		<0.001		<0.001	<0.001	1.38	0.001			
BPG4d	13/01/2021	<0.01	0.219			<0.0001		<0.001		<0.001	<0.001	1.32	0.002			
BPG4d	9/02/2021	<0.01	0.215			<0.0001		<0.001		<0.001	<0.001	1.39	<0.001			
BPG4d	23/03/2021	<0.01	0.235	<0.001	0.018	<0.0001	0.006	<0.001	<0.001	<0.001	<0.001	1.47	<0.001	<0.01	<0.001	0.055
BPG4d	24/06/2021	<0.01	0.203	<0.001	0.018	<0.0001	0.006	<0.001	<0.001	<0.001	<0.001	1.29	<0.001	<0.01	<0.001	0.049
BPG4i	21/10/2020	1.38	0.338			<0.0001		0.011		0.002	0.003	0.697	0.002			
BPG4i	23/11/2020	<0.01	0.256			<0.0001		0.001		<0.001	<0.001	0.720	<0.001			
BPG4i	17/12/2020	<0.01	0.222			<0.0001		<0.001		<0.001	<0.001	0.675	<0.001			
BPG4i	13/01/2021	<0.01	0.207			<0.0001		<0.001		<0.001	<0.001	0.673	<0.001			
BPG4i	9/02/2021	0.29	0.206			<0.0001		<0.001		<0.001	0.001	0.708	<0.001			
BPG4i	23/03/2021	<0.01	0.217	<0.001	0.038	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	0.802	<0.001	<0.01	<0.001	0.027
BPG4i	24/06/2021	<0.01	0.214	<0.001	0.024	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	0.696	<0.001	<0.01	<0.001	0.017
BPG4s	20/10/2020	0.01	0.009			<0.0001		<0.001		<0.001	<0.001	0.169	0.006			
BPG4s	24/11/2020															
BPG4s	17/12/2020	<0.01	0.012			<0.0001		<0.001		<0.001	<0.001	0.15	0.005			
BPG4s	13/01/2021	<0.01	0.014			<0.0001		<0.001		<0.001	0.001	0.176	0.006			
BPG4s	9/02/2021	0.4	0.012			<0.0001		<0.001		<0.001	0.009	0.173	0.006			
BPG4s	17/03/2021	0.01	0.013	0.001	0.021	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	0.207	0.003	<0.01	<0.001	0.002
BPG4s	24/06/2021	0.01	0.019	0.002	0.021	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	0.169	0.002	<0.01	<0.001	0.002
BPG5i	27/10/2020	0.17	0.017			<0.0001		<0.001		<0.001	<0.001	0.058	<0.001			
BPG5i	19/11/2020	<0.01	0.018			<0.0001		<0.001		<0.001	<0.001	0.060	<0.001			
BPG5i	16/12/2020	<0.01	0.018			<0.0001		<0.001		<0.001	<0.001	0.052	<0.001			
BPG5i	13/01/2021	<0.01	0.017			<0.0001		<0.001		<0.001	<0.001	0.061	<0.001			
BPG5i	10/02/2021	<0.01	0.019			<0.0001		<0.001		<0.001	<0.001	0.057	<0.001			
BPG5i	18/03/2021	<0.01	0.028	<0.001	0.054	<0.0001	0.002	<0.001	<0.001	<0.001	<0.001	0.056	<0.001	<0.01	<0.001	0.081
BPG5i	23/06/2021	<0.01	0.019	<0.001	0.062	<0.0001	0.002	<0.001	<0.001	<0.001	<0.001	0.065	<0.001	<0.01	<0.001	0.11
BPG5s	21/10/2020	<0.01	0.002			<0.0001		<0.001		<0.001	<0.001	0.018	0.007			
BPG5s	19/11/2020															
BPG5s	16/12/2020	<0.01	<0.001			<0.0001		<0.001		<0.001	<0.001	0.013	0.004			
BPG5s	13/01/2021	<0.01	<0.001			<0.0001		<0.001		<0.001	<0.001	0.058	0.006			
BPG5s	10/02/2021	<0.01	<0.001			<0.0001		<0.001		<0.001	<0.001	0.045	0.003			
BPG5s	17/03/2021	<0.01	<0.001	<0.001	0.138	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	0.038	0.003	<0.01	<0.001	0.173
BPG5s	23/06/2021	<0.01	<0.001	<0.001	0.111	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	0.028	0.002	<0.01	<0.001	0.091
BPG6	26/10/2020	0.02	0.244			<0.0001		<0.001		<0.001	<0.001	0.190	<0.001			
BPG6	19/11/2020	0.01	0.218			<0.0001		<0.001		<0.001	<0.001	0.199	<0.001			
BPG6	16/12/2020	0.01	0.25			<0.0001		<0.001		<0.001	<0.001	0.145	<0.001			
BPG6	13/01/2021	0.02	0.229			<0.0001		<0.001		<0.001	<0.001	0.196	<0.001			
BPG6	10/02/2021	0.01	0.213			<0.0001		<0.001		<0.001	<0.001	0.188	<0.001			
BPG6	18/03/2021	<0.01	0.228	<0.001	0.026	<0.0001	0.002	<0.001	<0.001	<0.001	<0.001	0.176	<0.001	<0.01	<0.001	0.084
BPG6	23/06/2021	<0.01	0.226	<0.001	0.029	<0.0001	0.002	<0.001	<0.001	<0.001	<0.001	0.215	<0.001	<0.01	<0.001	0.11
BPG7i	27/10/2020	<0.01	0.140			<0.0001		<0.001		<0.001	<0.001	0.129	<0.001			
BPG7i	19/11/2020	<0.01	0.140			<0.0001		<0.001		<0.001	<0.001	0.136	<0.001			
BPG7i	16/12/2020	<0.01	0.143			<0.0001		<0.001		<0.001	<0.001	0.113	<0.001			
BPG7i	20/01/2021	<0.01	0.154			<0.0001		<0.001		<0.001	<0.001	0.126	<0.001			
BPG7i	10/02/2021	<0.01	0.128			<0.0001		<0.001		<0.001	<0.001	0.127	<0.001			

Site	Date Sampled DD/MM/Y										Total Metals									
		Thorium	Tin	Titanium	Uranium	Vanadium	Zinc	Boron	Iron	Mercury	Aluminium	Arsenic	Beryllium	Barium	Cadmium	Caesium	Chromium	Cobalt	Copper	
		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	
ANZECC 95% Aquatic Ecosystem Protection (freshwater)							0.008			0.0006										
BPG1	26/10/2020						0.014		<0.05	<0.0001	0.23	0.004			<0.0001		<0.001		0.005	
BPG1	23/11/2020						0.024		<0.05	<0.0001	0.14	0.005			<0.0001		<0.001		0.009	
BPG1	16/12/2020						0.031		<0.05	<0.0001	0.03	0.004			<0.0001		<0.001		0.002	
BPG1	20/01/2021						0.04		<0.05	<0.0001	0.03	0.005			<0.0001		<0.001		0.008	
BPG1	10/02/2021						0.035		<0.05	<0.0001	0.02	0.005			<0.0001		<0.001		0.006	
BPG1	18/03/2021	<0.001	<0.001	<0.01	<0.001	<0.01	0.036	<0.05	<0.05	<0.0001	0.02	0.005	0.001	0.032	<0.0001	<0.001	<0.001	<0.001	0.011	
BPG1	23/06/2021	<0.001	<0.001	<0.01	<0.001	<0.01	0.032	<0.05	<0.05	<0.0001	0.04	0.004	<0.001	0.032	<0.0001	<0.001	<0.001	<0.001	0.002	
BPG2i	21/10/2020						0.015		<0.05	<0.0001	0.33	0.002			<0.0001		<0.001		<0.001	
BPG2i	19/11/2020						0.029		<0.05	<0.0001	0.1	0.002			<0.0001		<0.001		0.005	
BPG2i	15/12/2020						0.031		0.05	<0.0001	0.28	0.002			<0.0001		<0.001		0.001	
BPG2i	13/01/2021						0.018		<0.05	<0.0001	0.03	0.002			<0.0001		<0.001		0.008	
BPG2i	9/02/2021						<0.005		0.06	<0.0001	0.02	0.002			<0.0001		<0.001		<0.001	
BPG2i	17/03/2021	<0.001	<0.001	<0.01	<0.001	<0.01	<0.005	<0.05	<0.05	<0.0001	<0.01	0.002	0.002	0.029	<0.0001	<0.001	<0.001	<0.001	<0.001	
BPG2i	24/06/2021	<0.001	<0.001	<0.01	<0.001	<0.01	0.02	<0.05	<0.05	<0.0001	0.02	0.003	0.002	0.033	<0.0001	<0.001	<0.001	<0.001	0.002	
BPG2s	20/10/2020																			
BPG2s	19/11/2020																			
BPG2s	15/12/2020																			
BPG2s	13/01/2021																			
BPG2s	9/02/2021						0.023		0.3	<0.0001	0.29	0.002			<0.0001		<0.001		<0.001	
BPG2s	17/03/2021	<0.001	<0.001	<0.01	<0.001	<0.01	0.022	<0.05	0.46	<0.0001	0.08	0.004	<0.001	0.135	<0.0001	<0.001	<0.001	0.002	<0.001	
BPG2s	24/06/2021	<0.001	<0.001	<0.01	<0.001	<0.01	0.014	<0.05	0.06	<0.0001	0.51	0.008	<0.001	0.104	<0.0001	<0.001	<0.001	0.001	<0.001	
BPG3i	27/10/2020						<0.005		0.18	<0.0001	0.23	0.172			<0.0001		<0.001		0.008	
BPG3i	19/11/2020						<0.005		0.17	<0.0001	0.01	0.169			<0.0001		<0.001		<0.001	
BPG3i	15/12/2020						<0.005		0.16	<0.0001	0.03	0.159			<0.0001		<0.001		0.001	
BPG3i	20/01/2021						0.01		0.12	<0.0001	0.02	0.158			<0.0001		<0.001		<0.001	
BPG3i	10/02/2021						0.007		0.14	<0.0001	0.01	0.143			<0.0001		<0.001		0.001	
BPG3i	18/03/2021	<0.001	<0.001	<0.01	<0.001	<0.01	0.017	<0.05	0.17	<0.0001	0.03	0.155	<0.001	0.058	<0.0001	0.002	<0.001	<0.001	0.003	
BPG3i	24/06/2021	<0.001	<0.001	<0.01	<0.001	<0.01	0.007	<0.05	0.17	<0.0001	0.05	0.142	<0.001	0.043	<0.0001	0.001	<0.001	<0.001	<0.001	
BPG3s	20/10/2020																			
BPG3s	19/11/2020																			
BPG3s	15/12/2020																			
BPG3s	20/01/2021																			
BPG3s	10/02/2021																			
BPG3s	17/03/2021	<0.001	<0.001	<0.01	<0.001	<0.01	0.026	<0.05	<0.05	<0.0001	0.34	0.004	<0.001	0.156	<0.0001	<0.001	<0.001	0.001	0.002	
BPG4d	17/12/2020						0.007		1.58	<0.0001	0.04	0.218			<0.0001		<0.001		<0.001	
BPG4d	13/01/2021						0.005		2.82	<0.0001	0.03	0.236			<0.0001		<0.001		<0.001	
BPG4d	9/02/2021						<0.005		2.87	<0.0001	0.02	0.225			<0.0001		<0.001		<0.001	
BPG4d	23/03/2021	<0.001	<0.001	<0.01	<0.001	<0.01	<0.005	<0.05	2.18	<0.0001	0.03	0.254	<0.001	0.024	<0.0001	0.007	<0.001	<0.001	<0.001	
BPG4d	24/06/2021	<0.001	<0.001	<0.01	<0.001	<0.01	<0.005	<0.05	2.9	<0.0001	0.01	0.212	<0.001	0.018	<0.0001	0.007	<0.001	<0.001	<0.001	
BPG4i	21/10/2020						0.006		1.29	<0.0001	1.61	0.337			<0.0001		0.011		0.002	
BPG4i	23/11/2020						<0.005		<0.05	<0.0001	4.11	0.296			<0.0001		0.008		0.007	
BPG4i	17/12/2020						0.012		<0.05	<0.0001	1.52	0.26			<0.0001		0.004		0.001	
BPG4i	13/01/2021						<0.005		<0.05	<0.0001	0.54	0.228			<0.0001		<0.001		<0.001	
BPG4i	9/02/2021						0.013		0.14	<0.0001	3.23	0.229			<0.0001		0.006		0.003	
BPG4i	23/03/2021	<0.001	<0.001	<0.01	<0.001	<0.01	0.006	<0.05	<0.05	<0.0001	7.45	0.252	0.001	0.095	<0.0001	0.021	0.014	0.003	0.007	
BPG4i	24/06/2021	<0.001	<0.001	<0.01	<0.001	<0.01	<0.005	<0.05	<0.05	<0.0001	4.32	0.242	<0.001	0.067	<0.0001	0.013	0.007	0.003	0.003	
BPG4s	20/10/2020						0.02		<0.05	<0.0001	8.25	0.037			<0.0001		0.016		0.011	
BPG4s	24/11/2020																			
BPG4s	17/12/2020						0.008		<0.05	<0.0001	1.24	0.018			<0.0001		0.002		<0.001	
BPG4s	13/01/2021						0.009		<0.05	<0.0001	1.53	0.02			<0.0001		0.003		0.002	
BPG4s	9/02/2021						0.019		0.18	<0.0001	5.55	0.026			0.0006		0.012		0.01	
BPG4s	17/03/2021	<0.001	<0.001	<0.01	<0.001	<0.01	0.008	<0.05	<0.05	<0.0001	10.9	0.041	0.006	0.168	<0.0001	0.088	0.023	0.004	0.02	
BPG4s	24/06/2021	<0.001	<0.001	<0.01	<0.001	<0.01	0.007	<0.05	<0.05	<0.0001	4.97	0.034	0.005	0.082	<0.0001	0.041	0.011	0.002	0.006	
BPG5i	27/10/2020						<0.005		1.42	<0.0001	0.30	0.018			<0.0001		<0.001		<0.001	
BPG5i	19/11/2020						<0.005		1.60	<0.0001	0.46	0.018			<0.0001		<0.001		<0.001	
BPG5i	16/12/2020						0.013		1.39	<0.0001	0.02	0.017			<0.0001		<0.001		<0.001	
BPG5i	13/01/2021						<0.005		1.6	<0.0001	0.05	0.019			<0.0001		<0.001		<0.001	
BPG5i	10/02/2021						0.015		1.49	<0.0001	0.04	0.021			<0.0001		<0.001		<0.001	
BPG5i	18/03/2021	<0.001	<0.001	<0.01	<0.001	<0.01	0.012	<0.05	1.6	<0.0001	0.01	0.028	<0.001	0.06	<0.0001	0.002	<0.001	<0.001	<0.001	
BPG5i	23/06/2021	<0.001	<0.001	<0.01	<0.001	<0.01	0.012	<0.05	2.27	<0.0001	0.03	0.022	<0.001	0.062	<0.0001	0.002	<0.001	<0.001	<0.001	
BPG5s	21/10/2020						0.018		0.85	<0.0001	0.84	0.002			<0.0001		<0.001		<0.001	
BPG5s	19/11/2020																			
BPG5s	16/12/2020						0.009		0.21	<0.0001	0.06	<0.001			<0.0001		<0.001		<0.001	
BPG5s	13/01/2021						0.011		<0.05	<0.0001	0.03	<0.001			<0.0001		0.001		<0.001	
BPG5s	10/02/2021						0.008		<0.05	<0.0001	0.02	<0.001			<0.0001		<0.001		<0.001	
BPG5s	17/03/2021	<0.001	<0.001	<0.01	<0.001	<0.01	0.007	<0.05	<0.05	<0.0001	0.24	0.001	<0.001	0.167	<0.0001	0.001	<0.001	0.001	<0.001	
BPG5s	23/06/2021	<0.001	<0.001	<0.01	<0.001	<0.01	0.01	<0.05	<0.05	<0.0001	0.05	<0.001	<0.001	0.125	<0.0001	<0.001	<0.001	<0.001	0.002	
BPG6	26/10/2020						<0.005		0.52	<0.0001	0.03	0.226			<0.0001		<0.001		<0.001	
BPG6	19/11/2020						<0.005		0.43	<0.0001	0.03	0.245			<0.0001		<0.001		<0.001	
BPG6	16/12/2020						<0.005		0.6	<0.0001	0.02	0.239			<0.0001		<0.001		<0.001	
BPG6	13/01/2021						<0.005		0.8	<0.0001	0.04	0.232			<0.0001		<			

Site	Date Sampled DD/MM/YY																
		Lead	Lithium	Nickel	Selenium	Silver	Strontium	Thorium	Tin	Titanium	Uranium	Vanadium	Zinc	Boron	Iron	Mercury	
		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	
ANZECC 95% Aquatic Ecosystem Protection (freshwater)																	
BPG1	26/10/2020	0.002	0.042	0.003									0.017		0.14	<0.0001	
BPG1	23/11/2020	<0.001	0.047	0.004									0.026		0.08	<0.0001	
BPG1	16/12/2020	<0.001	0.041	0.003									0.034		<0.05	<0.0001	
BPG1	20/01/2021	<0.001	0.045	0.003									0.043		<0.05	<0.0001	
BPG1	10/02/2021	<0.001	0.049	0.003									0.037		<0.05	<0.0001	
BPG1	18/03/2021	<0.001	0.05	0.003	<0.01	<0.001	0.009	0.001	<0.001	<0.01	<0.001	<0.01	0.046	<0.05	<0.05	<0.0001	
BPG1	23/06/2021	<0.001	0.045	0.002	<0.01	<0.001	0.009	<0.001	<0.001	<0.01	<0.001	<0.01	0.034	<0.05	<0.05	<0.0001	
BPG2i	21/10/2020	<0.001	0.067	0.008									0.018		0.33	<0.0001	
BPG2i	19/11/2020	<0.001	0.067	0.003									0.026		0.09	<0.0001	
BPG2i	15/12/2020	<0.001	0.064	0.004									0.039		0.34	<0.0001	
BPG2i	13/01/2021	<0.001	0.07	0.003									0.021		<0.05	<0.0001	
BPG2i	9/02/2021	<0.001	0.066	0.002									<0.005		1.44	<0.0001	
BPG2i	17/03/2021	<0.001	0.065	0.002	<0.01	<0.001	0.01	0.001	<0.001	<0.01	<0.001	<0.01	<0.005	<0.05	0.07	<0.0001	
BPG2i	24/06/2021	<0.001	0.065	0.003	<0.01	<0.001	0.011	<0.001	<0.001	<0.01	<0.001	<0.01	0.021	<0.05	<0.05	<0.0001	
BPG2s	20/10/2020																
BPG2s	19/11/2020																
BPG2s	15/12/2020																
BPG2s	13/01/2021																
BPG2s	9/02/2021	<0.001	0.094	0.004									0.024		0.68	<0.0001	
BPG2s	17/03/2021	<0.001	0.098	0.005	<0.01	<0.001	0.022	0.002	0.002	<0.01	<0.001	<0.01	0.022	<0.05	0.76	<0.0001	
BPG2s	24/06/2021	<0.001	0.082	0.003	<0.01	<0.001	0.008	<0.001	<0.001	0.02	<0.001	<0.01	0.012	<0.05	4.25	<0.0001	
BPG3i	27/10/2020	0.002	0.105	<0.001									0.016		0.35	<0.0001	
BPG3i	19/11/2020	<0.001	0.112	<0.001									<0.005		0.2	<0.0001	
BPG3i	15/12/2020	<0.001	0.112	<0.001									<0.005		0.2	<0.0001	
BPG3i	20/01/2021	<0.001	0.102	<0.001									0.011		0.17	<0.0001	
BPG3i	10/02/2021	<0.001	0.104	<0.001									0.009		0.19	<0.0001	
BPG3i	18/03/2021	<0.001	0.107	<0.001	<0.01	<0.001	0.15	<0.001	<0.001	<0.01	<0.001	<0.01	0.019	<0.05	0.22	<0.0001	
BPG3i	24/06/2021	<0.001	0.098	<0.001	<0.01	<0.001	0.079	<0.001	<0.001	<0.01	<0.001	<0.01	0.008	<0.05	0.34	<0.0001	
BPG3s	20/10/2020																
BPG3s	19/11/2020																
BPG3s	15/12/2020																
BPG3s	20/01/2021																
BPG3s	10/02/2021																
BPG3s	17/03/2021	0.002	0.03	0.01	<0.01	<0.001	0.04	<0.001	<0.001	<0.01	<0.001	<0.01	0.037	<0.05	0.27	<0.0001	
BPG4d	17/12/2020	<0.001	1.44	0.002									0.012		2.5	<0.0001	
BPG4d	13/01/2021	<0.001	1.22	0.002									0.009		4.51	<0.0001	
BPG4d	9/02/2021	<0.001	1.28	0.001									0.008		2.92	<0.0001	
BPG4d	23/03/2021	<0.001	1.59	<0.001	<0.01	<0.001	0.065	<0.001	<0.001	<0.01	<0.001	<0.01	0.008	<0.05	3.71	<0.0001	
BPG4d	24/06/2021	<0.001	1.49	<0.001	<0.01	<0.001	0.052	<0.001	<0.001	<0.01	<0.001	<0.01	0.005	<0.05	4.36	<0.0001	
BPG4i	21/10/2020	0.006	0.742	0.002									0.016		1.96	<0.0001	
BPG4i	23/11/2020	0.002	0.707	0.004									0.03		6.25	<0.0001	
BPG4i	17/12/2020	0.001	0.73	0.002									0.02		2.14	<0.0001	
BPG4i	13/01/2021	0.002	0.694	<0.001									0.008		0.46	<0.0001	
BPG4i	9/02/2021	0.002	0.674	0.003									0.029		5.05	<0.0001	
BPG4i	23/03/2021	0.002	0.909	0.005	<0.01	<0.001	0.035	0.006	<0.001	0.79	<0.001	<0.01	0.05	<0.05	13.3	<0.0001	
BPG4i	24/06/2021	0.002	0.786	0.004	<0.01	<0.001	0.024	0.002	<0.001	0.45	<0.001	<0.01	0.029	<0.05	7.89	<0.0001	
BPG4s	20/10/2020	0.012	0.177	0.019									0.101		12.20	<0.0001	
BPG4s	24/11/2020																
BPG4s	17/12/2020	<0.001	0.156	0.008									0.016		2.02	<0.0001	
BPG4s	13/01/2021	0.009	0.173	0.01									0.026		2.19	<0.0001	
BPG4s	9/02/2021	0.016	0.208	0.014									0.074		8.48	<0.0001	
BPG4s	17/03/2021	0.011	0.239	0.014	<0.01	<0.001	0.012	0.018	<0.001	1.1	0.002	0.01	0.123	<0.05	18.9	<0.0001	
BPG4s	24/06/2021	0.004	0.2	0.008	<0.01	<0.001	0.006	0.01	<0.001	0.49	0.002	<0.01	0.069	<0.05	8.89	<0.0001	
BPG5i	27/10/2020	<0.001	0.055	<0.001									<0.005		1.47	<0.0001	
BPG5i	19/11/2020	<0.001	0.061	<0.001									0.006		1.96	<0.0001	
BPG5i	16/12/2020	<0.001	0.063	<0.001									0.014		1.48	<0.0001	
BPG5i	13/01/2021	<0.001	0.06	<0.001									<0.005		1.9	<0.0001	
BPG5i	10/02/2021	<0.001	0.061	<0.001									0.018		1.49	<0.0001	
BPG5i	18/03/2021	<0.001	0.06	<0.001	<0.01	<0.001	0.091	<0.001	<0.001	<0.01	<0.001	<0.01	0.012	<0.05	1.82	<0.0001	
BPG5i	23/06/2021	<0.001	0.06	<0.001	<0.01	<0.001	0.104	<0.001	<0.001	<0.01	<0.001	<0.01	0.012	<0.05	2.47	<0.0001	
BPG5s	21/10/2020	<0.001	0.018	0.005									0.018		2.91	<0.0001	
BPG5s	19/11/2020																
BPG5s	16/12/2020	<0.001	0.014	0.004									0.01		0.19	<0.0001	
BPG5s	13/01/2021	<0.001	0.054	0.007									0.011		0.05	<0.0001	
BPG5s	10/02/2021	<0.001	0.049	0.003									0.009		0.06	<0.0001	
BPG5s	17/03/2021	<0.001	0.039	0.003	<0.01	<0.001	0.23	<0.001	<0.001	<0.01	<0.001	<0.01	0.06	<0.05	0.54	<0.0001	
BPG5s	23/06/2021	<0.001	0.027	<0.001	<0.01	<0.001	0.082	<0.001	<0.001	<0.01	<0.001	<0.01	0.011	<0.05	0.09	<0.0001	
BPG6	26/10/2020	0.001	0.177	<0.001									<0.005		0.70	<0.0001	
BPG6	19/11/2020	<0.001	0.202	<0.001									<0.005		0.8	<0.0001	
BPG6	16/12/2020	<0.001	0.168	<0.001									<0.005		0.82	<0.0001	
BPG6	13/01/2021	<0.001	0.197	<0.001									<0.005		1.03	<0.0001	
BPG6	10/02/2021	<0.001	0.195	<0.001									0.008		0.84	<0.0001	
BPG6	18/03/2021	<0.001	0.207	<0.001	<0.01	<0.001	0.114	<0.001	<0.001	<0.01	<0.001	<0.01	0.009	<0.05	0.81	<0.0001	
BPG6	23/06/2021	<0.001	0.194	<0.001	<0.01	<0.001	0.105	<0.001	<0.001	<0.01	<0.001	<0.01	0.01	<0.05	0.84	<0.0001	
BPG7i	27/10/2020	<0.001	0.132	<0.001									<0.005		0.28	<0.0001	
BPG7i	19/11/2020	<0.001	0.138	<0.001									<0.005		0.28	<0.0001	
BPG7i	16/12/2020	<0.001	0.116	<0.001									0.013		0.18	<0.0001	
BPG7i	20/01/2021	<0.001	0.135	<0.001									0.006		0.21	<0.0001	
BPG7i	10/02/2021	<0.001	0.132	<0.001									<0.005		0.28	<0.0001	
BPG7i	18/03/2021	<0.001	0.14	<0.001	<0.01	<0.001	0.106	<0.001	<0.001	<0.01	<0.001	<0.01	0.009	<0.05	0.21	<0.0001	
BPG7i	23/06/2021	<0.001	0.134	<0.001	<0.01	<0.001	0.108	<0.001	<0.001	<0.01	<0.001	<0.01	<0.005	<0.05	0.22	<0.0001	
BPG7s	21/10/2020	<0.001	0.005	0.010									0.058		0.12	<0.0001	
BPG7s	19/11/2020																
BPG7s	16/12/2020	<0.001	0.004	0.006									0.056		0.26	<0.0001	
BPG7s	20/01/2021	0															

Site	Date Sampled DD/MM/YY	Nutrients									
		Ammonia as N	Nitrite as N	Nitrate as N	Nitrite + Nitrate as N	TKN as N	Total Nitrogen as N	Total Phosphorus as P	Reactive Phosphorus as P	E. coli	Enterococci
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	CFU/100mL	CFU/100mL
ANZECC 95% Aquatic Ecosystem Protection (freshwater)					0.008	0.23	0.01	0.005			
BPG1	26/10/2020	0.11	<0.01	0.16	0.16	<0.1	0.2	0.04	0.026	1	0
BPG1	23/11/2020	<0.01	<0.01	0.13	0.13	<0.1	0.1	0.05	0.053	<1	<1
BPG1	16/12/2020	0.04	0.07	0.04	0.11	<0.1	0.1	0.05	0.063	<1	~2
BPG1	20/01/2021	<0.01	<0.01	0.09	0.09	<0.1	<0.1	0.04	0.038	<1	<1
BPG1	10/02/2021	<0.01	<0.01	0.08	0.08	<0.1	<0.1	0.06	0.075	<1	<1
BPG1	18/03/2021	<0.01	<0.01	0.10	0.10	<0.1	0.1	0.07	0.061	<1	<1
BPG1	23/06/2021	<0.01	<0.01	0.10	0.10	<0.1	0.1	0.07	0.063	<1	<1
BPG2i	21/10/2020	0.03	<0.01	0.10	0.10	<0.1	0.1	0.02	0.018	<1	<1
BPG2i	19/11/2020	<0.01	<0.01	0.13	0.13	<0.1	0.1	0.04	0.054	<1	<1
BPG2i	15/12/2020	0.07	<0.01	0.12	0.12	<0.1	0.1	0.07	0.045	<1	<1
BPG2i	13/01/2021	0.12	<0.01	0.10	0.10	0.2	0.3	0.07	0.076	<1	<1
BPG2i	9/02/2021	<0.01	<0.01	0.11	0.11	<0.1	0.1	0.05	0.063	<1	<1
BPG2i	17/03/2021	<0.01	<0.01	0.09	0.09	<0.1	<0.1	0.05	0.053	<1	~1
BPG2i	24/06/2021	0.22	<0.01	0.12	0.12	1.5	1.6	0.05	0.044	~5	<1
BPG2s	20/10/2020										
BPG2s	19/11/2020										
BPG2s	15/12/2020										
BPG2s	13/01/2021										
BPG2s	9/02/2021	0.05	<0.01	0.05	0.05	0.1	0.2	0.01	0.015	~11	30
BPG2s	17/03/2021	0.04	<0.01	<0.01	<0.01	<0.1	<0.1	<0.01	0.007	<1	<1
BPG2s	24/06/2021	<0.01	<0.01	0.02	0.02	<0.1	<0.1	0.04	0.028	~13	<1
BPG3i	27/10/2020	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	0.48	0.410	<1	<1
BPG3i	19/11/2020	<0.01	<0.01	0.04	0.04	<0.1	<0.1	0.36	0.400	<1	<1
BPG3i	15/12/2020	0.13	<0.01	0.05	0.05	0.2	0.2	0.42	0.382	<1	<1
BPG3i	20/01/2021	0.01	<0.01	<0.01	<0.01	<0.1	<0.1	0.44	0.252	<1	<1
BPG3i	10/02/2021	0.02	<0.01	<0.01	<0.01	<0.1	<0.1	0.52	0.515	<1	~1
BPG3i	18/03/2021	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	0.55	0.528	<1	<1
BPG3i	24/06/2021	0.07	<0.01	<0.01	<0.01	<0.1	<0.1	0.66	0.563	<1	<1
BPG3s	20/10/2020										
BPG3s	19/11/2020										
BPG3s	15/12/2020										
BPG3s	20/01/2021										
BPG3s	10/02/2021										
BPG3s	17/03/2021	0.06	<0.01	0.07	0.07	0.4	0.5	0.12	0.008	~1600	290
BPG4d	17/12/2020	0.04	<0.01	0.02	0.02	<0.1	<0.1	1.30	0.620	<1	<1
BPG4d	13/01/2021	0.03	<0.01	0.04	0.04	0.1	0.1	1.34	0.410	<1	<1
BPG4d	9/02/2021	0.03	<0.01	<0.01	<0.01	0.2	0.2	1.26	0.437	<1	<1
BPG4d	23/03/2021	0.03	<0.01	<0.01	<0.01	<0.1	<0.1	1.00	0.390	<1	<1
BPG4d	24/06/2021	<0.01	<0.01	0.02	0.02	<0.1	<0.1	1.04	0.290	<1	<1
BPG4i	21/10/2020	0.05	<0.01	0.04	0.04	0.2	0.2	1.03	0.977	<1	<1
BPG4i	23/11/2020	0.03	<0.01	0.07	0.07	0.2	0.3	1.34	1.290	<2	<2
BPG4i	17/12/2020	<0.01	<0.01	0.04	0.04	<0.1	<0.1	1.44	1.330	<2	~12
BPG4i	13/01/2021	<0.01	<0.01	0.06	0.06	0.2	0.3	1.27	1.230	<1	<1
BPG4i	9/02/2021	<0.01	<0.01	0.11	0.11	<0.1	0.1	1.39	1.240	<2	<1
BPG4i	23/03/2021	0.20	<0.01	0.04	0.04	0.6	0.6	1.34	1.240	<1	<1
BPG4i	24/06/2021	0.02	<0.01	0.08	0.08	<0.5	<0.5	1.67	1.000	~10	<2
BPG4s	20/10/2020	<0.01	<0.01	0.22	0.22	<0.5	<0.5	0.40	0.039	<2	~8
BPG4s	24/11/2020										
BPG4s	17/12/2020	<0.01	0.01	0.14	0.15	0.2	0.4	0.24	0.051	<2	~4
BPG4s	13/01/2021	0.03	<0.01	0.14	0.14	<0.1	0.1	0.13	0.092	<1	<1
BPG4s	9/02/2021	0.03	<0.01	0.16	0.16	0.1	0.3	0.17	0.082	<2	<1
BPG4s	17/03/2021	0.06	<0.01	0.10	0.10	<0.1	0.1	0.20	0.051	<1	<1
BPG4s	24/06/2021	0.04	<0.01	0.15	0.15	<0.5	<0.5	0.30	0.103	<2	<2
BPG5i	27/10/2020	0.06	<0.01	<0.01	<0.01	<0.1	<0.1	0.19	0.167	<1	<1
BPG5i	19/11/2020	0.04	<0.01	0.02	0.02	<0.1	<0.1	0.21	0.222	<1	<1
BPG5i	16/12/2020	0.06	<0.01	0.02	0.02	0.2	0.2	0.24	0.158	<1	<1
BPG5i	13/01/2021	0.02	<0.01	<0.01	<0.01	<0.1	<0.1	0.25	0.172	<1	<1
BPG5i	10/02/2021	0.01	<0.01	0.01	0.01	<0.1	<0.1	0.17	0.129	<1	~9
BPG5i	18/03/2021	0.02	<0.01	0.06	0.06	<0.1	<0.1	0.24	0.224	<1	<1
BPG5i	23/06/2021	0.03	<0.01	0.09	0.09	<0.1	<0.1	0.32	0.093	<1	<1
BPG5s	21/10/2020	0.03	<0.01	0.05	0.05	0.4	0.4	<0.01	0.006	<1	<1
BPG5s	19/11/2020										
BPG5s	16/12/2020	<0.01	0.1	0.06	0.16	0.2	0.4	0.02	0.020	<1	<1
BPG5s	13/01/2021	0.01	<0.01	0.20	0.20	<0.1	0.2	0.02	0.020	<1	<1
BPG5s	10/02/2021	0.01	<0.01	0.19	0.19	<0.1	0.2	<0.01	0.011	<1	<1
BPG5s	17/03/2021	0.05	<0.01	0.12	0.12	<0.1	0.1	<0.01	0.006	<1	<1
BPG5s	23/06/2021	<0.01	<0.01	0.14	0.14	<0.1	0.1	0.01	0.006	<1	<1
BPG6	26/10/2020	0.06	<0.01	<0.01	<0.01	<0.1	<0.1	0.20	0.099	0	0
BPG6	19/11/2020	<0.01	<0.01	0.04	0.04	<0.1	<0.1	0.19	0.105	<1	<1
BPG6	16/12/2020	0.03	<0.01	0.02	0.02	<0.1	<0.1	0.25	0.100	<1	<1
BPG6	13/01/2021	0.02	<0.01	<0.01	<0.01	<0.1	<0.1	0.21	0.093	<1	<1
BPG6	10/02/2021	0.04	<0.01	<0.01	<0.01	<0.1	<0.1	0.22	0.104	<1	<1
BPG6	18/03/2021	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	0.23	0.112	<1	<1
BPG6	23/06/2021	0.01	<0.01	0.01	0.01	<0.1	<0.1	0.26	0.074	<1	<1
BPG7i	27/10/2020	0.13	<0.01	<0.01	<0.01	0.1	0.1	0.13	0.060	<1	<1
BPG7i	19/11/2020	<0.01	<0.01	0.03	0.03	<0.1	<0.1	0.09	0.079	<1	<1
BPG7i	16/12/2020	0.03	<0.01	0.02	0.02	<0.1	<0.1	0.12	0.088	<1	<1
BPG7i	20/01/2021	0.02	<0.01	<0.01	<0.01	<0.1	<0.1	0.12	0.089	<1	<1
BPG7i	10/02/2021	<0.01	<0.01	0.02	0.02	<0.1	<0.1	0.09	0.08	<1	~6
BPG7i	18/03/2021	<0.01	<0.01	0.02	0.02	<0.1	<0.1	0.12	0.093	<1	<1
BPG7i	23/06/2021	<0.01	<0.01	0.02	0.02	<0.1	<0.1	0.14	0.059	<1	<1
BPG7s	21/10/2020	0.02	<0.01	0.11	0.11	0.2	0.3	<0.01	0.003	<1	<1
BPG7s	19/11/2020										
BPG7s	16/12/2020	<0.01	<0.01	0.02	0.02	<0.1	<0.1	0.02	0.006	<1	<1
BPG7s	20/01/2021	0.02	<0.01	0.12	0.12	<0.1	0.1	<0.01	0.005	<1	<1
BPG7s	10/02/2021	0.01	<0.01	0.37	0.37	<0.1	0.4	<0.01	0.005	<1	<1
BPG7s	17/03/2021	0.03	<0.01	0.52	0.52	<0.1	0.5	<0.01	<0.001	<1	<1
BPG7s	23/06/2021	<0.01	<0.01	0.22	0.22	<0.1	0.2	<0.01	0.001	<1	<1