LITHIUM DEVELOPMENTS (GRANTS NT)

ASX | CXO

# Finnis Lithium Project BP33 Mine Closure Plan

May 2024

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**Document Control**

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# 1. Purpose

Core Lithium is developing an underground mine at the brownfields BP33 resource (the Project), located approximately 4.5 km south-east of the Grants Lithium project in the Northern Territory of Australia. The Project will involve underground mining of ore and trucking to the Grants processing plant via a dedicated 4.5 km purpose-built haul road.

Mining authorisation under the NT's *Mining Management Act* requires the Mining Management Plan (MMP) for the project to outline the proponent's mine closure planning. The Department of Industry, Tourism and Trade (DITT) require proponents to demonstrate their operation can be closed in a manner that prevents or minimises the potential adverse long-term environmental and social impacts that may otherwise have resulted from the mining and/or processing operation. DITT refer to the Western Australian Government's "*Mine Closure Plan Guidance - How to prepare a mine closure plan in accordance with Part 1 of the Statutory guidelines for mine closure plans*" (the guidelines) (DMIRS 2020) as providing a leading practice and regulator-accepted approach to preparing a Mine Closure Plan (MCP) and these guidelines have been followed in the preparation of this MCP.

The following leading-practice guidelines also inform the mine closure planning for the Project:

- APEC (2018). Mine Closure Checklist for Governments. Asia Pacific Economic Consortium (APEC), Canada. 70p.
- DIIS (2016). *Leading Practice Sustainable Development Program for the Mining Industry - Mine Closure.* Department of Industry, Innovation and Science (DIIS), Canberra, Australia. 131p.
- DIIS (2016). Leading Practice Sustainable Development Program for the Mining Industry - Mine Rehabilitation. Department of Industry, Innovation and Science (DIIS), Canberra, Australia. 76p.
- DIIS (2016). Leading Practice Sustainable Development Program for the Mining Industry - Preventing Acid and Metalliferous Drainage Handbook. Department of Industry, Innovation and Science (DIIS), Canberra, Australia. 221p.
- DIIS (2016). Leading Practice Sustainable Development Program for the Mining Industry - Community Engagement and Development. Department of Industry, Innovation and Science (DIIS), Canberra, Australia. 72p.
- ICMM (2019). *Integrated Mine Closure: Good Practice Guide (2nd edition)*. International Council on Mining and Metals (ICMM), London, UK. 132p.
- Young, R.; Manero, A.; Miller, B.; Kragt, M.; Standish, R. & Boggs, G. (2019). A framework for developing mine-site completion criteria in Western Australia. The Western Australian Biodiversity Science Institute, Perth, Australia. 45p.

The previous version of the MCP was approved in 2022. This version of the MCP is required to account for changes to the Project including:

- General revision of site surface infrastructure that provides a greater level of detail over previous preliminary layout.
- Revision of the box cut design dimensions and inclusion of backfilling during construction rather than closure.
- Intention to use WRD1 as a secondary WRD for underground waste after backfilling of the box cut is complete.
- Removal of raw water dam and replacement with raw water tanks.

- Revised drainage network, sediment basin layout and other ESC measures..
- Revision of the mine design and mining methodology to include backfilling with cemented paste backfill.
- Construction of a paste plant for production of cemented paste backfill.
- Realignment of the haul road to Grants in a 4.5 km infrastructure corridor that also includes provision for overhead power and pipelines to pipe to transfer mine water between the Project and Grants mine water storages, and for transferring processed fines to the Project paste plant.
- Upgrade of an existing intersection and portion of access track as the permanent site entrance to the Project.
- Inclusion of ventilation shafts and surface infrastructure for the underground.
- Inclusion of a site security fence / fire break.
- Inclusion of a communications tower pad and access road.
- Inclusion of a power generation pad.

# 2. Project Overview

## 2.1 Background

The area has a long history of exploration and mining activity, with the majority of the known resources discovered in the late 1800s to early 1900s. The BP33 deposit was mined previously in the 1980s and 1990s as an open pit mine. The ore was trucked to a central processing facility located nearby at Observation Hill which operated for over a decade.

The Finniss Lithium Project comprises a number of pegmatite prospects that are being explored by Core Lithium. Core Lithium currently holds MA 1020-01 pursuant to the Mining Management Act for mining and processing of the Grants ore resource on Mineral Lease (ML) 31726. Further exploration drilling programs across the Finniss Lithium Project area in 2018–2019 identified a number of satellite ore resources nearby the Grants project, that extended the life of mine for the Finniss Lithium Project. This includes the current Project and Carlton deposit. Ore mined at these deposits will be trucked to the Grants processing facility. The Project was assessed under the Environmental Assessment Act and Mining Managment Act with Environmental Approval EP2020/001-001 issued in April 2022 and Mining Authorisation 1138-01 granted in April 2023. Early works construction began in 2023.

## 2.2 Project location and tenure

The Project is located 2.5 km south-west of the Cox Peninsula Road, approximately 33 km west of the Berry Springs Township and around 10 km from the coast (Figure 1 and Table 1). Mineral Leases (ML32074 and ML32346) cover the Project. Mineral Lease ML32346 covers the underground and associated surface infrastructure and was granted 12 December 2019, under the Mineral Titles Act (MTA). Whilst the project area is not located within the boundaries of any local government area, the haul route is along Northern Territory Government (NTG) controlled main roads that pass through the areas of Litchfield, Palmerston and Darwin municipalities.

**Table 1: Land information for the project area**

| Aspect | Details |
|---|---|
| Latitude | -12.71° S |
| Longitude | 130.79° E |
| Area | 61.4 ha |
| Tenement details | ML32074, MLN16, ML32346 |
| Street address | 2873 Cox Peninsula Road, Cox Peninsula |
| Parcel description | Section 1 Hundred of Parsons & Section 2746 Hundred of Hughes |
| Zoning | Rural |
| Tenure | Vacant Crown Land owned by the NTG |
| Local government area | Unincorporated (Cox-Daly) area |

700000

750000

8650000

8600000

8550000

8500000

**Legend**

- Roads
- National parks

**Project location**

Darwin

Holmes

Cox Peninsula

Darwin

Belyuen

Southport

Blackmore

Acacia Hills

Manton

Manton Dam Recreation Area

Batchelor

Adelaide River

Litchfield National Park

Tipperary

MINE EARTH

# Regional location

Figure 1

N

0 12.5 25 50

Kilometers

Scale: 1:450,000 at A3

Spatial Reference
GCS: GCS WGS 1984
Datum: WGS 1984

Author: H.Crisp
Reviewed by: A. Paton
Date:15.05.2024

## 2.3 Mine Plan

### 2.3.1 Resource

Rock mass characterisation for the BP33 deposit and surrounding host rock is summarised as a host rock consisting of sandstone and phyllite, with the orebodies or lodes consisting of pegmatite that contain a simple mineral assemblage of quartz, feldspar, spodumene (lithium pyroxene) and muscovite (white mica) (SRK, 2020). The resource at the Project is pegmatite, a granite type rock containing spodumene (LiAlSi2O6). The deposit is a narrow ~40 m wide near vertical pegmatite with drilling to date intersecting pegmatite down to 400 m vertical depth. Additional definition drilling found the pegmatite to extend beyond 800 m vertical depth with a potential or reverse of 10.5 MT.

The definitive mine design is based on mining a total (proved and probable) 2.3 MT resource at 1.4% as Li2O giving a total of 32.2 kt as Li2O. The design also considers the larger 10.5 million tonne resource that may be subject to future approval.

### 2.3.2 Mining method

The preferred mining method selected is to be long hole open stoping (LHOS) with paste backfill. The ore body width, vertical orientation, and competent host rock ground conditions allows this to be considered as a suitable mining method. The proposed method provides:

- Favourable production profile over Life of Mine (LOM).
- Delivers early access to stope production, minimising ore production gaps.
- All waste rock can be returned underground as stope backfill.
- Enables production from several mining areas concurrently.
- Delays the requirement for commissioning of the paste plant.

Drill and blast methods will be used to extract the ore, which will be removed by underground production loaders. Mined material will be stockpiled on the production level or loaded directly into underground mining trucks and hauled to the surface ROM via the decline. The mine will extend to a nominal depth of 320 m as currently approved, however the mine design also considers a larger 10.5 million tonne resource that may be subject to future approval.

### 2.3.3 Processing

Ore stockpiled on the Project ROM pad will be hauled to the processing facility at the Grants Lithium Project via the dedicated 4.5 km internal haul road. The ore mined at the Project will be used to continue production from the processing plant only after the Grants ore resource is exhausted.

### 2.3.4 Transport

Once processed at Grants, ore will be loaded onto road trains for transport to Darwin Port (East Arm), a total distance tof 94.5 km. The haul route is along Cox Peninsula Road, through to the Stuart Highway, along the Stuart Highway to Tiger Brennan Drive and then Berrimah Road, to the East Arm Port.

## 2.4 Mine Features

The key components of the Project are as follows (Figure 2).

- Site infrastructure, including a contractor's area, internal access roads and drainage infrastructure, water storages and Run of Mine (RoM) pad.
- A boxcut portal to an approximate depth of 40 m to remove weathered waste rock and provide a stable foundation for construction of an underground portal.
- A 600 m long decline from the base of the boxcut to the top of the spodumene and progressive construction of a further 2.5 km of decline over the mine life to connect lower levels of the underground mine.
- Two onsite waste rock dumps (WRDs) for temporary storage of oxide waste rock (from the boxcut) and transitional/fresh waste rock (from the underground) prior to progressively backfilling the material.
- A historical void and pit lake at the south of the project.

694000
696000
8598000
8596000
8594000

Grants Pad
Communication Tower
ROM Pad
Box-cut Stockpile Area
Waste Rock Stockpile Area
Box-cut and WRD
Decline Development Laydown Area
Mine water dam
Box-cut Laydown Area
Sediment Basin
Soil Stockpile Area
Paste Plant Pad
Civil Contractor Area
Generator Pad
Vent Pad
Site Access Road
Haul Road / Infrastructure Corridor Alignment

**Legend**

Infrastructure

- Exisiting Infrastructure
- Proposed / New Infrastructure

Maxar

MINE EARTH

# Existing and Proposed Infrastructure

Figure 2

N

0 0.5 1 2

Kilometers

Scale: 1:16,000 at A3

Spatial Reference
PCS: GDA 1994 MGA Zone 52
GCS: GCS GDA 1994
Datum: GDA 1994

Author: H.Crisp
Reviewed by: A. Paton
Date:29.05.2024

### 2.4.1 Boxcut

The boxcut commenced construction in 2023 and has been excavated to 35m with a design depth of 40 m below ground level. Foundations for the construction of the steel arch tunnel liner have commenced and are partially completed. The tunnel liner is a nominal 6 m in diameter and will be 288 m long.

In addition to other excavated onsite materials, oxide waste rock material excavated from the boxcut was used as a source of fill for early works civil construction. Excess waste was transported to WRD1 for temporary storage whilst the portal and steel tunnel liner is completed. All boxcut oxide waste in WRD1 will be used to backfill the boxcut upon completion of the tunnel liner and the area used for rehabilitation trials during operations. Some boxcut material may be used to construct the low permiability foundations of WRD1 and WRD2.

### 2.4.2 Portal and upper and lower decline

A portal located in the southern wall of the boxcut will be constructed at a depth of 40 mbgl. It will be 25 m long and 6 m wide. From the portal at the base of the boxcut a 0.6 km upper decline will be used to access the upper ore body. A further 2.5 km lower decline constructed over the life of mine to provide access to each production level, to a depth of approximately 320 m below surface.

The underground mine will comprise ten production levels. 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.

The underground will be progressively backfilled with underground waste from WRD2 and then underground waste from WRD1.

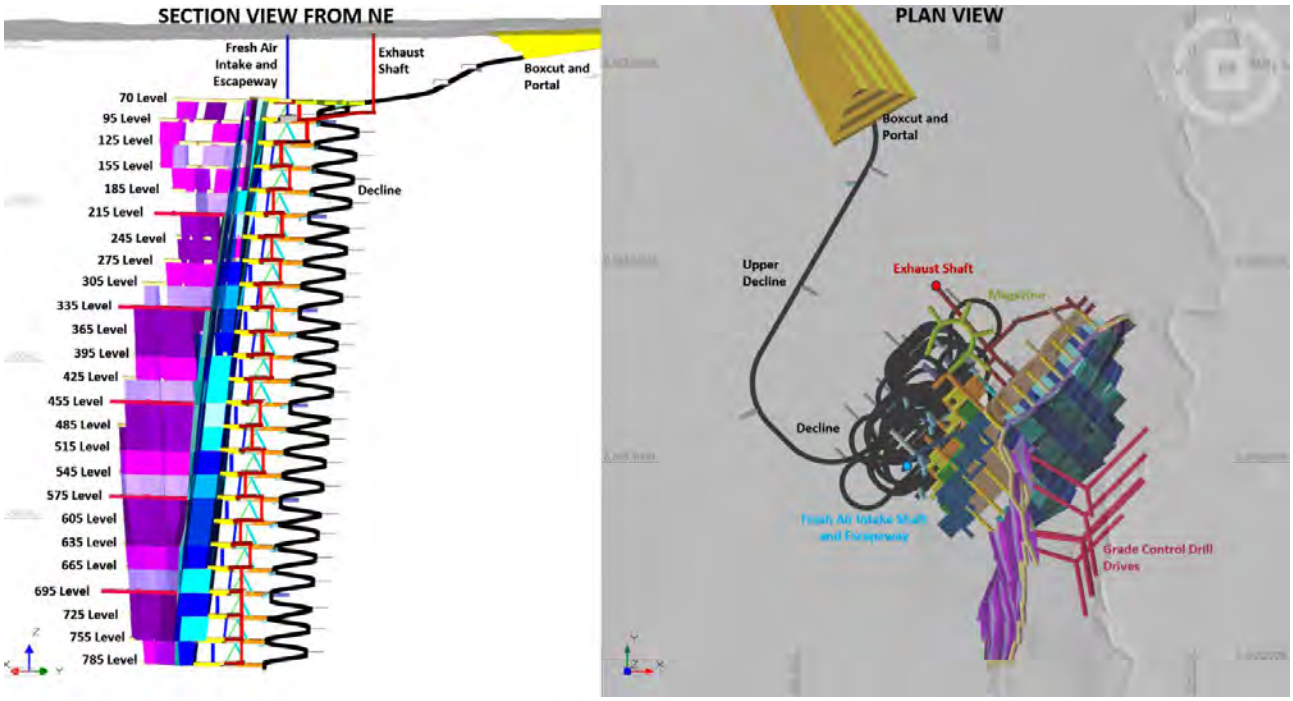



**Figure 3: Underground section and plan view**

### 2.4.3 Ventilation shafts

Three RAR and Fresh Air Raise (FAR) shafts will be constructed in two areas in the southern portion of the site and will provide fresh air to the underground operations and extract return air. Ventilation fans and ancillary infrastructure will be constructed at the surface to service both areas.

### 2.4.4 Waste Rock Dumps

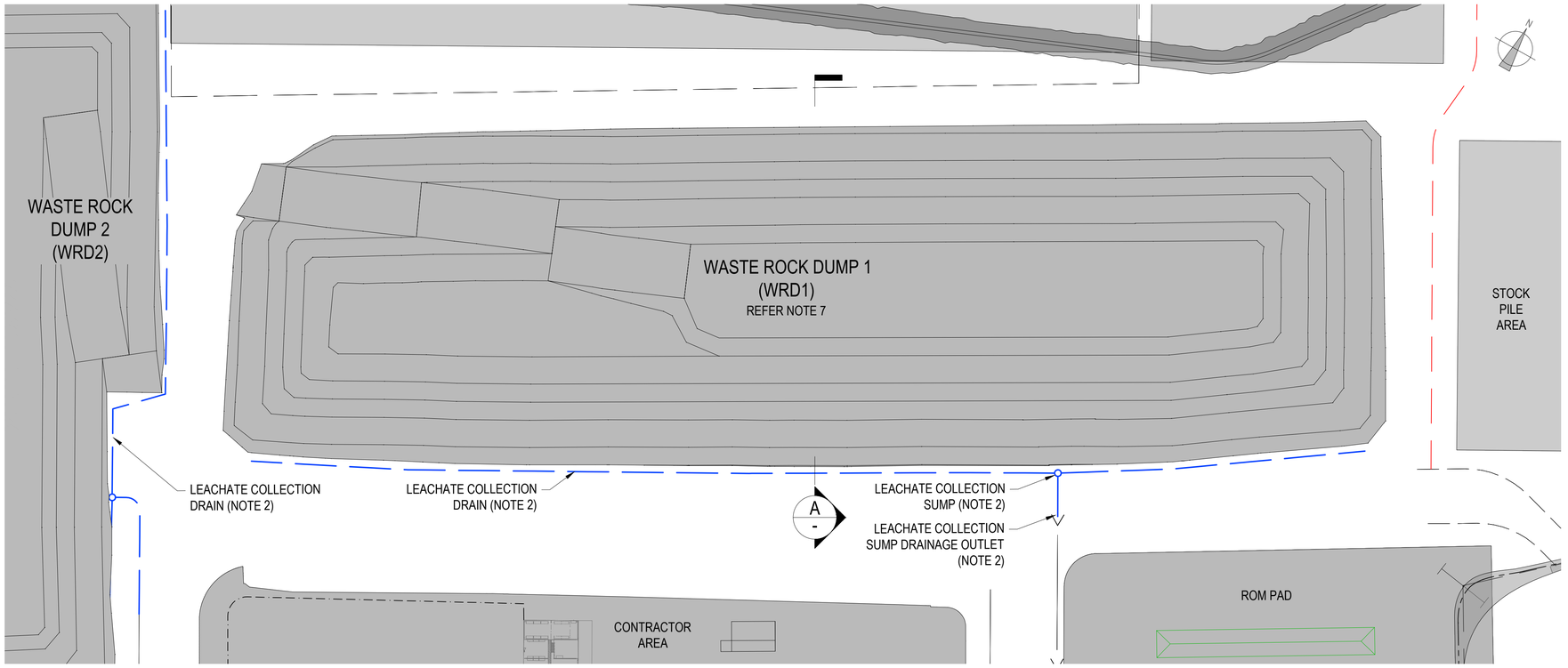
Two separate WRDs will be established for temporary storage of waste rock prior to it being used to backfill the boxcut and underground mine. WRDs will be constructed with a low permiability foundation. The physical and geochemical characteristics of the waste rock materials is discussed in Section 5.4.

#### 2.4.4.1 WRD 1

Weathered material excavated from the boxcut has been placed WRD 1, located to the north-east of the boxcut. WRD 1 will be temporary in nature with stored material used for civil works and to backfill the boxcut. After backfilling is complete, WRD 1 will be upgraded with a low permeability foundation and leachate collection system to provide a secondary WRD for underground mining waste.

WRD 1 contains oxide waste from the boxcut and has a maximum design height of 15 m and design volume of 400,000 LCM. WRD 1 has currently been dumped to an approximate height of 12 m and contains 356,596 LCM.

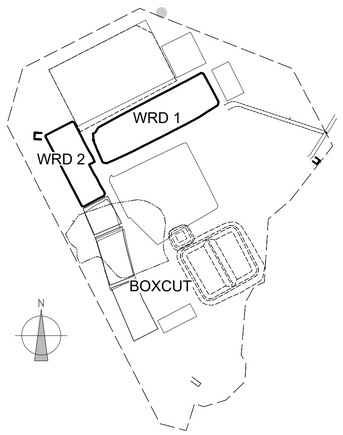
WRD 1 is shown in Figure 4.



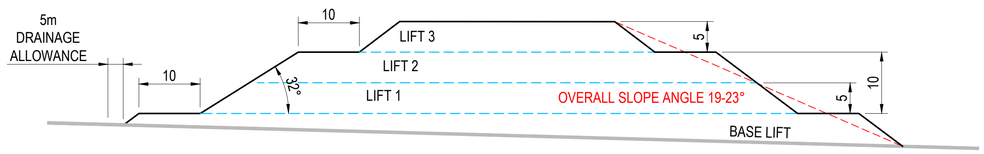

## LAYOUT PLAN
SCALE 1:1000

## NOTES:

1. THE DRAWINGS AND INFORMATION SHOWN ARE TYPICAL AND REPRESENT DESIGN INTENT WHICH WILL BE DEVELOPED AND DETAILED IN FINAL DESIGNS PRIOR TO CONSTRUCTION.
   THE DESIGN FOR MINE WASTE STORAGES WILL BE PREPARED BY INDEPENDENT AND SUITABLY QUALIFIED AND EXPERIENCED PERSONS AND CERTIFIED TO DEMONSTRATE THAT THE DESIGN MEETS APPROPRIATE AND APPLICABLE ENGINEERING STANDARDS.
   INDEPENDENT QUALIFIED PERSONS SHALL BE PROFESSIONAL ENGINEERS WHO ARE SUITABLY CHARTERED OR HAVE NATIONAL ENGINEERING REGISTER CREDENTIALS IN CIVIL, STRUCTURAL AND/OR GEOTECHNICAL ENGINEERING.
2. THE SIZING, ALIGNMENT, POSITION AND EXTENT OF THE LEACHATE DRAIN AND COLLECTION SYSTEM IS INDICATIVE ONLY.
   FINAL OFFSET (PARTICULARLY IN RELATION TO THE WASTE ROCK DUMP EMBANKMENT), SIZING AND DESIGN OF THE DRAIN AND LEACHATE STORAGE SYSTEM WILL BE UNDERTAKEN BY SUITABLY QUALIFIED ENGINEER AND IS SUBJECT TO GEOTECHNICAL ENGINEERING ADVICE.
3. AS REQUIRED, WASTE ROCK DUMP SITE PREPARATION SHALL BE IN ACCORDANCE WITH GEOTECHNICAL ENGINEERING SPECIFICATIONS. INCLUDING (BUT NOT LIMITED TO) REMOVAL OF: EXISTING FILL, TREES WITHIN THE AREA BOUNDARIES, TREE SUB-SURFACE STRUCTURE AND STRIPPING OF TOPSOIL.
4. WASTE ROCK DUMP SUBGRADE PREPARATION SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE GEOTECHNICAL ENGINEERING SPECIFICATIONS, INCLUDING REQUIREMENTS FOR PLACEMENT OF SUBGRADE FOR LEACHATE BARRIER FILL.
5. WASTE ROCK DUMP FOUNDATION AND LEACHATE BARRIER MATERIALS SHALL COMPLY WITH FINAL DESIGN, GEOTECHNICAL ENGINEERING AND CONSTRUCTION SPECIFICATIONS AND SHALL INCLUDE AS A MINIMUM:
   - ENGINEERED FILL CHARACTERISTICS AND PARAMETERS FOR EITHER SITE WON OR IMPORTED MATERIALS, AND
   - LEACHATE BARRIER FILL CHARACTERISTICS AND PARAMETERS, INCLUDING APPROPRIATE PERMEABILITY COEFFICIENTS FOR NAF AND IF APPLICABLE PAF MATERIALS; AND
   - ALL RECOMMENDED FILL THICKNESSES, PLACEMENT, COMPACTION AND TESTING REQUIREMENTS.
6. EARTHWORKS TESTING TO BE UNDERTAKEN UNDER THE SUPERVISION OF A GEOTECHNICAL TESTING AUTHORITY, ADOPTING A LEVEL 2 RESPONSIBILITY AS DESCRIBED IN CLAUSE 8.3 OF AS 3798:2007 “GUIDELINES ON EARTHWORKS FOR COMMERCIAL AND RESIDENTIAL DEVELOPMENTS”.
7. WRD1 IS THE CURRENT STOCKPILE AREA FOR EXCAVATED BOX CUT MATERIAL.




## LOCALITY PLAN / GENERAL ARRANGEMENT
SCALE 1:10000




REFER TO NOTES FOR SITE PREPARATION DESIGN AND CONSTRUCTION

## TYPICAL SECTION A
SCALE 1:500

CONCEPT

| rev | description | app'd | date |
|---|---|---|---|
| B | ISSUED AS CONCEPT DESIGN | DVO | 24.05.24 |
| A | ISSUED FOR REVIEW | DVO | 22.05.24 |

0 10 20 30 40 50m
SCALE 1:1000 AT ORIGINAL SIZE

0 100 200 300 400 500m
SCALE 1:10,000 AT ORIGINAL SIZE

0 5 10 15 20 25m
SCALE 1:500 AT ORIGINAL SIZE

CORE LITHIUM

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CORE LITHIUM
BP33 MINE - INFRASTRUCTURE DESIGN
BP33 MINE SITE
WASTE ROCK DUMP #1
LOCALITY, LAYOUT AND TYPICAL SECTION

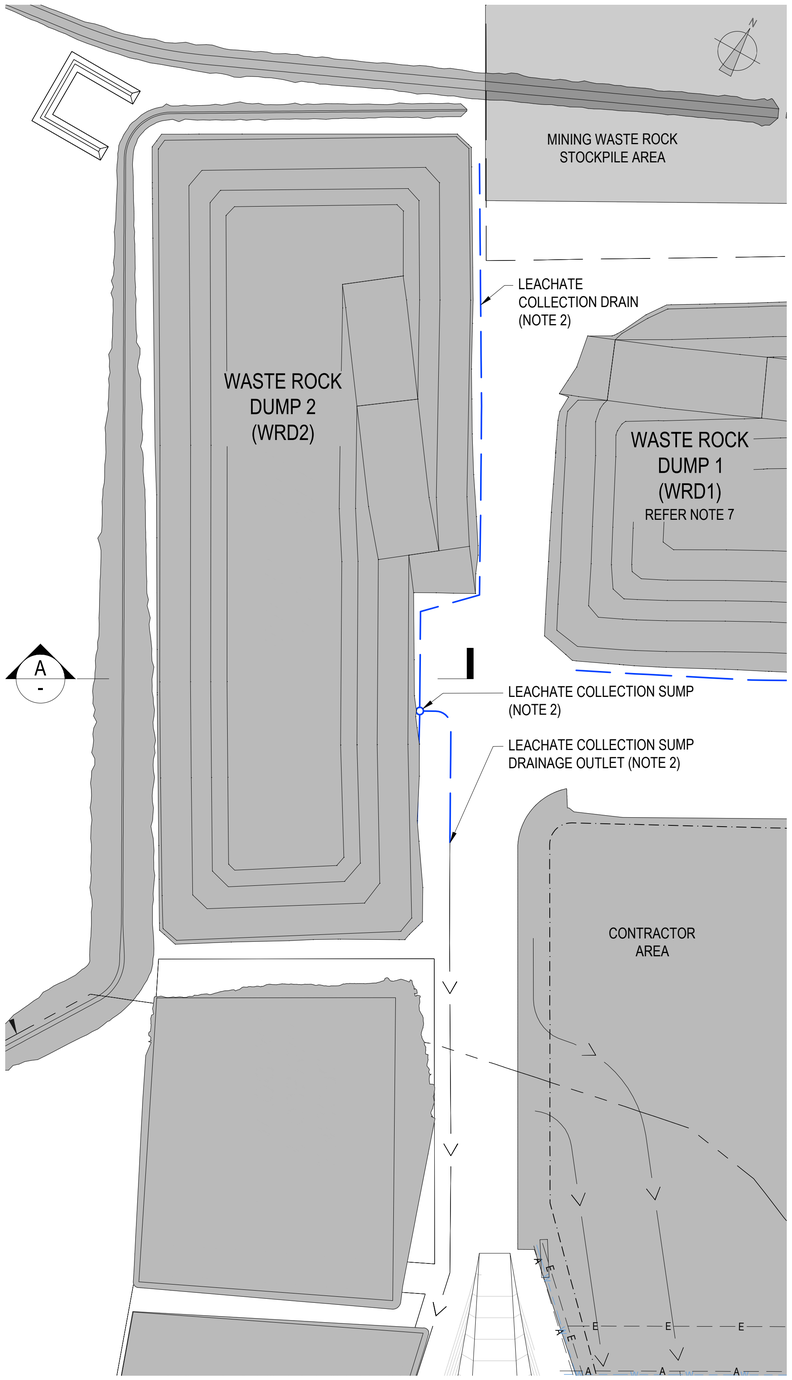
size: A1
project no.: P1004
sketch no.: P1004-IEA-SKT-CI-01
rev no.: B

plot date: 24 May 2024 - 8:35 AM
plotted by:
file name:

#### 2.4.4.2 WRD 2

WRD 2 will comprise transitional and fresh material from the underground with a design capacity of 150,000 LCM. Initially, suitable onsite material will be used to construct a flat compacted low permeability foundation with underground waste paddocked dumped to a height of up to 20 m. Waste material from WRD 2 will be progressively used to backfill underground workings in conjunction with cemented paste backfill. On completion of mining, there will be no waste material remaining on the project surface.

WRD 2 is shown in Figure 3




LAYOUT PLAN
SCALE 1:1000

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   THE DESIGN FOR MINE WASTE STORAGES WILL BE PREPARED BY INDEPENDENT AND SUITABLY QUALIFIED AND EXPERIENCED PERSONS AND CERTIFIED TO DEMONSTRATE THAT THE DESIGN MEETS APPROPRIATE AND APPLICABLE ENGINEERING STANDARDS.
   INDEPENDENT QUALIFIED PERSONS SHALL BE PROFESSIONAL ENGINEERS WHO ARE SUITABLY CHARTERED OR HAVE NATIONAL ENGINEERING REGISTER CREDENTIALS IN CIVIL, STRUCTURAL AND/OR GEOTECHNICAL ENGINEERING.

2. THE SIZING, ALIGNMENT, POSITION AND EXTENT OF THE LEACHATE DRAIN AND COLLECTION SYSTEM IS INDICATIVE ONLY.
   FINAL OFFSET (PARTICULARLY IN RELATION TO THE WASTE ROCK DUMP EMBANKMENT), SIZING AND DESIGN OF THE DRAIN AND LEACHATE STORAGE SYSTEM WILL BE UNDERTAKEN BY SUITABLY QUALIFIED ENGINEER AND IS SUBJECT TO GEOTECHNICAL ENGINEERING ADVICE.

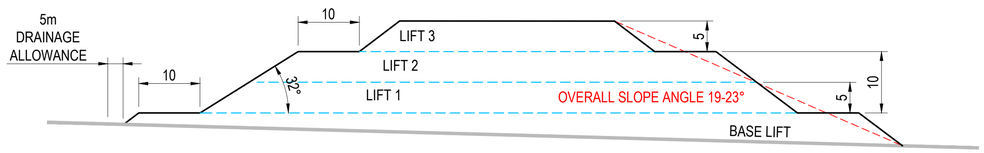
3. AS REQUIRED, WASTE ROCK DUMP SITE PREPARATION SHALL BE IN ACCORDANCE WITH GEOTECHNICAL ENGINEERING SPECIFICATIONS. INCLUDING (BUT NOT LIMITED TO) REMOVAL OF: EXISTING FILL, TREES WITHIN THE AREA BOUNDARIES, TREE SUB-SURFACE STRUCTURE AND STRIPPING OF TOPSOIL.

4. WASTE ROCK DUMP SUBGRADE PREPARATION SHALL BE UNDERTAKEN IN ACCORDANCE WITH THE GEOTECHNICAL ENGINEERING SPECIFICATIONS, INCLUDING REQUIREMENTS FOR PLACEMENT OF SUBGRADE FOR LEACHATE BARRIER FILL.

5. WASTE ROCK DUMP FOUNDATION AND LEACHATE BARRIER MATERIALS SHALL COMPLY WITH FINAL DESIGN, GEOTECHNICAL ENGINEERING AND CONSTRUCTION SPECIFICATIONS AND SHALL INCLUDE AS A MINIMUM:
   - ENGINEERED FILL CHARACTERISTICS AND PARAMETERS FOR EITHER SITE WON OR IMPORTED MATERIALS, AND
   - LEACHATE BARRIER FILL CHARACTERISTICS AND PARAMETERS, INCLUDING APPROPRIATE PERMEABILITY COEFFICIENTS FOR NAF AND IF APPLICABLE PAF MATERIALS; AND
   - ALL RECOMMENDED FILL THICKNESSES, PLACEMENT, COMPACTION AND TESTING REQUIREMENTS.

6. EARTHWORKS TESTING TO BE UNDERTAKEN UNDER THE SUPERVISION OF A GEOTECHNICAL TESTING AUTHORITY, ADOPTING A LEVEL 2 RESPONSIBILITY AS DESCRIBED IN CLAUSE 8.3 OF AS 3798:2007 “GUIDELINES ON EARTHWORKS FOR COMMERCIAL AND RESIDENTIAL DEVELOPMENTS”.

7. WRD1 IS THE CURRENT STOCKPILE AREA FOR EXCAVATED BOX CUT MATERIAL.




REFER TO NOTES FOR SITE PREPARATION DESIGN AND CONSTRUCTION

TYPICAL SECTION A
SCALE 1:500

CONCEPT

| rev | description | app'd | date |
|---|---|---|---|
| B | ISSUED AS CONCEPT DESIGN | DVO | 24.05.24 |
| A | ISSUED FOR REVIEW | DVO | 22.05.24 |

0 10 20 30 40 50m
SCALE 1:1000 AT ORIGINAL SIZE

0 5 10 15 20 25m
SCALE 1:500 AT ORIGINAL SIZE

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CORE LITHIUM
BP33 MINE - INFRASTRUCTURE DESIGN
BP33 MINE SITE
WASTE ROCK DUMP #2
LAYOUT AND TYPICAL SECTION

size A1
project no. P1004
sketch no. P1004-IEA-SKT-CI-02
rev no. B

plot date: 24 May 2024 - 8:36 AM
plotted by:
file name:

### 2.4.5 Explosives magazine

The explosive magazine will likely remain at Grants with material transported to the Project in service trucks as required. If a suitable area is identified within the Project development footprint that complies with applicable standards and legislation then the explosives magazine may be located at the Project.

### 2.4.6 Topsoil and sub-soil stripping and storage

Approximately 4.3 ha has been allocated to storage of topsoil and subsoil stripped from the site. Topsoil and where possible, subsoil has been stripped from all cleared areas. Approximately 44,500 LCM of topsoil / subsoils is currently stockpiled in the topsoil dump located east of WRD1. Topsoil from the upgraded portions of the site access track has been windrowed along the clearing extents. Topsoil and subsoil have not yet been removed from the haul road / infrastructure corridor.

Stockpile heights will be limited at a maximum height of 1.5 m with subsoil placed in a maximum of 3 m high stockpiles. The design criteria and controls required for each stockpile has been detailed in the BP33 Erosion and Sediment Control Plan prepared in accordance with IECA (2008).

### 2.4.7 Run of Mine (ROM) pad

A ROM pad will be constructed for temporary storage of mined ore ready for transport to the Grants processing facility. The ROM pad will be a raised compacted pad with a footprint of approximately 3.4 ha. Drainage from the ROM pad will require management as mine affected water.

### 2.4.8 Contractor area and laydowns

The mining contractor area includes all administration, workshops, stores, ablutions and crib rooms. Additional laydown areas are located to west of the boxcut excavation and will be used to support civil construction and underground mining activities.

### 2.4.9 Other mine support infrastructure

Other mine support infrastructure includes potable water treatment system and tanks, wash down bays, diesel storage and refuelling facilities, concrete batch plant and a core shed.

### 2.4.10 Security fence and firebreak

A 10 m wide fire break and security fence corridor has been constructed around the Project operational area. Topsoil has not been removed from this footprint.

### 2.4.11 Water management system

#### 2.4.11.1 Observation Hill Dam (OHD)

OHD is an existing dam and will be the primary raw water supply for the Grants processing facility and the Project underground mine. OHD is filled by rainfall and surface water flows each wet season and will be used for processing, dust suppression and surface amenities. The OHD is not within the Project development footprint and is described in the Grants MCP (Core, 2022a).

#### 2.4.11.2 Raw Water Tanks

Water will be received from OHD and stored in two 600 Kl tanks and will be used primarily for dust suppression and as a secondary supply to the underground operations as required.

#### 2.4.11.3 Mine Water Dam

A Mine water dam (MWD) (previously referred to as the mine settling dam or MSD) has been constructed to store and treat mine affected water from underground operations and excess decant water from the paste plant. The proposed maximum operating volume is 132.6 ML. The dam is a turkeys nest type construction with water used to meet operational mine demands including dust suppression. Mine affected water that is excess to operational mine demands will be released to the environment under a Waste Discharge Licence (WDL) during the wet season or transferred to Grants operations as operational needs require.

The dam is a full perimeter embankment, with materials for construction taken from within the storage areas (cut/fill balance). The dam includes a low permeability basal liner and erosion protection with future provision for a HDPE liner should geotechnical assessment require it.

#### 2.4.11.4 Diversion bunds/drains

Clean stormwater runoff is diverted around the site by a series of diversion bunds and drains. Internal to the mine site a stormwater drainage network provides for collection and treatment of water in sediment basins prior to controlled discharge off site or used as top up water to MWD to meet mine water demands if required.

#### 2.4.11.5 Groundwater bores

A network of groundwater monitoring bores has been installed across the development footprint to assess water quality and standing water levels.

#### 2.4.11.6 Sediment basins

Two Type B HES sediment basins have been constructed to manage surface water runoff from the Project disturbance footprint and have been sized for the required catchment area. The sediment basins employ automatic flocculant dosing. Water from these basins will be used as top up mine water demands.

#### 2.4.11.7 Water pipeline

A raw water pipeline will be installed between the OHD and the Project. The pipeline will be constructed of polyethylene plastic and will be buried to a sufficient depth to provide for protection from fire. The pipeline will be approximately 1.4 km and traverse alongside the existing access track, which has been widened and upgraded.

#### 2.4.11.8 Dewatering bores

Should dewatering be required ahead of decline and underground construction or if there is a deficit in mine water, a dewatering bore network will be established. The location and number of bores has not yet been determined and will be confirmed prior to the commencement of underground construction. Applicable extraction licences will be obtained prior to construction and commissioning.

## 2.4.12 Roads

### 2.4.12.1 Light vehicle access and inspection track

An existing light vehicle access track runs between Grants operations and the Project. The track follows the alignment of the OHD to Grants raw water pipeline and is described in the Grants MCP (Core, 2022a).

### 2.4.12.2 Haul road and infrastructure corridor

A 4.5 km dedicated haul road will be constructed to facilitate transport of ore from the Project ROM pad to the Grants processing facility. The haul road will be located within a 50 m wide cleared infrastructure corridor that will include provision for future overhead power, buried HDPE pipe for transfer of mine affected water between Grants and the Project, and a second buried pipe for transfer of processing fines to Project paste plant.

### 2.4.12.3 Site access road

An existing track has been upgraded into a dual lane all weather access road. During construction, a temporary site access intersection with Cox Peninsula Road was utilised and will be decommissioned upon construction of a secondary operational intersection located approximately 500 m north from the temporary construction site access.

### 2.4.12.4 Permanent site access point

The relocation of the site access intersection with Cox Peninsula Road will require upgrade / widening along a 350 m section of existing track and upgrade of the intersection to include a slip lane.

### 2.4.12.5 Internal access roads

Various internal light vehicle access and haul roads have been constructed to facilitate early civil construction works.

## 2.4.13 Communications tower pad and access road

A single 19 m guyed communication tower and associated solar unit will be constructed on an elevated ridge north of the Project development area. The area will be cleared and vegetation maintained but no topsoil removed.

## 2.4.14 Power generation pad

A generator pad will be constructed to the south of the boxcut and provide area for diesel generators to power mine infrastructure.

## 2.4.15 Paste plant

The paste plant is designed to mix milled tailings that is dewatered into a filter cake with additional milled tailings (in slurry form) and binder added to produce paste. The plant will be a continuous mixing operation with paste delivered underground via gravity. Mine affected water dewatered from the slurry will be transferred to the MWD.

## 2.4.16 Historical pit void

The historical BP33 pit is located above the BP33 ore body and has a surface area of approximately 3,500 $m^2$ and depth of 9.97 m with a calculated fill volume of the pit of 19,457 $m^3$. The pit is proposed to be backfilled to

remove water storages above the underground mine and facilitate construction of proposed surface infrastructure.

The BP33 pit lake contains water that typically persists through the dry season, however during construction water was not observed to recharge when extracted for construction activities, indicating it is unlikely to represent a groundwater feature. However, water levels in the 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; especially in the late dry season (Cloud-GMS, 2021).

## 2.5 Closure Domains

To facilitate mine closure planning the Project has been divided into domains that represent groups of disturbed sites and/or infrastructure that will have comparable requirements at closure. Each domain and their associated disturbed sites are present in Table 2 and Figure 6.

**Table 2: Closure domains and disturbed sites**

| Domain | Disturbed sites |
|---|---|
| Boxcut and underground workings | Boxcut, portal, upper and lower decline, ventilation shafts |
| Waste rock and topsoil dumps, ROM pad | WRD1, WRD2, topsoil stockpile, ROM pad |
| Historical pit void | Historical pit void |
| Roads | Haul road, access roads, access intersection, internal access roads |
| Infrastructure and pipelines | Contractor area and laydowns, other mine support infrastructure, water pipeline, communication tower pad, power generation pad, paste plant. |
| Dams and ponds | Observation Hill Dam (OHD), raw water tanks, mine water dam, diversion bunds and drains, sediment ponds |

693000
694500
696000
8598000
8596500
8595000
8593500

**Legend**

Closure domains

- Box cut and underground workings
- Waste rock, topsoil dumps and ROM
- Infrastructure and pipelines
- Damn and ponds
- Roads

ROM Pad

WRD

Waste stockpile

Box-cut

Paste Plant Pad

MINE EARTH

# Closure domains

Figure 6

N

0 0.25 0.5 1 1.5

Kilometers

Scale: 1:15,000 at A3

Spatial Reference
PCS: GDA 1994 MGA Zone 52
GCS: GCS GDA 1994
Datum: GDA 1994

Author: H.Crisp
Reviewed by: A. Paton
Date:29.05.2024

# 3. Closure Obligations and Commitments

This section provides an overview of the key Commonwealth and NT environmental and heritage legislation applicable to the project, and key approvals, licences or permits received and/or required to proceed.

## 3.1 Commonwealth

### 3.1.1 Environment Protection and Biodiversity Conservation (EPBC) Act 1999

The EPBC Act is the Australian Government's key environmental legislation. Approval under the EPBC Act may be required for any proposed action likely to have a significant impact on a matter protected by that Act. The environment assessment and approvals process of the EPBC Act aims to protect Matters of National Environmental Significance (MNES), as well as the environment in general where actions proposed are on, or will affect Commonwealth land, and/or where Commonwealth agencies are proposing to take an action. A significant impact assessment (SIA) was undertaken by Epic Environmental (2024) and did not identify a risk of significant impact, therefore not triggering referral under the EPBC Act.

### 3.1.2 Native Title Act 1993

The project area is not located on land subject to native title claim and therefore the Native Title Act does not apply.

### 3.1.3 National Greenhouse and Energy Reporting Act 2007

Core Lithium report annually under the National Greenhouse and Energy Reporting (NGER) Act for cumulative emissions from Grants operations and the Project.

## 3.2 Northern Territory

### 3.2.1 Environment Protection Act 2019

A Supplementary Environmental Report (SER) was submitted to the Northern Territory Environmental Protection Authority (NTEPA). NTEPA assessed the SER and issued Assessment Report 94 which summarises its finding and provides recommendations and draft approval conditions. Environmental Approval EP2020/001-001 was issued in April 2022 and subsequently approved by the Minister.

Environmental approval conditions 2 and 3 of the EPA's Environmental Approval (Appendix X) required the following considerations to be explicitly addressed in the MCP.

**2 Action implementation and closure**

2-1 The approval holder must implement the action to meet the following environmental outcomes:

(1) The action must be rehabilitated and closed in such a manner that the approval holder can demonstrate that it:

(a) is physically safe to humans and animals; and

(b) is geo-technically stable; and

(c) is non-polluting, non-contaminating; and

(d) does not cause material environmental harm or significant environmental harm; and

(e) is able to sustain the post-mining land use in the approved Mine Closure Plan required by condition 3.

**3 Mine Closure Plan**

3-1 To demonstrate that the outcomes required by condition 2-1 are achieved, the approval holder must prepare a Mine Closure Plan, before substantial disturbance, that is consistent with contemporary best practice guidance on mine closure.

In November 2023 the Northern Territory Legislative Assembly passed the Environmental Protection Legislation Amendment Act 2023. The Amendment Act establishes a new environmental licensing framework for managing environmental impacts of mining activities under the EP Act 2019.

### 3.2.2 Mineral Titles Act 2010

The Mineral Titles Act (MTA) establishes the framework within which activities to explore for and mine mineral resources can occur. It sets out the administrative processes for authorising activities through the granting of a title. Granted mineral titles include: ML32346, ML32074 and MLN16.

### 3.2.3 Mining Management Act 2001

Prior to any activities taking place on a granted EL or ML, a Mining Authorisation (MA) must be obtained under the Mining Management Act (MMA). An application for an authorisation must be accompanied by a Mining Management Plan (MMP). Core Lithium currently hold MA1138-01 for the Project and submitted an MMP.. Once approved the MMP will be available to the public, excluding commercial-in-confidence information. Core currently holds an MA 1021-01 under the Mining Management Act for the Grants project associated with the development and mining and processing activities.

### 3.2.4 Traffic Act 1987

Under the Traffic Act, permit approval is required where construction activities are within a NT road reserve. A Development Approval (DA) and Traffic Impact Statement (TIS) was submitted with Grants MMP, to enable the use of public roads to haul processed ore from the Grants processing facility to Darwin Port.

### 3.2.5 Water Act 1992

The Water Act 1992 (NT) is the overarching legislation to water mitigation in the NT. The Water Act provides for the investigation, allocation, use, control, protection and management of surface water and groundwater resources, as well as the administrative process for licensing these activities. Under this Act the Water Regulations 1992 (NT), Water Control Districts, Allocation Plans, groundwater extraction licences and surface

water extraction licences are some of the measures used to mitigate, assess and control water resources in the NT. The project will require water for operational dust suppression and processing. The project area is located in the Darwin Rural water control district (DRWCD). Grants has an approved Surface Water Extraction Licence (SWEL) under the Water Act to extract water from Observation Hill Dam (OHD). Groundwater abstraction licenses will be sought for the Project and management of waste water disposal offsite from the mine water dam will occur under WDL 253.

### 3.2.6 Other approvals, permits and licences

Other key approvals, permits and licences that may be required under NT Government legislation are discussed in Table 3.

**Table 3: Other relevant NT legislation and approvals.**

| Legislation | Relevance to project |
|---|---|
| Bushfires Management Act 2016 | The project area is located within the declared Northern Fire Protection Zone, permits and conditions apply. |
| Building Act 1993 | The mine site is located within the Darwin Building Control Area. Building and occupancy permits will be required. A registered certified plumber will conduct any upgrades required to the wastewater management system (septic). |
| Crown Lands Act 1992 | The proposed Mineral Leases (ML) are located on Vacant Crown Land (VCL). |
| Dangerous Goods Act 1998 | Provides for the safe storage and handling of dangerous goods. The storage and transport of explosives requires an approval to be obtained from Worksafe NT. Explosives will be stored in a magazine to be constructed at the mine site. An Explosives Business Licences will be obtained. All fuel storages must meet Australian Standard 1940: Storage and Handling of Flammable and Combustible Liquids |
| Heritage Act 2011 | All sites on the NT Heritage Register and archaeological sites are protected under this Act. The proposal will not affect any sites listed on the NT Heritage Register. A number of unregistered historic mining sites were identified the closest being 500 m from the WRD pad. Core Lithium does not propose any activities that would disturb this site. |
| Northern Territory Aboriginal Sacred Sites Act 1989 | Provides for the protection and registration of sacred sites by the traditional owners or custodians. An AAPA Authority Certificate (C2019/077) (variation to C2019/024) has been provided by the Aboriginal Areas Protection Authority to ensure the protection of sacred sites throughout the project. |
| Public and Environmental Health Act 2011 | Approvals will be required for onsite wastewater management systems that accept black and greywater from ablutions. These approvals are obtained from Department of Health. |
| Territory Parks and Wildlife Conservation (TPWC) Act 1976 | Applies statutory obligations in relation to the protection of flora and fauna. This Act allows the listing of |

| Legislation | Relevance to project |
|---|---|
| | threatened species with special conservation status and requires a permit to be obtained prior to interference with these species. This MCP considers the potential for the project to impact on threatened species. |
| Soils Conservation and Land Utilisation Act 1969 | Provides for the prevention of soil erosion and for the conservation and reclamation of soil. Erosion and Sediment Control Plans will be required to facilitate compliance with the general provisions of this Act. |
| Waste Management and Pollution Control Act 1998 | This Act provides for the protection of the environment by encouraging effective waste management, and pollution prevention and control practices. The Act establishes which activities require environmental protection approvals or licences and establishes environmental nuisances as an offence. For wastes that are removed for off-site disposal, waste management contractors engaged by the project and facilities accepting listed wastes must be licensed under this Act. |
| Weeds Management Act 2001 | Declares certain plants to be weeds, classifies weeds according to management requirements, and places obligations on landowners and occupiers to manage weeds. Desktop and field assessments have identified listed weeds within the project area. A Weed Management Plan will be required for this project to facilitate compliance with this Act. |

Mine planning and design have also considered the following non-statutory standards, guidelines and codes of practice (Table 4).

**Table 4: Non statutory requirements**

| Requirement | Relevant information |
|---|---|
| Best Practice Erosion and Sediment Control (International Erosion Control Association, 2008) | The Project Erosion and Sediment Control Plan (ESCP) has been developed in accordance with IECA (2008) (Appendix X). |
| Global Acid Rock Drainage (GARD) guide (International Network for Acid Prevention, 2014) | The Project WRD and AMD Management Plan (Appendix X) has been developed. |
| Environmental Assessment Guidelines on Acid and Metalliferous Drainage (NT EPA, 2013) | |

# 4. Stakeholder Engagement

Core Lithium recognises the importance of engaging with relevant stakeholders. The ability to build relationships and work collaboratively and transparently with our host communities is critical to the Company's long-term success.

Core Lithium has engaged with stakeholders during project planning and as part of the Social Impact Assessment (SIA) process. Engagement has occurred through a variety of means including face-to face meetings with service agencies and NGO's (i.e., government, councils, Berry Springs School, Environment Centre, Chamber of Commerce, St Johns Ambulance), distribution of project fact sheets and community meetings. Core Lithium has made a commitment to ongoing engagement and communication with stakeholders, and as the project moves closer to commencement, will have in place an ongoing Stakeholder Engagement Plan.

The objectives of engagement are as follows:

- Provide information and the opportunity to comment to government agencies and other stakeholders who may potentially be interested in activities (including closure and rehabilitation) at the Project.
- Identify the key issues and concerns of government agencies and other stakeholders in regard to the design and management of activities (including closure and rehabilitation) at the Project.
- Periodically provide updated information and results of the development and closure planning process to government agencies and other stakeholders as more information comes to hand.
- Allow for adjustments to the design and/or management of any proposed activities to accommodate concerns or issues raised by government agencies and other stakeholders, where relevant.

## 4.1 Stakeholder engagement findings

A register of stakeholder engagement undertaken to date regarding the Project is presented in Table 5.

**Table 5: Stakeholder engagement register**

| Date | Activity | Detail |
|---|---|---|
| Ongoing | Community hotline and contact@corelithium.com.au email | Core Lithium maintains a 1800 community hotline and advertised on all community materials. All interactions are recorded in a database. |
| | Dedicated stakeholder and community email address | Core Lithium has an established stakeholder and community contact database that can receive email updates on the project. Update emails to stakeholders from the contact@corelithium.com.au email address. |
| | Complaints and grievances | Core Lithium has established process receive, assess, respond to and action community andstakeholder complaints or grievances about the Finniss Lithium Project. Contact details for lodging complaints are publicised. |
| | Company website | Post regular updates and community reports on a designated page on Core Lithium's website. The new website is currently in development. |
| | Social media | Share ESG and community-focused updates on Core Lithium's LinkedIn and Twitter profiles. |
| 2024 | | |
| 5 March 2024 | Litchfield Council Meeting | Provided an update on the Finniss Lithium Operation, including the suspension of mining operations at Grants mine with the shift in focus to processing ore from stockpiles, as well as pausing early works at BP33 but progressing the mine study.<br>Discussed traffic and road safety.<br>Provided hard copies of the latest newsletter and Community Grants Program fact sheet. |
| 1 March 2024 | Community newsletter | Provided an update on the Finniss Lithium Operation, including the suspension of mining operations at Grants mine with the shift in focus to processing ore from stockpiles, as well as pausing early works at BP33 but progressing the mine study.<br>Shared an article about the 2024 Community Grants Program launch with features on past recipients including Belyuen School and the Milne Volunteer Bushfire Brigade.<br>Shared community hotline details. |
| 1 March 2024 | Launched 2024 Community Grants Program | Sent community members and stakeholders an application form and fact sheet for the 2024 Community Grants Program. |
| 2023 | | |

| Date | Activity | Detail |
|---|---|---|
| 1 December 2023 | Community newsletter | Provided a year in review update on operations and community engagement activities.<br>Shared details about the 2023 Community Grant Program with features on Palmerston Cricket Club and Palmerston Netball Club.<br>Board visited the Finniss Lithium Operation to review progress, meet team members and contracting partners.<br>Reflected on NT Resources Week.<br>Shared update on the Department of Environment, Parks and Water Security's site inspection at the Finniss Lithium Operation.<br>Featured an article about Darwin Festival Sponsorship.<br>Shared community hotline details. |
| 11 November 2023 | Wagait Shire Meeting | Provided updates on progress to date at the Finniss Lithium Operation.<br>There were concerns raised about sludge on the road from Core Lithium's vehicles, inadequacy of the entrance to BP33 for heavy vehicles and speed restrictions. |
| 1 October 2023 | Community newsletter | Provided updates on early works at the BP33 project including the sod turning event, early works and awarding local contract to Northern Australia Civil.<br>Update on Kenbi Rangers' fire management activities at the Finniss Lithium Operation.<br>Article about recent management appointments.<br>Details about round 2 of the Community Grants Program.<br>Shared community hotline details. |
| 13 September 2023 | Mining the Territory conference | Core Lithium held a both at the conference and General Manager Operations Alicia Sherwood presented.<br>Representatives from Core Lithium also attended the Gala dinner. |
| 27 August 2023 | Berry Springs markets | Representatives from Core Lithium held a community information stall at Berry Springs Markets to provide information to the community about the Finniss Lithium Operation, answer questions and hear feedback from the community about any concerns or opportunities. |
| 17 August 2023 | Sod turning event at the BP33 Project | The Honourable Nicole Manison, Minister for Mining and Industry attended a sod turning at BP33 to celebrate the significant milestone.<br>The company the BP33 early works package to local contractor, Northern Australia Civil. |
| 10 August 2023 | Darwin Festival | Core Lithium sponsored the festival and attended the opening night. |

| Date | Activity | Detail |
|---|---|---|
| 3 August 2023 | Launched 2023 Community Grants Program | Sent community members and stakeholders an application form and fact sheet for round 2 of the 2023 Community Grants Program. |
| 2 August 2023 | Facing North Conference | Representatives from Core Lithium attended the conference at Parliament House in Canberra. CEO Gareth Manderson participated in a panel discussion. |
| 2 June 2023 | Newmont 2023 Women in Resources Gala Award Dinner | Core Lithium representatives attended the award dinner. |
| 1 June 2023 | Meeting with Belyuen Council | Provided an update about the Finniss Lithium Operation. |
| 1 May 2023 | Community newsletter | Provided an update on progress at the Finniss Lithium Operation, including commissioning the Dense Media Separation processing plant and the appointment of Melissa Winks as the Executive General Manager, Sustainability.<br>Update on trucking movements.<br>Shared a story about Core Lithium funding a bus to transport Berry Springs School students to and from their annual school trip.<br>Update on the Community Grants Program.<br>Shared community hotline details. |
| 6 April 2024 | Launched 2023 Community Grants Program | Sent community members and stakeholders an application form and fact sheet for round 1 of the 2023 Community Grants Program. |
| 2022 | | |
| 12 November 2022 | Wagait Beach community meeting | Provided an update to the Wagait Beach community about the Finniss Lithium Operation.<br>Community members raised questions about Core Lithium's truck and road safety, and requested a truck timetable. |
| 8 November 2022 | Haul road notification | Prepared a communication strategy before the start of haul trucks in November 2022 for the Finniss Lithium Operation to inform community members upcoming operations.<br>Advised the stakeholder email distribution list that the haul trucks would travel between the Finniss Lithium Operation and the Darwin Port in November. Provided a fact sheet with details.<br>Held community information sessions to provide updates on haul trucks, blasting, road closures, and general mine updates. |

| Date | Activity | Detail |
|---|---|---|
| 10 October 2022 | Mine open event | Held a mine open event for the Finniss Lithium Operation, attended by the previous Minister for Mining and Industry, the Hon Nicole Manison MLA. |
| 1 October 2022 | Community newsletter | Updated the community on construction activities at the Finniss Lithium Operation.<br>Announced Gareth Manderson's appointment as CEO.<br>Appointed local company Northern Australian Civil with civil construction works contract and awarded Ironbark Services with a cleaning contract.<br>Provided updates on environmental monitoring, wet season preparation, trial blasting and temporary road closures.<br>Communicated plans for community meetings to gather feedback about the road closures.<br>Encouraged residents to submit their CVs for jobs.<br>Shared community hotline contact details. |
| 2 August 2022 | Blasting notice and temporary road closure | Produced and distributed a blasting and road closures fact sheet, including details of the blasting process, road closures, timeframes and communication processes to keep the community informed.<br>Sent notices to local councils to share with their communities and posted them on the Wagait Beach Community Facebook page. |
| 18 July 2022 | Blasting notice and temporary road closure | Shared the latest schedule for blasting and temporary closure of Cox Peninsula Road with local stakeholders and councils. |
| 1 May 2022 | Community newsletter | Shared updates on activities at the Grants open pit mine.<br>Showcased the partnership with Tumbling Waters Holiday Park, which provides office space, accommodation and support to Core Lithium.<br>Provided a temporary road closure update.<br>Featured a story about Kenbi Rangers' services at the Finniss Lithium Operation.<br>Announced environmental approval for the BP33 underground lithium mine within the Finniss Lithium Operation.<br>Encouraged residents to submit their CVs for employment opportunities.<br>Shared community hotline contact details and local interest stories. |
| 2021 | | |

| Date | Activity | Detail |
|---|---|---|
| 1 October 2021 | Community newsletter | Announced the final investment decision for the Finniss Lithium Operation.<br>Informed stakeholders that BP33 was being assessed by the NT EPA as part of the NT's environmental impact assessment process.<br>Announced major contracts with Lucas Total Contract Solutions and Primero Group.<br>Provided update on preliminary works on site. |
| 19 May 2021 | Meeting with Larrakia Development Corporation | Provided an overview of both the Grants mine and BP33 Lithium Projects.<br>Discussed Aboriginal employment opportunities for the Finniss Lithium Operation.<br>Advertised Expressions of Interest to Aboriginal organisations and placed in the NT News.<br>Attended by 2 representatives from Larrakia Development Corporation. |
| 19 May 2021 | Meeting with Litchfield Shire Council | Provided an overview of both the Grants and BP33 Lithium Projects.<br>Attended by 8 council members who expressed positive feedback and support for the projects.<br>Discussed various topics including timeframes, employment numbers, truck sizes, transportation of workers, and possible road upgrades by NT Government. |
| 18 May 2021 | Meeting with Wagait Shire Council | Provided an overview of both the Grants and BP33 Lithium Projects.<br>Attended by 5 council members who gave generally positive feedback.<br>Discussed topics including mine life, jobs, procurement, lithium refineries, blasting, road closures, and community communication. |
| 18 May 2021 | Meeting with Traditional Owners and Kenbi Rangers | Provided an overview of both the Grants and BP33 Lithium Projects.<br>Addressed concerns about the increased traffic on the road and opportunities for Aboriginal participation.<br>Attended by Traditional Owners, Kenbi Rangers, Northern Land Council, and Department of Infrastructure, Planning and Logistics. |
| 18 May 2021 | Meeting with Wagait Beach Supermarket | Discussed opportunities for ferry transportation between Darwin and the mine.<br>Explored potential benefits for the Wagait Beach community, including sponsorship opportunities.<br>Raised concerns about the impact on the water table, chemicals and environmental impacts.<br>Discussed different ways to communicate with the community. |
| 18 May 2021 | Meeting with Berry Springs School Principal | Discussed opportunities for further education for students.<br>Pleased with the truck movement scheduling considerations. |

| Date | Activity | Detail |
|---|---|---|
| 18 May 2021 | Information stall at Berry Springs Shopping Village | Held a community information stall to provide updates about the Finniss Lithium Operation and gather feedback from the community. |
| 16 May 2021 | Information stall at Berry Springs Shopping Village | |
| 15 May 2021 | Information stall at Wagait Beach Supermarket | Held a community information stall to provide updates about the Finniss Lithium Operation and gather feedback from the community. |
| 13 May 2021 | Meeting with Litchfield Shire Council Mayor | Discussed community interests and concerns regarding the BP33 project i.e. Litchfield community members are passionate about maintaining their rural lifestyle and activities.<br>Mayor raised concerns about the condition of the roads and water availability.<br>Community interest in benefits of the mine such as local jobs and economic flow on benefits. |
| 6 May 2021 | Sent an email to stakeholders about the BP33 project | Sent stakeholders a project fact sheet advising that the project was open for public comment on the NT EPA website, and inviting stakeholders to attend a briefing, provide feedback, or contact True North or Core Lithium for more information.<br>Held 10 project briefings, where stakeholders were provided with an online presentation on the project and invited to provide feedback or ask questions. |
| 6 May 2021 | Meeting with Wagait Shire Council CEO and President | Highlighted that Wagait is a small, quiet community that values the bush lifestyle with easy access to amenities.<br>The council acknowledged an influx of new residents, including retirees and families over the last year.<br>Concerns were raised about the road condition and safety.<br>Agreement that Core Lithium should maintain active engagement with the community. |
| 5 May 2021 | Meeting with Belyuen Community Government Council CEO | Discussed road safety concerns and other community issues. |
| 20 April 2021 | Meeting with Darwin Motorcycle Club (Kamfari event) president | Regular communication with Core Lithium regarding Kamfari event.<br>Didn’t foresee any issues. |

## 4.2 Future strategy

Core Lithium is committing to keeping all stakeholders informed throughout the life of the Project as part of broader Finniss River Project planning. Future stakeholder engagement is outlined in Table 6.

**Table 6: Future stakeholder engagement**

| Stakeholder | Proposed engagement |
|---|---|
| Shires | Yearly meetings – post closure land use, residual assets, access to Project domains |
| Government departments | Annual reporting – MCP and AER updates<br>Meetings as required to discuss Project changes – post closure land use, closure objectives and completion criteria, identification and management of closure risks, closure implementation strategies, residual assets |
| Traditional Owners and Kenbi rangers | Yearly meetings - post closure land use, residual assets, access to Project domains |
| Local community groups | Ongoing meetings – Project operations, road safety, post closure land use, residual assets, access to Project domains. |

# 5. Collection and Analysis of Closure Data

## 5.1 Climate

The region of the project area experiences a tropical climate with a distinct Dry season (May to October) and Wet season (November to April). Typically, for this region, humidity, maximum and minimum temperatures are highest in the Wet season, and annual evaporation far exceeds annual rainfall. Climate observations are made by the Bureau of Meteorology (BoM) with the closest BoM weather monitoring station to the Project being Darwin Airport (station number 014015). Figure 7 shows average monthly rainfall and temperature (1941-2024). Wind direction is predominately from the north through west most of the year (August to March) and particularly during the wet season (September to March). During the dry months (April to July) winds come predominately from the east.

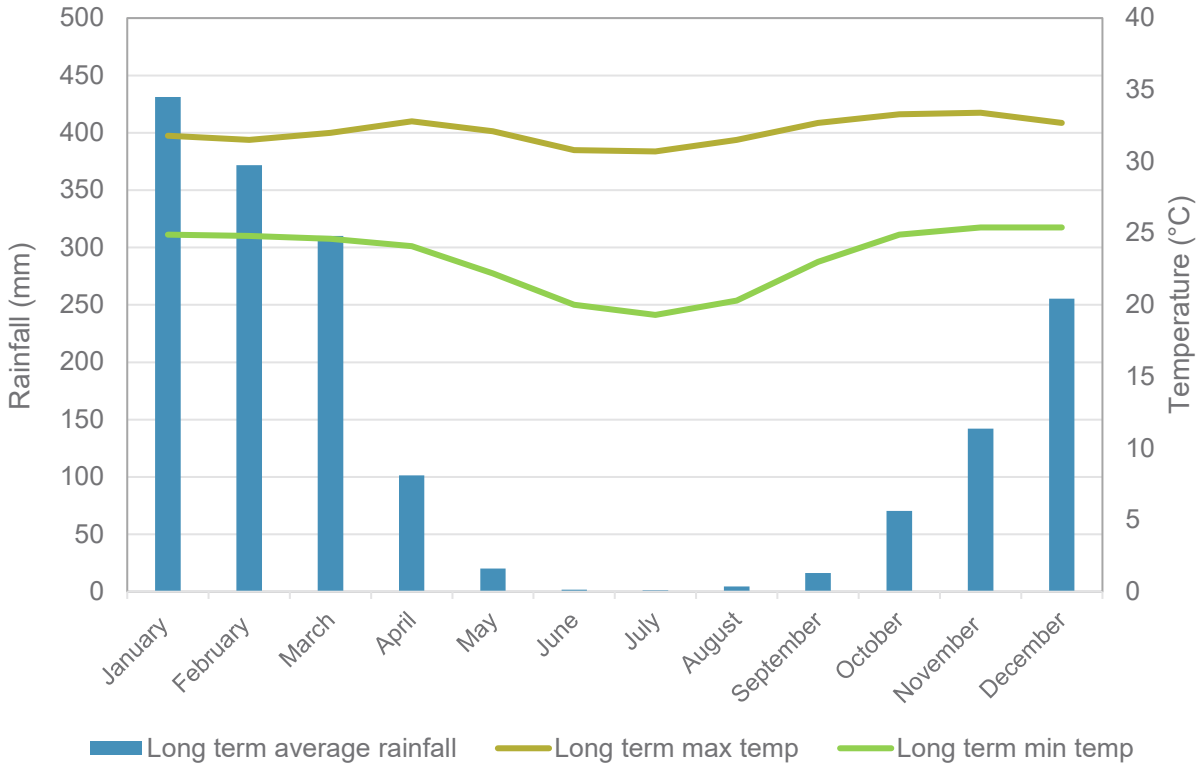


**Figure 7: Average monthly rainfall and temperature (1941—2024)**

### 5.1.1 Climate change

Impacts of a changing climate are not expected to affect the Project due to the short mine, after which all mining landforms will be removed and the land rehabilitated (EcOz, 2021a). The mine closure design has taken into consideration the variable nature of the local climatic conditions in relation to rainfall, temperature (evaporation) and extreme weather events. Flood modelling has been used to inform siting of infrastructure and the need for inundation bunds to prevent, for instance, flooding of rehabilitated mine disturbances based on SILO data, which provided a continuous daily data set for 132 years (1889–2021). By accounting for the extremes in the local climatic conditions, closure planning is expected to be resilient to changes in climate expected to occur following closure.

### 5.1.2 Overburden characteristics

## 5.2 Geology

Geological information for the Project is summarised by SRK (2020) and Cloud GMS (2021).

### 5.2.1 Regional geology

The Project area covers most of the northern extremity of a swarm of complex-zoned, rare element pegmatites that comprise the 55 km-long by 10 km-wide West Arm–Mt Finniss pegmatite belt.

The main pegmatites in this belt are Mt Finniss, Grants, BP33, Bilato's (Pickett's), Hang Gong and Bells Mona, which are up to 300 m long and 100 m wide. The Finniss pegmatites have intruded early Proterozoic shales, siltstones, and schists of the Burrell Creek Formation (BCF), which lies on the northwest margin of the Pine Creek Geosyncline. To the south and west are the granitoid plutons and pegmatitic granite stocks of the Litchfield Complex. The source of the fluids that have formed the intruding pegmatites is accepted as being the Two Sisters Granite to the west of the belt. The Two Sisters Granite outcrops ~3 km to the west and is thought to underlie the entire area at a depth of 5–10 km.

### 5.2.2 Geological units

The geological units exposed in the area include:

- Soil and laterite cover.
- Phyllite–BCF.
- Sandstone.
- Pegmatite (mineralised).
- Quart z veins (localised and thin; thickness range of 0.01 to 1 m).

The weathering profile in these units ranges from ~30 m to 50 m deep across the study area with the upper 30 m typically showing extensive weathering and the bottom 30 m showing moderate to slight weathering. The near -vertical pegmatite body hosts the economic ore (lithium) that is surrounded on each side by the BCF (phyllite)/sandstone. The transition from oxide to fresh rock in the pegmatite occurs over a short vertical distance but in the surrounding BCF (phyllite) it is more gradual (over less than 20 m).

#### 5.2.2.1 Soil and laterite cover

The uppermost 0–3 m of the Project area is composed of red/brown soils and weakly cemented laterite. These contain a large amount of iron oxide and clay/silt derived from the underlying BCF.

#### 5.2.2.2 Pegmatite (ore)

The pegmatite contains a simple mineral assemblage of quartz, feldspar, spodumene (lithium pyroxene) and muscovite (white mica). Weathering of pegmatite is profound where feldspar and spodumene break down to clay, leaving behind only residual quartz and muscovite from the original mineral assemblage. The narrow transitional zone retains much of the pegmatite texture, but the labile minerals are broken down along grain boundaries, forming a box-work of residual pegmatite surrounded by clay. Fresh pegmatite is hard, impermeable, and densely crystalline (granite-like).

#### 5.2.2.3 Burrell Creek Formation–phyllite

The BCF has been weakly metamorphosed to lower greenschist facies, developing a weak fabric that strikes parallel to the orientation of the pegmatite. The rock is referred to as phyllite (a low-grade metamorphic rock). In fresh form, the phyllite is grey, finely bedded or cleaved, and composed of quartz, feldspar, lithic fragments, micas, and clay.

Weathered phyllite becomes brown in colour, with the breakdown of labile sedimentary components such as feldspar to clay and iron oxides. The transitional phyllite from oxide to fresh is more gradual (over less than 20 m) and difficult to define.

#### 5.2.2.4 Sandstone

Sandstone was logged in the most recent (2019 onwards) geotechnical logs. The difference between BP33 phyllite and sandstone is subtle. However, in general, sandstone is less foliated than phyllite.

#### 5.2.2.5 Quartz veins

The quartz veins are a very minor component of the geological system. When fresh, these are very simple massive microcrystalline quartz with rare iron sulfide (pyrite). In the weathered horizon, the veins remain intact, apart from the destruction of any sulfide to iron oxide. The veins range in width from 0.01–1 m. The quartz veins are localised and low occurrence and their impact on rock mass stability is considered insignificant.

## 5.3 Soils

Four soil samples suggest that soil at the site is an infertile, gravelly sandy loam (EGI, 2020). The Emerson test indicates that the soil should be non-dispersive but, given the low level of organic matter and sandy texture, the soil likely has poor structure and limited water-holding capacity, and therefore could be susceptible to erosion under wet conditions. It is expected that successful rehabilitation will require increasing the physical and chemical fertility of the soil to some extent, consistent with the proposed final end use.

## 5.4 Materials characterisation

Materials characterisation has been undertaken by EGI (EGI, 2020; EGI, 2021; EGI, 2022; EGI, 2024). The following conclusions have been made.

### 5.4.1 Waste rock

Oxide waste rock samples, representative of material that will be encountered in the boxcut, are largely devoid of sulfur and are classified as non-acid forming (NAF). Water extracts have very low salinity. Oxide waste rock, which will form the majority of rock excavated during development of the boxcut and the majority of waste rock generated during the project as a whole, will present a very low risk of acid and metalliferous (AMD) or saline drainage (SD). However, drainage from oxidised rock stored in the boxcut WRD may contain low concentrations of Al and Zn.

Transitional waste rock, which will comprise a small portion of the rock removed during development of the boxcut and the mine decline, is generally low in sulfur content and can, in the main, be classified as NAF. Transitional samples also gave water extracts with low salinity. These results show that transitional rock will present a low risk of AMD or SD.

Fresh waste rock will comprise the major portion of rock removed during development of the underground mine and therefore of waste rock stored in the underground WRD. However, the volume of fresh waste rock mined will be relatively small (<10% of the total volume). Fresh waste rock is generally low in sulfur, but with

some areas of higher sulfur associated with fresh phyllite. Most fresh waste rock can be classified as NAF, but there is evidence that fresh phyllite may include potentially acid forming (PAF) material. This material appears to have limited readily available ANC. Fresh waste rock samples also produced water extracts with low salinity, although salinity was higher than for other rock types. Fresh rock may also contain water leachable arsenic and zinc. These results show that fresh waste rock may present some risk of AMD including elevated arsenic and zinc concentrations in drainage from the WRD2. Further testing is required to confirm these findings and to quantify the likely volume of PAF material.

Exploration assay data provided by Core Lithium for around 2,500 samples from 48 drill holes was used to classify waste rock and ore using the above criteria and the volumes of each class were estimated and are shown in **Error! Reference source not found.**.

Results show:

- Oxide rock excavated from the boxcut, which will be placed in WRD1, is expected to be NAF. All but one of the oxide samples contained Total S below the reporting limit of 0.01.
- Transition waste rock, which will be placed in WRD2, is expected to be mostly NAF. Around 95% of samples contained below 0.2% Total S; however, a small portion containing Total S above 0.2% are likely to be classified as PAF-LC (low capacity) with limited acid producing potential.
- Fresh waste rock, which will be placed in WRD2, is expected to encompass a range of materials from NAF through to PAF. While most of the fresh waste rock contained below 0.2% Total S, there is a significant proportion of the fresh rock samples with higher Total S content.
- Ore that will be stored on the ROM pad while awaiting transport to the processing plant is expected to be NAF. Of the ore samples examined, a clear majority have a Total S content below 0.2%. These samples classified as NAF materials with a couple of exceptions, which while having a NAG pH below 4.5, produced very little acidity when treated with peroxide (NAG(pH4.5) <2 kg H2SO4/t).

Waste rock classification and volume is presented in Table 7.

**Table 7: Waste rock classification and volume**

| Material | Criteria | Volume (% of waste) |
|---|---|---|
| PAF | Total S ≥ 0.4% | 0.3% |
| PAF-LC | S ≥0.2% and < 0.4% | 3.1% |
| NAF | S < 0.2% | 96.6% |

## 5.4.2 Acid and metalliferous drainage

### 5.4.2.1 Static testing

Representative samples were collected from oxide, transitional and fresh waste rock and subject to static geochemical testing. Results indicated:

- Oxide rock excavated from the boxcut is expected to be NAF.

- Oxide waste rock stored in the Boxcut WRD (WRD1) or transitional and fresh waste rock stored in the underground WRD (WRD1 and WRD2) would unlikely produce low pH saline seepage during short-term surface storage.
- The mobility of aluminium in all waste rock and arsenic in fresh waste rock on contact with water, could potentially result in elevated concentrations of these elements in seepage during short-term surface storage.
- Should substantial oxidation of fresh waste rock occur during surface storage, the concentrations of Al, As, Co, Cr, Cu and Zn may by elevated in comparison to baseline environmental conditions.

#### 5.4.2.2 Kinetic testing

Following the results of the static leach testing, three kinetic leach column tests were established for oxide, transitional and fresh waste rock.

Results from leach column testing suggest that while acidic drainage from wastes stored in WRD at the Project or following backfilling of mine voids is unlikely, there is potential for water in contact with these materials to contain elevated concentrations arsenic, copper, lead, zinc, and possibly aluminium relative to local surface and groundwaters.

#### 5.4.2.3 AMD management

Current test results suggest that the risk of AMD from surface storage of waste rock from the underground mine will be low, due to the likely low volume of PAF material present in fresh waste rock. The risk of AMD is further limited by the fact that waste rock will be stored temporarily on the surface and then backfilled (EcOz, 2020b). However, currently there is insufficient evidence to say conclusively that there will be no PAF material removed from the underground mine which may require management to mitigate AMD whilst the material is on the surface. Mined waste rock from the Project could represent a source of arsenic, copper, lead and zinc, and possibly aluminium, that may adversely impact surface and groundwater in the vicinity of the project. While groundwater modelling suggests that movement of groundwater away from the Project post closure will be limited (Cloud GMS, 2021), contamination of groundwater by metals sourced from backfilled mine waste rock and/or mine voids walls is a possibility.

The following criteria can be used to classify the waste rock by Acid Rock Drainage (ARD) type (Table 8).

**Table 8: Geochemical classification of waste rock**

| Primary geochemical waste type class | Material | Total sulfur content |
|---|---|---|
| NAF | Ore/oxide waste rock/<br>Transitional and fresh waste rock | S<0.2% |
| PAF-LC | Transitional and fresh waste rocks | S>0/2% and <0.4% |
| PAF | Transitional and fresh waste rock | S>0.4% |

The management of waste rock and AMD at the Project should be undertaken in accordance with the BP33 Waste Rock and AMD Management Plan (Core Lithium, 2023). Key features of this plan include low permeability foundations for the WRDs, a leachate collection system and separation of PAF or PAF-LC materials during dumping. The management plan also includes a monitoring program and management triggers.

### 5.4.3 Paste backfill

As part of operations, the underground operation will be backfilled with cemented paste generated from the ore processing waste streams. Environmental Geochemistry International (EGI) undertook geochemical characterisation of cemented paste backfill samples to determine the potential for acid rock drainage (ARD) and leaching from these materials once they submerged by groundwater.

Results from the ARD characterisation were as follows (EGI, 2024):

- Samples were characterised by very low sulfur content.
- Samples had significant neutralising capacity.
- Samples were classified as NAF.
- EGI concluded that ARD from oxidised cemented paste was extremely unlikely (EGI, 2024).

Leach testing from batch leach tests conducted on paste backfill samples found (EGI, 2024):

- Over long periods of up to 14 days, the pH of groundwater in contact with cemented paste backfill dropped but remained higher than 9.5.
- Solutes in the cemented paste backfill that dissolved during the first 14 days of contact with groundwater included Al, As, K, Li, Na, Sr and SO4. Several of the solutes precipitated including Ba precipitating as barite, Ca and Mg as dolomite, Fe as ferrihydrite or geothite and Si as semi-crystalline silica.
- There was no evidence of significant leaching of metals/metalloids into the groundwater.

EGI concluded that if cemented paste backfill is inundated with groundwater, that deterioration of groundwater quality at the Project would be minimal (EGI, 2024).

## 5.5 Surface water

Surface water is described by EnviroConsult (EnviroConsult, 2020), WRM (WRM, 2023a) and in the Water Management Plan (WMP) (WRM, 2024).

The Project area broadly comprises of well-drained low hills and rises, intersected by seasonally waterlogged drainage systems and alluvial plains. The regional topography surrounding the Project is largely subdued and flat lying. Locally the Project is situated in a subtle valley with a south to south-west orientation. Higher elevations occur to the north-east around Observation Hill Dam (OHD). This elevated area extends to the north-west and forms a catchment divide that separates the Project from Grants, located 4.5 km to the north-west. The land surface falls away from the Project to the south-west with the lowest lying areas found along drainage lines running into Bynoe Harbour (for catchment figure see 2024 WMP).

The Project is located in the Finniss River drainage basin and falls within the Bynoe Harbour catchment. There are no permanent water courses in the vicinity of BP33. The area is drained by a number of small unnamed ephemeral water courses which rise in the higher elevations to the north-west of the Project and drain south-west into the Charlotte River and ultimately Bynoe Harbour. The Project is located on the western edge of a small drainage line that connects OHD to the Charlotte River. The harbour is captured under the Fog Bay area, which has a declared beneficial use under the Water Act of aquatic ecosystem protection and recreational water quality aesthetics.

Existing water storages at the Project include OHD and the historical BP33 pit lake.

Flood modelling undertaken indicates minimal flood impact with flood events used in the basis of design for site infrastructure.

A surface water monitoring program with water level triggers and management actions is laid out in the WMP (WRM, 2024).

### 5.5.1 Surface water quality

Baseline water quality has been collected from water storages (OHD and historical pit lake) and surface water creek sites between 2017 and 2023. A summary of baseline water quality is provided in the Water Management Plan and has been summarised as follows (WRM, 2024):

- Total nitrogen and total phosphorus are elevated across all sites.
- OHD is pH neutral when compared to the slightly acidic nature of Bynoe Harbour catchment.
- All metals with the exception of aluminium are lower than ANZG limits for protection of freshwater species.
- OHD has elevated arsenic, iron, and lithium.
- Ammonia is slightly higher in OHD compared to the Bynoe Harbour catchment.

## 5.6 Groundwater

Groundwater assessments at the Project have been undertaken by Groundwater Enterprises (Groundwater Enterprises, 2020; Groundwater Enterprises) and Cloud GMS (CloudGMS, 2021; CloudGMS, 2023). Findings are presented below.

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.

There are minor occurrences of shallow groundwater in localised alluvial deposits that are expected to operate at a local scale, as they are limited in lateral extent (200-300 m) and thickness (up to 6 m).

Groundwater levels in the shallow laterite bores are highly responsive to rainfall with water quality reflecting a close connection between surface and groundwater. Water levels in monitoring bores at the end of the dry season range between 4.5 mBGL and 9.8 mBLG for the deeper bores and 4.4 mBGL and 6.6 mBGL for the shallow bores. The seasonal change in the deep bores ranges from 3.7 m to 9.6 m and 3.1 m and 5.5 m in the shallow bores.

Groundwater flow directions reflect the topographic gradient with groundwater moving from higher groundwater elevations in the north-east around OHD to lower elevations around Bynoe Harbour in the south-west.

The existing historical pit does not appear to be hydraulically linked to regional groundwater as recharge was not observed when it was dewatered during construction in 2023.

The Project is within the Darwin Rural Water Control District declared under the NT Water Act 1992. The district declared beneficial uses include agriculture, aquaculture, public water supply, environment, cultural, industry, rural stock and domestic, mining activity and petroleum activity.

No existing groundwater users were identified downgradient of Project area. The nearest registered groundwater bore is RN041993 (domestic supply bore) located 4.6 km south and cross-gradient to the Project. This bore is unlikely to be impacted by BP33 mining activities.

Groundwater Dependent Ecosystems (GDE) have the potential to occur along the drainage lines to the immediate east and south of Project. Small pools have been observed to persist in the watercourse into the late dry season and a narrow zone of riparian rainforest occurs, suggests a level of groundwater dependence. These ecosystems are likely facultative GDEs, with an infrequent or partial dependence on groundwater. A review of the BOM GDE Atlas indicates portions of the Project mine infrastructure area and haul road / infrastructure corridor traverses areas of low potential GDE. GDEs and monitored and managed as per the GDE Management Plan (Appendix F).

The original modelled extent of groundwater drawdown around the Project Indicates a drawdown cone extending approximately 2 km from the underground mine and a recovery time of three years post mining. Revised groundwater modelling, calibrated with observed boxcut and Grants pit groundwater inflow rates, indicate a substantial reduction in groundwater inflows and hence drawdown. It is anticipated that the drawdown cone and recovery time of the BFC aquifer will be significantly less than previously assessed.

The Grants and the Project drawdown cones do not interact, indicating that groundwater impacts are localised around each of the mine sites.

A groundwater monitoring program with water level triggers and management actions is laid out in the Water Management Plan (WRM, 2024).

### 5.6.1 Groundwater quality

Baseline groundwater quality monitoring was undertaken between 2017 and 2023. The results are summarised as follows:

- Groundwater in the weathered and un-weathered BCF aquifer has moderate alkalinity, with anion and cation levels increasing with depth into the aquifer.
- Total phosphorus, strontium, lithium and zinc levels were found the be significantly higher than the surface water environment.
- Major anion and cation concentrations measured in the shallow laterite aquifer show the groundwater has negligible levels of alkalinity, hardness and dissolved major cations – which is similar to those measured in the surface water around the mine footprint.
- Total nitrogen concentrations in the shallow aquifers are similar to surface water of the Bynoe Harbour catchments, while concentrations in the deep aquifers are lower than the Bynoe Harbour catchments.
- Total phosphorus in the shallow aquifers is elevated in comparison to the surface water of the Bynoe Harbour catchments, while concentrations in the deeper aquifers are significantly higher.

## 5.7 Flora

Vegetation at the Project has been described by EcOz (2020a, 2020b and 2021). The dominant vegetation types within the mine infrastructure and site access areas comprise (**Error! Reference source not found.**):

- Open woodland typically consisting of Darwin Woolybutt (*Eucalyptus miniata*) and Darwin Stringybark (*E. tetrodonta*) (Land unit 2a1).
- Tall shrubland to low open woodland consisting of *Grevillea* sp., *Melaleuca* sp. over annual sorghum grasses (Land unit 6b).
- Grasslands of *Sorghum stipoideum*, *Arachne buriti*, *Paspalum straticulate* with emergent trees (Land unit 5a).

- Woodland consisting of Darwin Woolybutt (*E. miniata*) and Darwin Box (*E. tectifica*), Broad-leaved Bloodwood over *Sorghum plumosum*. (Land unit 1b).

The only sensitive vegetation type relevant to the Project is a narrow fringe of riparian vegetation (land unit 5b1) along an ephemeral watercourse downstream of OHD and east of the mine infrastructure area . The well-developed riparian vegetation indicates some level of groundwater dependence supporting this vegetation community throughout the dry season; however, there is no evidence of spring-fed surface water flows.

Two listed threatened plant species with a high or medium likelihood of occurring within the Project footprint were identified including *Typhonium praetermissum* and *Stylidium ensatum*.

Areas within the project footprint, modelled as being moderate likelihood habitat for *T. praetermissum* were surveyed in February 2020 with no individuals identified. Additional surveys were conducted in February 2024 where four individuals of a *Typhonium* species were recorded but are awaiting genetic identification. *Typhonium* was not recorded elsewhere and no further surveys are recommended (Epic Environmental, 2024).

Areas within the Project footprint, modelled as being potentially suitable habitat for *Stylidium ensatum* were surveyed in July 2020 with no individuals identified. Additional surveys were undertaken in 2024 with no individuals recorded and determined there was little suitable habitat for the species. Further surveys for *S.ensatum* were not considered necessary (Epic Environmental, 2024).

Three declared weed species have been observed within the disturbed areas of the Project and include Gamba Grass, Perennial Mission Grass and Hyptis. Of these, Gamba grass is a weed of national significance (WONS). These species have been subject to active management within the BP33 project area since 2021 (Core, 2021b).

Other weed species observed within the project area include Annual Mission grass, Stylos, Red Natal grass and Wild Passionfruit vine.

## 5.8 Fauna

A fauna survey in 2024 recorded a total of 71 fauna species including six frogs, three reptiles, 49 bird and 13 mammal species at the Project. The fauna comprised a range of mostly widespread and common fauna species from the region (Epic Environmental, 2024).

The faunal habitat values were relatively homogenous with some localised impacts caused by clearing for exploration and mining. Monsoonal savanna woodland communities dominated the vegetation in the study area. The main fauna habitats and their suitability for conservation significant species were as follows (Epic Environmental, 2024):

- Savanna woodlands with varying canopy cover. This habitat provides seasonal food resources for nectiverous birds and year round prey resources for smaller insectivorous birds and microbats. Large tree hollows provide shelter for brush-tailed possums, black-footed tree rats and the bare-rumped sheath tail bat.
- Wetlands. Recent rain allowed for substantial areas of pooled and flowing water to the north of the haul road. There are also several artificial waterbodies in the surrounding area which are associated with previous mining and cattle grazing. These areas may provide habitat for waterbirds but are unlikely to be suitable for threatened/or migratory species. They also provide habitat for aquatic fauna. The Merten's water monitor was observed during the survey and will readily use both natural and artificial water bodies.

The survey recorded the following species listed as threatened under Commonwealth and/or NT legislation (Epic Environmental, 2024):

- Partridge pigeon (eastern) (Vulnerable under the EPBC Act and TPWC Act).

- Merten's water monitor (Endangered under the EPBC Act and Vulnerable under the TPWC Act).
- Bare-rumped sheath tailed bat (Vulnerable under the EPBC Act and TPWC Act).

The desktop assessment component of the study identified further species as listed as threatened under the EPBC Act as potentially occurring in the study area or surrounds. Of these, two species were known to occur, two species are considered likely to occur and five species possibly occur (Epic Environmental, 2024).

### 5.8.1 Faunal pests

Regionally common introduced fauna species are expected to be present within the Project area. These include :

- feral pig (*Sus scrofa*);
- Cane toad (*Bufo marinus*);
- black rats *(Rattus rattus*); and
- feral cats (*Felis cattus*).
- feral cattle (*Bos taurus*); and
- feral water buffalo (*Bubalus bubalis*).

## 5.9 Site contamination

No contaminated site assessments have been conducted over the site specifically. However, although the site was operational in 1980s, ongoing contamination is unlikely as no infrastructure other than the remnant pipeline from OHD has occurred within the Project tenements.

## 5.10 Local land uses and mining history

The primary underlying land use is mineral exploration with Core Lithium holding approximately 400 $km^2$ of granted exploration tenements across the Bynoe Pegmatite Field. The Project is surrounded by undeveloped Vacant Crow Land (VCL) owned by the NT government.

The area has an extensive history of exploration and mining with tin and tantalum mined from the Bynoe Pegmatite Field for over 100 years. A summary of the relevant historical mining development is provided below:

- 1979: Greenbushes commenced exploration in the Bynoe pegmatite district.
- 1980 - 1989: Tin-tantalum mining footprint expanded with a short, sporadic mine life.
- 1995 - 1999: Greenbushes commenced mining several new pegmatites in the Observation Hill area, including small open-cut mines (Booths South, Lees, Yan Yams, Hang Gong, Highland, BP33, Rubiks and Carlton). Material was processed through their Observation Hill trial plant. Observation Hill Dam nearby settling ponds were likely constructed during this time.
- 2016 - 2017: Liontown Resources identified highly weathered and leached spodumene mineralisation from dump samples, and significant lithium mineralisation at depth in many prospects.
- 2016: Core Exploration commenced exploration for lithium mineralisation
- 2023: Lithium Developments (Grants NT) Pty Ltd commence early works construction on Core Lithium's BP33 underground mine.

- December 2023: BP33 early works construction paused due to a softening lithium market.

The area has extensive existing disturbance in the form of historical open cut mining pits, exploration activities and publicly accessible tracks. The largest area of existing disturbance occurs at the former Greenbushes processing area located at the entrance to the Project. This area comprises cleared land with various stockpiles of sand and gravel with numerous weed species present.

## 5.11 Nearest Towns

Berry Springs is the closest township, located 24 km east of the Project (33 km via road) and with a population of approximately 820 people (ABS, 2022). The nearest community is Belyuen, located approximately 21 km northwest of the project (27km by road) with a population of approximately 165 people (ABS, 2022).

There is no public access to the site. However, some local people currently access the area around OHD. There are no nearby residences, farms or industries within the catchment areas upstream or downstream, and no commercial or domestic uses for which surface water or groundwater is currently being extracted anywhere near the project area. Cox Peninsula Road is the closest gazetted road, approximately 2 km from the RoM pad.

## 5.12 Aboriginal Heritage

The current Aboriginal Areas Protection Authority (AAPA) certificate (C2022-049) does not identify any sacred sites or restricted areas within the Project development footprint. The nearest recorded sacred site is located approximately 4.5 km northeast of the Project beyond Cox Peninsula Road and will not be impacted by the Project.

## 5.13 Non Aboriginal Heritage

Review of the NT Heritage Register identified that the nearest site protected under the NT Heritage Act is ‘Site 5’, a previously recorded Aboriginal archaeological site located approximately 6 km to the north-west of the Project and beyond Grants operations. This site will not be impacted by Project activities.

Several historic mining sites, listed on the NT Heritage Register but not protected under the NT Heritage Act, were identified. The closest site is the Goulden Boulder Mine and will not be impacted by Project activities

# 6. Post Mining Land Use

Following the completion of mining operations, Core Lithium intends to leave the Project area in a safe and stable condition such that the tenements can be relinquished without any future financial, environmental or safety liability for the company, regulators, land managers or nearby communities. The post mining land use objective for the Project area is geotechnically stable and non-polluting landforms which supports self-sustaining native vegetation and fauna comprising local species.

Endorsement of the post-mining land use, closure objectives and completion criteria will be sought from the key stakeholders including Department of Environment, Parks and Water Security (DEPWS), Department of Infrastructure, Planning and Logistics (DIPL), Department of Industry, Tourism and Trade (DITT), and the NTEPA.

The Darwin Regional Land Use Plan identifies agriculture as a potential long-term land use for the Project area and adjacent areas. Although the Project is not currently used for agriculture, the area could potentially support these activities in the future if the NT Government were to permit this activity and if there was stakeholder support. Table 9 identifies the land use options for each domain.

**Table 9: Post mining land uses for BP33.**

| Domain | Location | Land uses |
|---|---|---|
| Backfilled Boxcut and underground workings | Natural environment | Access the box cut potal will be sealed to prevent ingress.<br><br>The previously backfilled box cut will be rehabilitated to be stable, non-polluting and support self-sustaining local provenance native vegetation which provides habitat for local native fauna. |
| Waste rock and topsoil dumps, ROM pad | Natural environment | Landforms will be backfilled into the pit and undergound.<br>The land will be rehabilitated to be stable, non-polluting and support self-sustaining local provenance native vegetation which provides habitat for local native fauna. |
| Historical pit void | Natural environment | The pit will be backfilled and rehabilitated during operations to support infrastructure construction.<br>The land will be rehabilitated to be stable, non-polluting and support self-sustaining local provenance native vegetation which provides habitat for local native fauna. |
| All other domains | Natural environment | Infrastructure not retained by stakeholders will be removed.<br>Some of the infrastructure may be of value to third parties. Opportunities to transfer rather than decommission potentially valuable infrastructure will be sought, provided that all associated liability (for maintenance, environmental protection and public safety) can also be properly transferred.<br>Land will be made safe, stable and non-polluting and support self-sustaining local provenance native vegetation which provides habitat for local native fauna. |

# 7. Closure Outcomes and Completion Criteria

Preliminary completion criteria have been developed for each site-specific closure outcome, relative to each domain. The criteria have been designed following the SMART framework. Each criterion is:

- **Specific** to an environmental or project consideration.
- **Measurable** to demonstrate that rehabilitation is trending towards outcomes.
- **Achievable** for the project.
- **Relevant** to the identified feature.
- **Timeframe** dependent.

This framework provides an accepted (DIIS, 2016b; APEC, 2018) approach for effective monitoring, reporting and auditing of mine closure and rehabilitation. Quantitative criteria have been developed where possible. Where quantitative values are not available, qualitative criteria have been used. Criteria will be refined as more data is obtained. Preliminary completion criteria for the project, along with associated measurement tools and/or monitoring programs are shown in Table 10. Details on monitoring programs are provided in Section 10.

## 7.1 Guiding principles

Core Lithium's closure vision for the Project mine site is to return the site to similar to pre-mining conditions so that there is no limitation to future land uses as a result of the mining activities. Closure planning for the Project will explicitly provide for a post mining landscape acceptable to stakeholders with expectations to at least 500 years after closure in line with recommendations from APEC (2018).

The closure vision will be further developed in consultation with stakeholders, in particular NT Government, as the mine site is located on Crown Land where there is currently no formal land use. This MCP will be submitted with the MMP and this closure vision will guide the development of future revisions of the MCP.

To guide the development and implementation of mine closure and rehabilitation for the NT operations, Core Lithium has established a set of guiding closure principles.

- Informed planning and design: rehabilitation and decommissioning requirements are considered at a mine deposit and regional scale upfront and integrated into mine plans to achieve optimal business value and a sustainable post-closure land use.
- Sustainable post-closure land use: post-closure land use and rehabilitated areas are acceptable to key stakeholders and consider the following.
    - Local land management practices.
    - Ongoing management requirements (e.g., roads and tracks).
    - Closure landform integration, including visual impacts, landform stability (physical and geochemical) and hydrological regimes.
    - Local baseline conditions (e.g., flora, vegetation, fauna and fauna habitat).
    - Ecosystem resilience in terms of flora, vegetation, fauna, and surface and groundwater hydrology.
    - Infrastructure transfer or decommissioning.
    - Management or remediation of contaminated sites; and amenity.

- Safety: All mine rehabilitation and decommissioning are planned so that the risks to health and safety of people within LD's area of influence are minimised. Unauthorised public access risk will be managed through the implementation of controls in accordance with regulatory requirements and consideration of industry guidance.
- Effective stakeholder engagement: transparent and proactive stakeholder engagement occurs for all planned activities that may impact surrounding communities, including consideration of communities impacted by closure.

## 7.2 Completion criteria

Completion criteria are the measures against which achievement of closure outcomes and guiding principles can be assessed. The purpose of completion criteria is to demonstrate rehabilitated areas will display self-sustaining characteristics. Characteristics are suitable to the post-mining land use and give stakeholders confidence that they can be managed in the long term), using reasonable management practices.

Completion criteria will be refined in consultation with stakeholders throughout the operational phase as new knowledge becomes available through the research and trial studies (e.g., landform trials, rehabilitation monitoring programs). These refinements will be presented in future iterations of this MCP. Future revisions of the criteria will focus on further developing measurable metrics based on site specific data.

Preliminary closure and rehabilitation outcomes and criteria are based on the land uses applicable to a particular area, in recognition of the fact that the land is altered fundamentally from its pre-existing condition. The completion criteria for the Project mine are currently based on an assumed outcome of Crown land with wildlife values only. In the event that alternate post-closure land uses are agreed for the site, different completion criteria may apply.

**Table 10: Site Specific Closure Criteria for BP33.**

| Domain | Component | Closure outcomes | Completion criteria | Validation |
|---|---|---|---|---|
| Compliance | All | All legally binding conditions and stakeholder commitments relevant to rehabilitation and closure are met. | All conditions and commitments relevant to rehabilitation and closure are met. | Audit of conditions of mining authorisation and commitments made in project assessment. |
| Underground workings | Backfilled boxcut footprint | Rehabilitated as a safe, stable, non-polluting and erosion resistant landform. | The backfilled boxcut footprint will ripped and covered with suitable growth medium on completion of operations. | Post-work inspection and construction designs demonstrating approved boxcut design been followed including topsoil coverage. |
| | | | Soils analysis results within acceptable criteria for successful plant growth (in accordance with criteria | Rehabilitation Management Plan (RMP – Appendix F) |
| | | | Erosion score 2 or less (minor erosion). No increase in erosion presence of severity from previous monitoring for at least two consecutive years. | Rehabilitation Management Plan (RMP – Appendix F) |
| | | | No evidence of contaminated runoff or seepage from the underground to groundwater. | Water Management Plan (Appendix F) |
| | | Boxcut supports self-sustaining native vegetation not significantly different to that of the surrounding ecosystems. | Groundcover % and groundcover species richness recorded at vegetation transects not less than analogue sites for two consecutive years post closure.<br>Abundance of woody plants (stems ≥ 2 cm DBH and greater than 3 m high) recorded at vegetation transects not less than representative analogue sites.<br>Not less than three dominant species (per strata) recorded at vegetation transects present in analogue sites.<br>Density of weed species within rehabilitated domain is not more than reference sites for three consecutive years. No declared weed species not previously recorded in the mining lease is present within the rehabilitated domains for three consecutive years.<br>No fire scars recorded at vegetation transects within first three years of rehabilitation. | Rehabilitation Management Plan (RMP – Appendix F) |
| | | The domain supports fauna recolonisation not significantly different to that of the | Trend of increasing native wildlife abundance and diversity each year with eventual results not significantly different to analogue sites. | Rehabilitation Management Plan (RMP – Appendix F) |

| Domain | Component | Closure outcomes | Completion criteria | Validation |
|---|---|---|---|---|
| | | surrounding ecosystems. | Key indicator invertebrate biota assemblages of rehabilitated areas not significantly different to analogue sites.<br>No significant difference in abundance of feral animal and pests compared to analogue sites. | |
| | Underground workings | Rehabilitated as safe and stable. | Inadvertent access to underground workings is prevented. | Audit by responsible person, or suitably qualified specialist of all known underground workings that present a risk, prior to relinquishment. |
| | | | Ground stability risk meets post mining land use and does not pose a significant risk to users. | Audit by mining engineer to confirm underground mine stability |
| Mine void | BP33 historic pit lake | Inadvertent public access to open pit will be prevented as far as practicable. | Pit ramps submerged or are blocked by abandonment bund(s) to deter access. | Inspection of pit ramps following closure. |
| | | | Pit abandonment bunds constructed in accordance with DoIR (1997).<br>Risk based approach to prevention of inadvertent access, as required by Mines Safety and Inspection Regulations 1995. | Audit by geotechnical engineer to confirm pit abandonment bunds are located and constructed in accordance with completion criteria. |
| Mine waste facilities | WRDs, ROM pad and topsoil footprints. | Operational waste rock dumps are entirely removed and footprint rehabilitated as a safe, stable, non-polluting and erosion resistant landform. | WRDs, ROM pad and topsoil landforms removed. | Inspection of landforms and footprints to confirm removal and rehabilitation with proposed topsoil coverage. |
| | | | Footprints have been covered with suitable growth medium on completion of operations. Surface is shaped, ripped and covered with a suitable growth medium to a minimum depth of 0.2 m. | Footprint soils analysis results within acceptable criteria for successful plant growth (in accordance with criteria specified in **Error! Reference source not found.**. |
| | | | Erosion score 2 or less (minor erosion). No increase in erosion presence of severity from previous monitoring event for at least two consecutive years. | RMP (Appendix F) |
| | | | Post mining surface water quality for turbidity downstream at monitoring sites meets site-specific guidelines values. | Water Management Plan (Appendix F) |

| Domain | Component | Closure outcomes | Completion criteria | Validation |
|---|---|---|---|---|
| | | | No evidence of contaminated soils in WRD and ROM footprints. | Contaminated sites assessment shows no site contamination of footprint soils. |
| | | Domain supports self-sustaining native vegetation not significantly different to that of the surrounding ecosystems. | Groundcover % and groundcover species richness recorded at vegetation transects not less than analogue sites for two consecutive years post closure.<br>Abundance of woody plants (stems ≥ 2 cm DBH and greater than 3 m high) recorded at vegetation transects not less than of representative analogue sites.<br>Not less than three dominant species (per strata) recorded at vegetation transects present in analogue sites.<br>Density of weed species within rehabilitated domain is not more than reference sites for three consecutive years. No declared weed species not previously recorded in the mining lease is present within the rehabilitated domains for three consecutive years.<br>No fire scars recorded at vegetation transects within first three years of rehabilitation. | RMP (Appendix F) |
| | | Footprints support fauna abundance and diversity not significantly different to that of the surrounding ecosystems. | Key indicator invertebrate biota assemblages of rehabilitated areas not significantly different to analogue sites.<br>Trend of increasing native wildlife abundance and diversity each year with eventual results not significantly different to analogue sites.<br>No notable increase in the presence of feral animal and pests within the vegetation transects each year compared to analogue sites. | |
| | | Surface water quality does not lose identified environmental values and beneficial uses. | Post mining surface water quality (for the identified parameters) downstream monitoring sites (at ML boundary GDS SW2 and downstream off lease GDS SW5), meet site- specific guidelines values. | Water Management Plan (Appendix F) |
| | | Beneficial uses are not adversely affected by altered groundwater levels or flows. | Post mining groundwater quality down groundwater gradient is within range of pre-mining groundwater quality.<br>Extent of groundwater drawdown around mine does not exceed modelled predictions at closure. | |
| Roads | Haul road | Rehabilitated as a safe, stable, non-polluting and erosion resistant landform. | Surface is profiled to match surrounds, ripped and covered with a suitable growth medium to a minimum depth of 0.2 m. | Post-work inspection including topsoil coverage. |

| Domain | Component | Closure outcomes | Completion criteria | Validation |
|---|---|---|---|---|
| | | Domain supports self-sustaining native vegetation not significantly different to that of the surrounding ecosystems. | Groundcover % and groundcover species richness recorded at vegetation transects not less than analogue sites for two consecutive years post closure.<br>Abundance of woody plants (stems ≥ 2 cm DBH and greater than 3 m high) recorded at vegetation transects not less than of representative analogue sites.<br>Not less than three dominant species (per strata) recorded at vegetation transects present in analogue sites.<br>Density of weed species within rehabilitated domain is not more than reference sites for three consecutive years. No declared weed species not previously recorded in the mining lease is present within the rehabilitated domains for three consecutive years.<br>No fire scars recorded at vegetation transects within first three years of rehabilitation. | RMP (Appendix F) |
| | | The domain supports fauna recolonisation not significantly different to that of the surrounding ecosystems. | Trend of increasing native wildlife abundance and diversity each year with eventual results not significantly different to analogue sites.<br>Key indicator invertebrate biota assemblages of rehabilitated areas not significantly different to analogue sites.<br>No significant difference in abundance of feral animal and pests compared to analogue sites. | RMP (Appendix F) |
| | Light vehicle road | As per haul road | As per haul road. However, completion not required until monitoring is complete so as to maintain access for monitoring. | As per haul road. |
| Dams and ponds | Raw water dam and sediment ponds | Surface water quality maintains environmental values and beneficial uses. | Riparian vegetation assemblages downstream of BP33 water storages at closure are not significantly different to pre-mining structure and composition. | RMP (Appendix F) |
| | | Decommissioning and removal of infrastructure. | All pumping infrastructure is removed from site on the completion of mining activities. | Inspection on completion of processing activities. |
| | | | Erosion score to remain 2 or less (minor erosion). No increase in erosion from previous monitoring event for at least two consecutive years. | RMP (Appendix F) |
| | | Rehabilitated dams and ponds congruent with pre-mining topography. | Hard-pack and above-ground infrastructure removed. | Inspection of areas post closure. |
| | | | Domain re-profiled to surrounding surface topography, ripped, covered with topsoil and seeded. | RMP (Appendix F) |

| Domain | Component | Closure outcomes | Completion criteria | Validation |
|---|---|---|---|---|
| | | | Erosion score 2 or less (minor erosion). No increase in erosion from previous monitoring event for at least two consecutive years. | |
| | | Domain supports self-sustaining native vegetation not significantly different to that of the surrounding ecosystems. | Groundcover % and groundcover species richness recorded at vegetation transects not less than analogue sites for two consecutive years post closure.<br>Abundance of woody plants (stems ≥ 2 cm DBH and greater than 3 m high) recorded at vegetation transects not less than of representative analogue sites.<br>Not less than three dominant species (per strata) recorded at vegetation transects present in analogue sites.<br>Density of weed species within rehabilitated domain is not more than reference sites for three consecutive years. No declared weed species not previously recorded in the mining lease is present within the rehabilitated domains for three consecutive years.<br>No fire scars recorded at vegetation transects within first three years of rehabilitation. | RMP (Appendix F) |
| | | The domain supports fauna recolonisation not significantly different to that of the surrounding ecosystems. | Trend of increasing native wildlife abundance and diversity each year with eventual results not significantly different to analogue sites.<br>Key indicator invertebrate biota assemblages of rehabilitated areas not significantly different to analogue sites.<br>No significant difference in abundance of feral animal and pests compared to analogue sites. | RMP (Appendix F) |
| Support infrastructure and pipelines | Mine workshop | Decommissioning and removal of infrastructure | All non-geological waste is removed from site on the completion of mining activities.<br>Plumbing standpipes and above ground components of the water supply and workshop wastewater system are removed to below ground. Washdown bays are scrapped clean and sediment stored as for sediment ponds, then demolished and topsoiled and revegetated.<br>All pumping infrastructure is removed from site on the completion of mining activities.<br>Final surfaces do not show signs of erosion more than reference sites. | Inspection of areas post closure. |
| | | Support infrastructure domain is returned to pre-mining and stable | Domain re-profiled to pre-mining conditions, ripped, covered with suitable growth medium to sustain plant growth and seeded. | |
| | | | Soils quality within acceptable criteria for successful plant growth. | RMP (Appendix F) |

| Domain | Component | Closure outcomes | Completion criteria | Validation |
|---|---|---|---|---|
| | | and non-polluting landform. | Erosion score to remain 2 or less (minor erosion).<br>No increase in erosion from previous monitoring event for at least two consecutive years. | RMP (Appendix F) |
| | | Domain supports self-sustaining native vegetation not significantly different to that of the surrounding ecosystems. | Groundcover % and groundcover species richness recorded at vegetation transects not less than analogue sites for two consecutive years post closure.<br>Abundance of woody plants (stems ≥ 2 cm DBH and greater than 3 m high) recorded at vegetation transects not less than of representative analogue sites.<br>Not less than three dominant species (per strata) recorded at vegetation transects present in analogue sites.<br>Density of weed species within rehabilitated domain is not more than reference sites for three consecutive years. No declared weed species not previously recorded in the mining lease is present within the rehabilitated domains for three consecutive years.<br>No fire scars recorded at vegetation transects within first three years of rehabilitation. | |
| | | The domain supports fauna recolonisation not significantly different to that of the surrounding ecosystems. | Trend of increasing native wildlife abundance and diversity each year with eventual results not significantly different to analogue sites.<br>Key indicator invertebrate biota assemblages of rehabilitated areas not significantly different to analogue sites.<br>No significant difference in abundance of feral animal and pests compared to analogue sites. | RMP (Appendix F) |
| | Pipeline Corridor | All surface infrastructure removed from site on the completion of operations. | Breather valves and surface infrastructure removed.<br>Domain is re-profiled to pre-mining conditions. Re-profiled surface is ripped and covered with topsoil. | Inspection of areas post closure. |
| | | Pipeline Corridor is returned to pre-mining and stable landform. | Erosion score to remain 2 or less (minor erosion). No increase in erosion from previous monitoring event for at least two consecutive years. | **Error! Reference source not found.**. |
| | | Domain supports self-sustaining native vegetation not significantly different to | Groundcover % and groundcover species richness recorded at vegetation transects not less than analogue sites for two consecutive years post closure.<br>Abundance of woody plants (stems ≥ 2 cm DBH and greater than 3 m high) recorded at vegetation transects not less than of representative analogue sites. | RMP (Appendix F) |

| Domain | Component | Closure outcomes | Completion criteria | Validation |
|---|---|---|---|---|
| | | that of the surrounding ecosystems. | Not less than three dominant species (per strata) recorded at vegetation transects present in analogue sites.<br>Density of weed species within rehabilitated domain is not more than reference sites for three consecutive years.<br>No declared weed species not previously recorded in the mining lease is present within the rehabilitated domains for three consecutive years.<br>No fire scars recorded at vegetation transects within first three years of rehabilitation. | |
| | | The domain supports fauna recolonisation not significantly different to that of the surrounding ecosystems. | Trend of increasing native wildlife abundance and diversity each year with eventual results not significantly different to analogue sites.<br>Key indicator invertebrate biota assemblages of rehabilitated areas not significantly different to analogue sites.<br>No significant difference in abundance of feral animal and pests compared to analogue sites. | RMP (Appendix F) |
| | | Surface water quality is protected to not present a significant risk to environmental values and beneficial uses. | Post mining surface water quality (for the identified parameters) downstream meet site-specific guidelines values for at least two consecutive years. | Water Management Plan (Appendix F) |
| | | | Erosion score to remain 2 or less (minor erosion). No increase in erosion from previous monitoring event for at least two consecutive years. | RMP (Appendix F) |
| | | | Post mining turbidity downstream at monitoring sites meet site- specific guidelines values for at least two consecutive years OR is not significantly different from upstream sites. | Water Management Plan (Appendix F) |

# 8. Closure Risk Assessment

A risk assessment workshop for the purposes of Care and Maintenance (C&M) planning was held during May 2024 and was attended by Mine Earth and Core Lithium staff members. The risk assessment workshop was undertaken to identify and quantify closure risks for the Project. This risk assessment was used to inform the closure risk assessment presented in this Section.

The risk assessment process that was adopted aligns with the Australian and New Zealand Risk Management Standard (AS/NZ 31000:2009). The risk matrices used to undertake the assessment were sourced from the International Council on Mining and Metals (ICMM) planning for integrated mine closure toolkit (International Council on Mining and Metals, 2019) (Appendix G).

The objectives of the risk assessment were to:

- Identify and rank inherent risks. Inherent risk is described as a risk event prior to implementing risk controls.
- Develop risk controls for those inherent risks that could compromise the achievement of closure objectives.
- Assess residual risk after risk controls have been implemented.

The Project closure risk assessment is provided in Table 11 within which risk events are ordered by domain and from highest to lowest residual risk rating. The outcomes of the risk assessment have been used to inform the development of closure plans for relevant domains (Section 9).

Only one risk event, poor revegetation outcomes, has a residual risk ranking of significant. The control options for this risk event include implementing an appropriate rehabilitation plan and managing weeds and grazing. Although the likelihood for this risk event was reduced by the control options, the residual risk remained significant as poor revegetation outcomes are still possible.

**Table 11: Closure risk assessment**

| Risk No. | Event | Causes | Consequences | Consequence | Likelihood | Inherent risk | Control options | Consequence | Likelihood | Residual risk |
|---|---|---|---|---|---|---|---|---|---|---|
| **Boxcut and underground workings and historical pit** | | | | | | | | | | |
| R1 | Poor revegetation outcomes on the rehabilitated boxcut. | Insufficient or poor quality growth medium.<br>Erosion of rehabilitated surfaces.<br>Rehabilitation materials have low water holding capacity.<br>Grazing pressures.<br>Excessive weeds occurrence.<br>Extreme climatic events.<br>Excessive erosion of rehabilitated surfaces<br>Poor seed supply or quality.<br>Ferals animals. | Requirement for ongoing remedial works.<br>Weeds become dominant<br>Erosion.<br>Excessive dust generation<br>Limited fauna recolonisation.<br>Do not achieve self-sustaining vegetation outcome.<br>Inability to meet closure criteria. | Moderate (3) | Likely (4) | Significant (17) | Implement an appropriate rehabilitation plan (surface treatments, seed selection, collection, storage and management).<br><br>Continue to implement appropriate design including surface drainage and material placement.<br>Identify and manage adequate volumes of suitable growth medium (i.e. topsoil and subsoil).<br>Ongoing weed control.<br>Post closure monitoring and maintenance as required.<br>Limit grazing pressure using temporary fencing, where appropriate. | Moderate (3) | Possible (3) | Significant (13) |
| R2 | Unauthorised access to boxcut tunnel, historical pit and underground workings. | Access to boxcut tunnel, historical pit and underground workings is not restricted after closure.<br>Abandonment bund failure due to poor placement.<br>Vent shafts access not restricted. | Human injury or fatality. | High (4) | Likely (4) | High (21) | Boxcut and underground will be backfilled during operations and the tunnel will be sealed.<br>Historical pit to be backfilled<br>Abandonment bunds have been designed in consideration of drainage and access.<br>Ventilation shafts will be closed or capped. | Moderate (3) | Unlikely (2) | Medium (9) |
| R3 | Geotechnical failure/unexpected unstable ground conditions around boxcut and underground | Uncontrolled surface water drainage.<br>Poor design of boxcut and underground.<br>Closure works do not meet design standards.<br>Low stability material on boxcut wall faces | Potentially hazardous conditions. | Moderate (3) | Likely (4) | Significant (17) | Boxcut and underground will be backfilled during operations.<br>Undertake inspections.<br>Landforms located outside of the ZoI. | Moderate (3) | Unlikely (2) | Medium (9) |
| R4 | Poor quality seepage to groundwater | Pit is backfilled with PAF phyllite material.<br>Groundwater is shallow. | Impacts to the receiving environment. | Moderate (3) | Unlikely (2) | Medium (9) | Low amounts of PAF material have been identified.<br>Monitoring and management as per the WRD and AMD Management Plan and Water Management Plan post closure. | Moderate (3) | Unlikely (2) | Medium (9) |
| **Waste rock landforms, topsoil dumps and ROM pad** | | | | | | | | | | |
| R5 | Geotechnical instability. | Incomplete design and construction of landforms.<br>Inappropriate materials characterisation and materials placement.<br>Uncontrolled drainage on and around landforms.<br>Seismic event. | Geotechnical instability.<br>The requirement for ongoing remedial works.<br>Unsafe conditions. | Moderate (3) | Possible (3) | Significant (13) | WRDs are being backfilled into the pit and underground. | Minor (2) | Improbable (1) | Low (3) |
| R6 | Unsafe conditions on landform | Large erosion features.<br>Slopes left at angle of repose. | Human injury or fatality. | Moderate (3) | Possible (3) | Significant (13) | WRDs are being backfilled into the pit and underground.<br>Construct security fencing with lockable gate and signage around the site. | Minor (2) | Improbable (1) | Low (3) |
| R7 | Poor revegetation outcomes. | Insufficient or poor quality growth medium.<br>Erosion of rehabilitated surfaces.<br>Rehabilitation materials have low water holding capacity.<br>Grazing pressures.<br>Excessive weeds occurrence. | Requirement for ongoing remedial works.<br>Weeds become dominant<br>Erosion.<br>Excessive dust generation<br>Limited fauna recolonisation. | Moderate (3) | Likely (4) | Significant (17) | Implement an appropriate rehabilitation plan (surface treatments, seed selection, collection, storage and management).<br>Implement RMP<br><br>Identify and manage adequate volumes of suitable growth medium (i.e. topsoil and subsoil). | Moderate (3) | Possible (3) | Significant (13) |

| Risk No. | Event | Causes | Consequences | Consequence | Likelihood | Inherent risk | Control options | Consequence | Likelihood | Residual risk |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Extreme climatic events.<br>Excessive erosion of rehabilitated surfaces<br>Poor seed supply or quality.<br>Ferals animals | Do not achieve self-sustaining vegetation outcome.<br>Inability to meet closure criteria | | | | Ongoing weed control.<br>Post closure monitoring and maintenance as required.<br>Limit grazing pressure using temporary fencing, where appropriate. | | | |
| R8 | Uncontrolled drainage on the landforms. | Drainage controls not constructed<br>Poor materials selection and placement.<br>Low stability waste rock is placed on landform slopes.<br>Extreme rainfall events<br>Slope is angle of repose | Unacceptable levels of erosion.<br>Increased sediment load to surface water.<br>Geotechnical instability<br>Loss of growth media and seed.<br>Unsafe conditions. | Minor (2) | Likely (4) | Medium (12) | WRDs are being backfilled into the pit and underground. | Minor (2) | Improbable (1) | Low (3) |
| R9 | Acid and metalliferous impacts. | Limited mine waste characterisation prior to mining.<br>Poor waste rock management during mining.<br>Excessive erosion results in fresh phyllite PAF becoming exposed on WRD. | Poor quality run-off and seepage.<br>Impacts to receiving environment.<br>The requirement for ongoing remedial works. | Minor (2) | Likely (4) | Medium (12) | Low proportion of PAF material has been identified.<br>WRDs are being backfilled into the pit and underground.<br>Low permeability layers form the base of WRDs<br>Monitoring and management as per the WRD and AMD Management Plan and Water Management Plan post closure. | Minor (2) | Unlikely | Low (5) |
| **All other closure domains** | | | | | | | | | | |
| R10 | Unauthorised access to roads and tracks | Access to roads and tracks not restricted | Human injury or fatality | High (4) | Possible (3) | Significant (18) | Rehabilitate unused roads. | High (4) | Unlikely (2) | Significant (14) |
| R11 | Poor revegetation outcomes. | Insufficient or poor quality growth medium.<br>Erosion of rehabilitated surfaces.<br>Rehabilitation materials have low water holding capacity.<br>Grazing pressures.<br>Excessive weeds occurrence.<br>Extreme climatic events.<br>Excessive erosion of rehabilitated surfaces<br>Poor seed supply or quality.<br>Ferals animals | Requirement for ongoing remedial works.<br>Weeds become dominant<br>Erosion.<br>Excessive dust generation<br>Limited fauna recolonisation.<br>Do not achieve self-sustaining vegetation outcome.<br>Inability to meet closure criteria | Moderate (3) | Likely (4) | Significant (17) | Implement an appropriate rehabilitation plan (surface treatments, seed selection, collection, storage and management).<br><br>Identify and manage adequate volumes of suitable growth medium (i.e. topsoil and subsoil).<br>Ongoing weed control.<br>Post closure monitoring and maintenance as required.<br>Limit grazing pressure using temporary fencing, where appropriate. | Moderate (3) | Possible (3) | Significant (13) |
| R12 | Assets left intact after closure deteriorate and become a liability. | Residual assets not maintained by new owner.<br>Liability for assets not agreed.<br>Stakeholder expectations not defined.<br>Asset not left with capacity to function. | Company reputation adversely affected.<br>Assets become a liability. | Moderate (3) | Possible (3) | Significant (13) | Remove assets and relocate to other sites<br>Leave only those assets that have an agreed owner and viable future use.<br>Transfer responsibility to the future owner.<br>Engage stakeholders to determine their expectations for assets beyond mine closure.<br>Where required, ensure that assets are left in good working order. | Minor (2) | Unlikely (2) | Medium (9) |
| R13 | Contamination resulting from hazardous materials storage and handling | Inadequate storage and management of hazardous materials.<br>Hazardous material spills.<br>Hazardous materials not removed | Detrimental effects to the receiving environment.<br>Company reputation adversely affected<br>Human injury | Minor (2) | Possible (3) | Medium (8) | Remove all remaining hazardous materials.<br>Manage and store hazardous materials in accordance with relevant licence conditions and internal procedures.<br>Effectively manage hazardous material spills during operations.<br>Undertake contaminated sites inspection. | Minor (2) | Unlikely (2) | Low (5) |

| Risk No. | Event | Causes | Consequences | Consequence | Likelihood | Inherent risk | Control options | Consequence | Likelihood | Residual risk |
|---|---|---|---|---|---|---|---|---|---|---|
| R14 | Impacts from uncontrolled surface water flow. | Surface water controls designed/constructed poorly.<br>Inadequate rehabilitation planning.<br>Extreme rainfall events exceeding the design capacity of surface water controls.<br>Built up areas remaining. | Erosion.<br>Increased sediment load to surface water.<br>Loss of growth media.<br>Poor revegetation. | Minor (2) | Possible (3) | Medium (8) | Design and construct adequate controls to manage surface water.<br>Develop and implement an appropriate rehabilitation plan. | Minor (2) | Unlikely (2) | Low (5) |
| R15 | Overflow of dams and sediment basins | Extreme rainfall event cause overflowing<br>Inactive maintenance of drainge diversions etc.<br>Build up of sediment in dams. | Erosion contributes to instability to dam walls/slippage<br>Sediment discharged to receiving environment | Minor (2) | Possible (3) | Medium (8) | Remove infrastructure.<br>Scrape dams and basins clean, backfill, profile and rehabilitate. | Minor (2) | Unlikely (2) | Low (5) |
| **Site wide** | | | | | | | | | | |
| R16 | Delay in tenement relinquishment. | Closure criteria are not achievable or not endorsed by regulators.<br>Poor closure and rehabilitation planning and implementation.<br>Custodial authority unwilling to accept residual liabilities. | Delay in tenement relinquishment.<br>Uncertainty for community, State and proponent about long term management of residual liabilities.<br>Ongoing closure management costs<br>Stakeholder expectations not met | Moderate (3) | Likely (4) | Significant (17) | Develop acceptable and achievable closure criteria in consultation with relevant stakeholders.<br>Continue to develop adequate closure and rehabilitation plans and implement works in accordance with approved closure designs.<br>Consider alternatives to encourage custodial transfer of residual liabilities.<br>Effective stakeholder engagement to develop a plan to relinquish mining tenure in a coordinated manner and to establish a plan for long term management of residual liabilities.<br>Monitor closure performance and present performance data to relevant stakeholders | Moderate (3) | Unlikely (2) | Medium (9) |
| R17 | Insufficient funds set aside for the implementation of the closure program. | Closure costs under estimated.<br>Inadequate funds are available to implement closure works. | Substandard or incomplete closure works.<br>Delay in tenement relinquishment | Moderate (3) | Unlikely (2) | Medium (9) | Continue to develop realistic closure cost estimates and make adequate accounting provision for closure costs.<br>Review closure costs on a periodic basis or following significant changes to the life of mine plan. | Moderate (3) | Improbable (1) | Medium (6) |
| R18 | Unplanned or early closure. | Fall in commodity prices or increased operating costs.<br>Significant safety / environmental / technical issue.<br>Non compliance issue | Substandard closure outcome.<br>Insufficient funds available for closure works.<br>Unable to achieve closure designs | Moderate (3) | Likely (4) | Significant (17) | Develop acceptable and achievable closure criteria in consultation with regulators.<br>Continue to develop adequate closure and rehabilitation plans and implement works in accordance with approved closure designs.<br>Continue to engage regulators to develop a plan to relinquish mining tenure in a coordinated manner and to establish a plan for the long term management of residual liabilities.<br>Monitor closure performance and present performance data to regulators.<br>Relatively short term Project<br>Develop and C&M plan | Moderate (3) | Unlikely (2) | Medium (9) |
| R19 | Poor quality surface water discharging from site impacts environment | Surface water quality deteriorates passing through site | Impacts to receiving environment | Minor (2) | Possible (3) | Medium (8) | Most areas will be rehabilitated and infrastructure removed<br>Implement water management plan in the post closure period | Minor (2) | Unlikely (2) | Low (5) |
| R20 | Dust generation | Loose material on landforms and topsoil stockpiles<br>High wind conditions | Environmental impacts<br>Nuisance | Insignificant (1) | Unlikely (2) | Low (2) | Dust deposition monitoring in place<br>Most areas will be rehabilitated. | Insignificant (1) | Improbable (1) | Low (1) |

# 9. Closure Implementation

Taking into account the identified closure risks and acknowledging the further studies, investigations and design work that will occur during the life of the mine, this section describes how the Project will be rehabilitated and closed in a manner that satisfies regulatory requirements, mine closure objectives, guiding principles and completion criteria, and addresses stakeholder expectations.

## 9.1 Domains

The following domains have been identified and will be generally treated as summarised below.

### 9.1.1 Boxcut and underground workings

The highest ranked closure risk for the boxcut and underground workings domain was unauthorised access to the boxcut tunnel /underground workings and poor revegetation. In response to this risk, the closure plan involves sealing the tunnel entrance at ground surface and implementing an appropriate rehabilitation plan for the previously backfilled boxcut domain. .

Closure and rehabilitation of BP33 will involve the following.

- All above ground infrastructure and salvageable underground infrastructure will be removed.
- Seal the boxcut tunnel entrance at ground surface.
- Ventilation shafts will be sealed with a steel plate to a concrete shaft cover (or equivalent).
- All access roads no longer required will be rehabilitated.
- Re-profiling of the final surface.
- Subsoil and topsoil re-spreading and contour ripping.
- Application of seed.

**Error! Reference source not found.Error! Reference source not found.**The following knowledge gaps will be progressively resolved to advance closure planning for the boxcut and underground workings domain:

- Finalise the plan for the sealing of the box cut tunnel entrance.
- Determine the expectations of primary stakeholders regarding access roads after closure. Negotiate the requirements for assets and liability transfer.
- Develop a site-wide rehabilitation materials inventory for use during rehabilitation works.
- Develop a plan to manage surface water around the boxcut and underground workings.
- Develop a programme for the collection, storage and management of seed.

### 9.1.2 Waste rock dumps, topsoil dumps and ROM pad

The highest ranked closure risks for the WRDs, topsoil dumps and ROM pad were geotechnical instability, unsafe conditions on the landform and poor revegetation outcomes. In response to these risks, the mining waste rock stored in WRD 1 and WRD2 will be progressively used to backfill the underground mine during operations. It is anticipated all waste rock will be consumed as backfill with only the empty WRD footprints remaining at closure. The mine closure concept for both WRD foundations assumes both WRDs and foundations have been removed and the area it occupied rehabilitated (topsoil spread, ripped and seeded).

Topsoil dumps will be systematically removed as they are used to cover re-profiled areas. The intent is to undertake this rehabilitation progressively as opportunities present.

Material from the ROM will be moved for processing at Grants and the remaining area will be rehabilitated (topsoil spread, ripped and seeded).

The following knowledge gaps will be progressively resolved to advance closure planning for the waste rock and topsoil dumps and ROM pad domain:

- Develop a site-wide rehabilitation materials inventory for use during rehabilitation works.
- Develop a plan for surface water management on and around rehabilitated areas.
- Develop a programme for the collection, storage and management of seed.

### 9.1.3 Historical pit void

The histocial BP33 pit void is proposed to be backfilled prior to the commencement of mining. The closure plan for the backfilled historical pit footprint is the implementation of an appropriate rehabilitation plan.

### 9.1.4 Roads

The highest ranked risk for the roads domain was unauthorised access to roads and tracks, poor revegetation outcomes and assets deteriorate and become a liability. In response to these risks, the closure plan for roads will involves rehabilitating unused roads, implementing an appropriate rehabilitation plan and leaving only those assets that have an agreed owner and viable future use.

Some roads will be retained after closure to provide access for post closure monitoring and maintenance. Roads that remain will be reduced in size to single lane unless stakeholders request the road to be retained at their full width. It is assumed that all roads will be completely removed at the end of the post closure monitoring and maintenance period. It is likely however that stakeholders may want some roads left intact permanently if:

- They have an agreed owner who is responsible for their maintenance and they have a viable future use.
- The owner accepts responsibility for rehabilitation, if required, to a standard nominated by Develop.
- The Territory agrees with the proposal.
- Core Lithium is indemnified against future liability.

The closure plan for the roads, borrow pits and hardstand domain will involve the following:

- Tidy disturbance areas and remove non-fixed assets where required.
- Remove all signage and road furnishings.
- Remove culverts, floodways and other drainage structures where no longer required.
- Identify and remediate or dispose of impacted soils.
- Batter down built-up sections where required.
- Install drainage management structures as required.
- Undertake a de-compaction rip of hardstand areas.
- Apply soil where required and available.
- Rip or scarify on the contour as required.
- Spread seed mix.

The following knowledge gaps will be progressively resolved to advance closure planning for the roads domain:

- Determine the expectations of primary stakeholders regarding assets after closure. Negotiate the requirements for assets and liability transfer.
- Develop a plan for the collection, storage and management of seed.
- Develop a site-wide rehabilitation materials inventory for use during rehabilitation works.

### 9.1.5 Infrastructure and pipelines

The highest ranked risk for the infrastructure and pipelines domain was unauthorised access to roads and tracks, poor revegetation outcomes and assets left intact become a liability. In response to these risks, the

closure plan for infrastructure and pipelines will involve rehabilitating unused roads, implementing an appropriate rehabilitation plan and leaving only those assets that have an agreed owner and viable future use.

Specifically, the closure plan for the infrastructure and pipelines domain will involve the following:

- Tidy disturbance areas and remove non-fixed assets, buildings and equipment and consumables, wastes and hazardous materials where required.
- Decommission and remove above ground equipment and infrastructure and dispose of decommissioning wastes in accordance with the decommissioning plan.
- Break up and remove concrete or bury in situ (>1 m cover).
- Retain below ground infrastructure  unless otherwise agreed.
- Identify, remove and dispose of all impacted soils, and import clean fill as required.
- Re-profile any voids or built-up areas.
- Install drainage management structures as required.
- Undertake a de-compaction rip of hardstand areas.
- Apply soil where required and available to a nominated depth.
- Rip or scarify on the contour as required.
- Spread seed mix.

The following knowledge gaps will be progressively resolved to advance closure planning for the infrastructure and pipelines domain:

- Determine the expectations of primary stakeholders regarding assets after closure. Negotiate the requirements for asset and liability transfer.
- Upon closure, investigate any known or suspected contaminated sites and develop an appropriate response
- Develop a plan for the effective management of surface water on and around the infrastructure and pipelines domain after closure.
- Develop a plan for the collection, storage and management of seed.
- Develop a site-wide rehabilitation materials inventory for use during rehabilitation works.

### 9.1.6 Dams and ponds

The highest ranked risk for the damns and ponds domain was unauthorised access to roads and tracks, poor revegetation outcomes and assets left intact deteriorate and become a liability. In response to these risks, the closure plan for infrastructure and pipelines will involved rehabilitating unused roads, implementing an appropriate rehabilitation plan and leaving only those assets with an agreed owner and viable future use.

The mine water dam will be decommissioned, and all infrastructure removed from site, including above ground pipework, pumps, standpipes, HDPE liner (RWD and MWD western cell). The construction material (overburden) used for the dam walls and base layer will be incorporated into underground backfill. These remaining areas will be re-profiled to pre-mining surface topography aligning with the surrounding area, then ripped, covered in topsoil and revegetated.

Stormwater drains and sediment ponds that remain functioning for rehabilitation activities will remain at least for the first wet season post rehabilitation of the Project area to capture sedimentation following the initial revegetation establishment. The sediment captured within the basins will be cleaned out at the end of each wet season as required and decommissioned once the domain has met the completion criteria.

The following knowledge gaps will be progressively resolved to advance closure planning for the dams and ponds domain:

- Upon closure, investigate any known or suspected contaminated sites and develop an appropriate response.
- Develop a plan for the effective management of surface water on and around the dams and ponds domain after closure.
- Develop a plan for the collection, storage and management of seed.
- Develop a site-wide rehabilitation materials inventory for use during rehabilitation works.

## 9.2 Closure and rehabilitation strategies

The overall rehabilitation strategy involves several stages which are described in the RMP (Appendix F). A summary is provided in Table 12 .

**Table 12: Summary of proposed stages of rehabilitation strategy and schedule of works**

| Stage | | Activities | Timing |
|---|---|---|---|
| 1 | Site planning | Develop RMP.<br>Additional flora surveys (specific to each domain to be rehabilitated) to validate existing baseline information and further develop species selection.<br>Engage local seed suppliers in preparation for seed collection. Seed suppliers to advise seeding rates per hectare based on seed size, viability (germination), site conditions and availability of stock.<br>Engage interest with local ranger groups regarding seed collection methods during the rehabilitation process.<br>Engage with key stakeholders. | Prior to commencement of operations<br>Seed collection is species and season dependant. |
| 2 | Site preparation | General site clean-up, minimise human disturbance, weed and pest control, install firebreaks, soil testing, salvaging resources, providing fauna habitat | Within 12 months leading up to the planting stage. |
| 3 | Soil preparation | Ripping the soil on the contour (ideally immediately prior seeding), applying topsoil, weed control (non-residual herbicide), fertiliser (if required from soil testing results) and erosion protection. | In months prior to wet season |
| 4 | Seeding and planting | Sowing technique - direct seeding will be the preferred method (aerial seeding in larger areas to be rehabilitated). However, supplementary tube is the preferred option in floodplain areas to prevent seeds washing away. | Direct seeding to occur during the wet season when there is sufficient soil moisture, typically late November through to January (depending on the season). |
| 5 | Maintenance | Management of birds and human activity, weeds and pests, and erosion. | Ongoing until closure criteria achieved. |
| 6 | Ecological monitoring | Drone monitoring–capturing aerial imagery for young/transitional rehabilitation (the first few years) to ensure native vegetation establishment, presence/absence of large weed infestations, and | Monitoring will be undertaken during both wet and dry season months. |

| Stage | | Activities | Timing |
|---|---|---|---|
| | | erosion. This is undertaken until rehabilitation risk is lowered (non-existent)<br>Permanent vegetation transects (species composition, evidence of weeds, pests and fire, and desirable biota such as ants and termites and other nutrient cycling or not significantly different to analogue sites).<br>Permanent photo monitoring sites.<br>Fauna and pest monitoring–camera trapping.<br>Weeds monitoring (site-based mapping). | |

## 9.3 Progressive rehabilitation

A key element to MCP revisions will be incorporation of feasibility studies for progressive rehabilitation opportunities. Some key potential early opportunities include the backfill area of the boxcut and other areas that are surplus to requirements such as laydown areas.

## 9.4 Unplanned closure

In the event of unplanned closure, this plan will be used to guide closure of the site so that all domains are rehabilitated meet the closure criteria detailed in Table 10.

## 9.5 Care and Maintenance

Should the Project enter a period of care and maintenance (C&M), a C&M Management Plan will developed and used to manage and maintain the site so that it remains safe, stable and non-polluting for the period of C&M. The C&M Management Plan should be informed by a risk assessment and include a work program to make areas safe and to manage surface water as well as provide for environmental audits, environmental monitoring and environmental performance objectives and targets.

## 9.6 Closure timeline

Mine closure and rehabilitation is expected to take further five months following removal of the last ore. Key closure activities and timing are summarised in Table 13.

**Table 13: Key closure activities and timing (after EcOz, 2021a)**

| Closure activities | Timing (indicative) |
|---|---|
| **Care and maintenance period** | Up to 4 years |
| **Construction complete** | 6 months |
| **Operations** | 44 months |
| **Resolve knowledge gaps** | 24 months |
| **Develop detailed MCP** | 12 months |
| **Closure works** | 5 months |
| **Monitoring and maintenance** | 10 years |

# 10. MONITORING AND MAINTENANCE

This section outlines the monitoring to be undertaken to assess the progression towards and success in meeting the completion criteria that define site-specific closure outcomes.

Maintaining access is critical for monitoring and maintenance. A single access track from the Cox Peninsula Highway into the mine site will be maintained to access the rehabilitated Project area.

## 10.1 Ecological monitoring

Ecological monitoring will be undertaken in accordance with the Rehabilitation Management Plan (RMP – Appendix F). A summary of the ecological monitoring to be undertaken is outlined below.

### 10.1.1 Vegetation monitoring

#### 10.1.1.1 Transitional

A type of short-term monitoring for young revegetation after initial establishment in the first three years will be undertaken to identify and manage rehabilitation and will continue until there are no revegetation risk areas identified in monitoring.

#### 10.1.1.2 Long-term vegetation monitoring

Quantitative monitoring to compare data obtained from vegetation sites against analogue sites.

#### 10.1.1.3 Weed monitoring

Weed surveys will be incorporated into the vegetation surveys and treatment conducted in accordance with the Weed Management Procedure (Core, 2021b). The weed monitoring is a mapping-based exercise encompassing the entire Project footprint to inform management.

### 10.1.2 Fauna and pest animal monitoring

#### 10.1.2.1 Transitional Fauna Monitoring

Transitional fauna monitoring will be undertaken from year one to year three to allow vegetation establishment and will continue until there are no rehabilitation risk areas identified in monitoring. This will occur opportunistically during site inspections.

#### 10.1.2.2 Long term fauna and pest monitoring

Using active methods (active searches and camera surveillance) to ensure the health of rehabilitated areas by detecting native fauna presence/absence over time and compare abundance/richness to the analogue sites.

## 10.2 Landform erosion and sediment monitoring

Terrain monitoring will be undertaken to evaluate the physical stability of the site. This will be undertaken through remote sensing methods, visual inspections and surveys.

### 10.2.1 Remote sensing

Remote sensing with drones, drone-based sensors and satellites is a useful method of monitoring during operations for landform construction, rehabilitation, pre and post closure. Early identification of issues such as high-risk areas for erosion and water pooling and infiltrating allows for remediation while machinery is still

available on site. Remote sensing can also be used to gather data to demonstrate that completion criteria such as landform stability and vegetation success have been achieved. A drone will be used to capture high quality aerial imagery (orthomosaic) during landform construction, rehabilitation, pre and post closure. Drone monitoring is critical for assessment of areas that are not easily assessable and has the ability to cover large areas. Areas of interest will be identified by an assessment of the imagery and will be further investigated in the field.

### 10.2.2 Visual inspections and surveys

Geotechnical inspections will be undertaken by a geotechnical engineer to assess for indications of instability and erosion (rehabilitated slopes, cover and toe for seepage, tunnelling, slumping, cracks and other signs of erosion), boxcut (abandonment bund, pit walls and access ramp for signs of mass slumping or excessive erosion). Inspections will occur annually as a minimum following each wet season (and more frequently following high intensity rainfall events) during rehabilitation, pre and post closure until ongoing stabilisation is achieved. On-ground field monitoring will be undertaken at the identified erosion monitoring locations identified through remote sensing techniques. Field monitoring will use the vegetation transect methods and criteria for erosion assessment identified in the RMP (Appendix F).

## 10.3 Water monitoring

The Water Management Plan contains measures to avoid, minimise and mitigate the impact of proposal activities on surface and groundwater, and potential GDEs (Appendix F).

A water monitoring program will be implemented to assess the water quality of the surrounding surface and groundwater around the pit void to ensure that it meets the defined post mining land use (EcOz, 2022a). Surface water and groundwater monitoring will be conducted as per the approved plan until rehabilitation completion criteria are achieved. The plan specifies locations of monitoring sites, frequency of monitoring and parameters to be assessed. Additional monitoring sites, events or parameters may be added to the water monitoring program in the event of a rehabilitation issue which may affect water quality. If this occurs, the Water Management Plan will be updated, as required, as part of the MCP review process.

Surface water and groundwater monitoring will be conducted at sites upstream/gradient and downstream/gradient on a quarterly basis to detect any AMD other impact to water quality from demolished facility e.g., workshop footprint and landforms such as WRD footprints.

### 10.3.1 Groundwater levels for GDEs

Once mining ceases, the water levels beneath the riparian vegetation are predicted to recover to pre-mining levels within three years. The resilience of the riparian vegetation to this short period of reduced water availability is difficult to predict with certainty and will need to be monitored to inform mine closure and rehabilitation requirements. Consequently, a monitoring program is provided where groundwater level monitoring will be used to validate the numerical groundwater flow model (Appendix F – GDE Management Plan).

### 10.3.2 AMD

AMD classification of waste rock will be verified by ongoing field and laboratory testing during operations. Following decommissioning and rehabilitation of the mine, on-going monitoring will occur to evaluate and validate the performance of the final landform designs, cover, structural integrity and rehabilitation success and ensure the post closure objective are met.

Surface and groundwater monitoring will be undertaken in accordance with the Water Management Plan and the WRD and AMD Management Plan (Appendix F).

## 10.4 Visual inspections

During and post construction, routine inspections of the rehabilitated landforms and pit lake will be undertaken to assess for signs of AMD. Suitable qualified and experienced geologists will assess the rehabilitated boxcut and a suitably qualified and experienced environmental scientist will assess revegetation and water quality. A number of visual observations can also be early detection mechanisms to prompt further testing:

- Discolouring of water–red colouration and/or iron oxide (orange/brown) precipitate.
- Very clear water.
- High nutrient loads such as green algae filaments from benthos in clear water or cloudy green water.
- Salt expressions forming on stream banks, WRD batters and toes, more noticeable in dry.

Visual observations will also include signs of seepages, erosion (tunnelling) and subsurface water flows.

## 10.5 Monitoring and maintenance summary

Table 14 summarises the monitoring to be undertaken to assess the success of mine closure.

**Table 14: Summary of closure monitoring and maintenance activities.**

| Monitoring | Monitoring | Frequency | Duration |
|---|---|---|---|
| Ecological | Vegetation | Annually (undertaken post wet season). Transitional vegetation monitoring during the dry season, for first two years to monitor transition from operations to closure. Vegetation monitoring following the first two years. | On-going until completion criteria are met and relinquishment of security by The Regulator |
| | | Fire monitoring included in the vegetation monitoring. Annually post wet season cool burns from 5 years of revegetation. | |
| | Weeds | Annually (mapping to be undertaken during wet season months or when the site is accessible and weeds easily identifiable and prior to fire management). Weed spraying will occur during the active plant growth stage at the end of the wet season and prior to seeding). Weed species, growth stage and method of control will determine the appropriate timing. | |
| | Fauna and Pests | Transitional monitoring for first three years. Fauna and pest monitoring bi-annually from year three. | |
| | Landform, sediment and erosion | Annually and following significant rainfall events, using aerial methods such as drone monitoring and follow-up on-ground site inspections and surveys of identified areas. | |
| Water | Surface water | Monthly from beginning of wet season following first flush of seasonal creeks to drying out of surface flows. | |
| | Groundwater | Biannual sampling for water quality and levels | |
| | Seepage monitoring and inspections | Quarterly basis to detect for indications of AMD seepage | |

# 11. CLOSURE FINANCIAL PROVISIONING

EcOz completed a security calculation for disturbances up to 2023. This was used to calculate the mine security that is held by the regulator in the event that Core Lithium can no longer fund its closure commitments. The costs are presented in the BP33 Mine Management Plan and the assumptions are presented in Table .

**Table 15: Key closure costing assumptions.**

| Item/activity | Assumption(s) |
|---|---|
| Ripping | Deep rip low level disturbance - 14G grader or equivalent with multishank ripper to 3 m width. At $180/h and at 3 km/h with 0.83 efficiency will cover 7,500 $m^2$/h = $240/ha.<br>Deep rip medium level disturbance- Cat D6 with triple shank rippers ripping to a depth of 0.3m and 3m width covered per pass. At $220/h and 2 km/h with 0.83 efficiency will cover 4,980 $m^2$/h = $441/ha.<br>Deep rip high level of disturbance and compaction - using a Cat D9 with multishank.<br>Ripper to a width of 2.64 m. At $300/h and 1.6 km/h with 0.83 efficiency will cover 3,320 $m^2$/h = $900/ha. |
| Tracks | Assume D9 used to rip to depth of 0.3 m, with speed 1.36 km/h. Assume $300/h. Requires two passes on track ~5m wide = $440/km.<br>Windrows - 14G grader will grade in windrows at 3 km/h (2nd gear) and require two passes each side of road = 1,500 m of road/h @ $180/h =$120/km.<br>Two passes with grader to rip track <4 m wide at 3 km/h =$120/km.<br>Grading firebreaks with 14G equivalent grader @$180/h. Blade width of 14', travelling at ~5 km/h. Two passes required = 24 min./km=$72/km. |
| Drill pads | Using a Komatsu PC650 excavator or similar at $320/h, can move 300 bcm/h assume one pad per hour. |
| haul roads | Haul roads assumed to be an average of 12 m wide with an additional buffer of 5m each side of the road which has been cleared or significantly disturbed. Surfaces are heavily compacted and constructed of imported fill.<br>Road fill which may be AMD producing is removed using an excavator ($320/h) and three 50 t dump truck ($750/h), watercart @ $140/h, dozer@$250/h. Excavator will produce 300 bcm/h = $4.86/bcm |
| Stockpile/WRD removal/pit infill | Assume load and haul to pit using excavator and three dump trucks. Excavator ($320/h) and three trucks ($840/h total) as above = $3.87/bcm |
| bund | Assume excavator and three dump trucks, with minimal haul distance (no greater than 1 km.) As per road fill above using and excavator and three trucks = $3.87/bcm. If bund is 5 m wide and 2 m high = 5 $m^3$/m then bund ~$19/m to construct. |
| fertiliser | Current (09/01/09) Landmark price per t for NPK fertiliser = $1,487.50.<br>Fertiliser applied at 500 kg/ha (best practice) = $743.75/ha.<br>If applied at only 100 kg/ha = $148.75/ha.<br>Application dependent on growth medium. |
| RC drill pads | Assume average 10 m x 10 m, DDH pads 10 m x 20 m |
| Pest, fire and weed management | Comes from contractor's estimate for analogous nearby Woodcutters Mine. |
| Contractor costs | Meals and accommodation @ $150/head/day.<br>Travel @$60/head/h.<br>Supervision@$1,000/day.<br>10.5 h day daily costs = $1,845/h/300 bcm/h of production = $6.15/bcm.<br>This tool has assumed cost of $210–$320/person/day. |

# 12. DATA MANAGEMENT

Core Lithium maintain the following for the Project:

- A register of environmental commitments and obligations.
- A history of mine development and operations.
- A history of closure implementation.
- Parameter trends over time.
- A way to determine continuous improvement actions and adaptive management.

The sections below outline how information and data will be managed.

## 12.1 Data collection and management

A dedicated database will be established that provides a source of collated information for each environmental monitoring area, namely the following.

- Closure inspections.
- Ecological monitoring (vegetation, weeds, fauna, landform, erosion and sediment and soil condition).
- Water monitoring.

Each database will be fit-for-purpose databases to enable analysis and interpretation of data trends, and graphic reporting for annual reports.

## 12.2 Availability of information

Key Project information will be contained with the following documents:

- Environmental Impact Statement.
- Commitments Register.
- Environmental Management Plan.
- Mining Management Plan and associated EMPs.
- Mine Closure Plan.
- Water Management Plan.

These documents will be stored on the Core Lithium server and retained within the administrative centre for use by project Core Lithium staff throughout mining operations until closure is complete.

# 13. REVIEWED MINE CLOSURE PLANS

The previous MCP was approved in 2022. A summary of the changes between the previous version of the MCP and this version is presented in Table 16.

**Table 16: Summary of changes between this and the previous version of the MCP**

| Section | Updated information |
|---|---|
| Section 1 – Purpose | Updated to describe key Project changes since the last MCP. |
| Section 2 – Project Overview | The mining method has been updated and descriptions of mine features have been updated. |
| Section 3 – Closure Obligations and Commitments | Closure obligations and commitments have been updated to reflect the most up to date approvals. |
| Section 4 – Stakeholder Engagement | This section has been updated to include the latest stakeholder engagement |
| Section 5 – Collection and Analysis of Closure Data | This section has been updated with the latest versions of baseline studies and to align with the Mining Management Plan |
| Section 6 – Post mining Land Uses and Objectives | Post mining land uses have been defined for each domain. |
| Section 7 – Closure Outcomes and Completion Criteria | This section remains unchanged. |
| Section 8 - Closure Risk Assessment | This section has been significantly revised and presents the results of site wide risk assessment with control options. |
| Section 9 – Closure Implementation | Closure plans for domains have been updated and include knowledge gaps. |
| Section 10 – Monitoring and Maintenance | Includes minor wording changes |
| Section 11 – Closure Financial Provisioning | The closure cost estimate has been updated. |
| Section12 – Data Management | This section has been made more brief. |
| Section 12 – Reviewed Mine Closure Plans | This section, previously known as Reporting, has been updated to include this table and a table of knowledge gaps as per the West Australian guidelines. |

A summary of knowledge gaps as identified in the Closure Implementation section and indicative timing are presented in Table 17.

**Table 17: Knowledge gaps and indicative timing**

| Knowledge gap | Indicative timing |
|---|---|
| Finalise the plan for the construction of the abandonment bund | Two years prior to closure |
| Determine the expectations of primary stakeholders regarding assets after closure. Negotiate the requirements for assets and liability transfer. | Two years prior to closure |

| Knowledge gap | Indicative timing |
|---|---|
| Develop a site-wide rehabilitation materials inventory for use during rehabilitation works | Once operations recommence. Update every three years prior to the MCP update |
| Develop a surface water management plan on and around rehabilitated areas | Two years prior to closure |
| Develop a plan for the collection, storage and management of seed | Two years prior to closure |
| Upon closure investigate any known or suspected contaminated sites and develop an appropriate response, in accordance with the CS Act. | One year prior to closure |

# 14. References


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# Appendix A Mine Closure Plan Checklist

| Q No | Mine Closure Plan (MCP) checklist | Y/N/NA | Page No. | Comments | Changes from previous version (Y/N) | Page No. | Summary |
|---|---|---|---|---|---|---|---|
| 1 | Has the Checklist been endorsed by a senior representative within the tenement holder/operating company? (See bottom of checklist.) | Y | 91 | | | | |
| **Public availability** | | | | | | | |
| 2 | Are you aware that from 2015 all MCPs will be made publicly available? | Y | NA | | | | |
| 3 | Is there any information in this MCP that should not be publicly available? | N | NA | | | | |
| 4 | If “Yes” to Q3, has confidential information been submitted in a separate document/section? | | NA | | | | |
| **Cover Page, Table of Contents** | | | | | | | |
| 5 | Does the MCP cover page include:<br>Project Title<br>Company Name<br>Contact Details (including telephone numbers and email addresses)<br>Document ID and version number<br>Date of submission (needs to match the date of this checklist) | Y | | | | | |
| **Scope and Purpose** | | | | | | | |
| 6 | State why the MCP is submitted (e.g. as part of a Mining Proposal, a reviewed MCP or to fulfil other legal requirements) | Y | | | | | Update |
| **Project overview** | | | | | | | |
| 7 | Does the project summary include:<br>Land ownership details (include any land management agency responsible for the land / reserve and the purpose for which the land / reserve [including surrounding land] is being managed)<br>Location of the project;<br>Comprehensive site plan(s); | Y | 9 | | N | | |

| Q No | Mine Closure Plan (MCP) checklist | Y/N/NA | Page No. | Comments | Changes from previous version (Y/N) | Page No. | Summary |
|---|---|---|---|---|---|---|---|
| | Background information on the history and status of the project. | | | | | | |
| **Legal obligations and commitments** | | | | | | | |
| 8 | Does the MCP include a consolidated summary or register of closure obligations and commitments? | Y | 25 | | N | | |
| **Stakeholder engagement** | | | | | | | |
| 9 | Have all stakeholders involved in closure been identified? | Y | 29 | | Y | | |
| 10 | Does the MCP include a summary or Register of historic stakeholder engagement with details on who has been consulted and the outcomes? | Y | 27 | | Y | | |
| 11 | Does the MCP include a stakeholder consultation strategy to be implemented in the future? | Y | 36 | | Y | | |
| **Post mining landuse(s) and closure objectives** | | | | | | | |
| 12 | Does the MCP include agreed post-mining land use(s), closure objectives and conceptual landform design diagram? | Y | 48 | | Y | | |
| 13 | Does the MCP identify all potential (or pre-existing) environmental legacies, which may restrict the post mining land use (including contaminated sites)? | NA | 50 | | Y | | |
| 14 | Has any soil or groundwater contamination that occurred, or is suspected to have occurred, during the operation of the mine, been reported to DER as required under the Contaminated Sites Act 2003? | NA | | | | | |
| **Development of completion criteria** | | | | | | | |
| 15 | Does the MCP include an appropriate set of specific completion criteria and closure performance indicators? | Y | 49 | | N | | |
| **Collection and analysis of closure data** | | | | | | | |
| 16 | Does the MCP include baseline data (including pre-mining studies and environmental data)? | Y | 37 to 47 | | Y | | |

| Q No | Mine Closure Plan (MCP) checklist | Y/N/NA | Page No. | Comments | Changes from previous version (Y/N) | Page No. | Summary |
|---|---|---|---|---|---|---|---|
| 17 | Has materials characterisation been carried out consistent with applicable standards and guidelines (e.g. GARD Guide)? | Y | 39 | | N | | |
| 18 | Does the MCP identify applicable closure learnings from benchmarking against other comparable mine sites? | Y | | | | | |
| 19 | Does the MCP identify all key issues impacting mine closure objectives and outcomes (including potential contamination impacts)? | Y | 34 to 49 | | Y | | |
| 20 | Does the MCP include information relevant to mine closure for each domain or feature? | Y | 11 | | Y | | |
| **Identification and management of closure issues** | | | | | | | |
| 21 | Does the MCP include a gap analysis/risk assessment to determine if further information is required in relation to closure of each domain or feature? | Y | 58 | | Y | | |
| 22 | Does the MCP include the process, methodology, and has the rationale been provided to justify identification and management of the issues? | Y | 61 | | Y | | |
| **Closure implementation** | | | | | | | |
| 23 | Does the MCP include a summary of closure implementation strategies and activities for the proposed operations or for the whole site? | Y | 62 to 68 | | Y | | |
| 24 | Does the MCP include a closure work program for each domain or feature? | Y | 62 to 68 | | Y | | |
| 25 | Does the MCP contain site layout plans to clearly show each type of disturbance as defined in Schedule 1 of the MRF Regulations? | Y | **Error! Bookmark not defined.** | | Y | | |
| 26 | Does the MCP contain a schedule of research and trial activities? | Y | 73 | | Y | | |
| 27 | Does the MCP contain a schedule of progressive rehabilitation activities? | Y | 67 | | Y | | |
| 28 | Does the MCP include details of how unexpected closure and care and maintenance will be handled? | Y | 67 | | Y | | |
| 29 | Does the MCP contain a schedule of decommissioning activities? | Y | 64 to 71 | | Y | | |

| Q No | Mine Closure Plan (MCP) checklist | Y/N/NA | Page No. | Comments | Changes from previous version (Y/N) | Page No. | Summary |
|---|---|---|---|---|---|---|---|
| 30 | Does the MCP contain a schedule of closure performance monitoring and maintenance activities? | Y | 70 | | Y | | |
| **Closure monitoring and maintenance** | | | | | | | |
| 31 | Does the MCP contain a framework, including methodology, quality control and remedial strategy for closure performance monitoring including post-closure monitoring and maintenance? | Y | 73 | | Y | | |
| **Financial provisioning for closure** | | | | | | | |
| 32 | Does the MCP include costing methodology, assumptions and financial provision to resource closure implementation and monitoring? | Y | 71 | | Y | | |
| 33 | Does the MCP include a process for regular review of the financial provision? | Y | 74 | | Y | | |
| **Management of information and data** | | | | | | | |
| 34 | Does the MCP contain a description of management strategies including systems and processes for the retention of mine records? | Y | 72 | | N | | |

**Corporate Endorsement:**

I hereby certify that to the best of my knowledge, the information within this Mine Closure Plan and checklist is true and correct and addresses all the requirements of the Guidelines for the Preparation of a Mine Closure Plan approved by the Director General of the Department of Mines and Petroleum.

Name: Signed:

Position: Date:

(NB: The corporate endorsement must be given by tenement holder(s) or a senior representative authorised by the tenement holder(s), such as a Registered Manager or Company Director).

# Appendix B Materials Characterisation

Reference 3203/1327

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**EcOz Environmental Consultants**

**Core Lithium BP33 Project**

# Geochemical characterisation of waste rock and ore

March 2020

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| **Job No.:** | J000390 |
| **REFERENCE:** | 1312/1346 |
| **SUBJECT:** | Core Lithium BP33Project - Geochemical characterisation of waste rock and ore |

| REV: | DESCRIPTION: | PREPARED: | REVIEW: | APPROVED | DATE: |
|---|---|---|---|---|---|
| A | Issued for internal review | R Schumann<br>J Jeffery | | | 21/02/2020 |
| B | Issued for internal review | R Schumann<br>J Jeffery | W.Stewart | W.Stewart | 26/03/2020 |
| C | Issued for internal review | | | | |
| 0 | Issued for use | | | | |
| | | | | | |

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# Executive Summary

Environmental Geochemistry International Pty Ltd (EGi) have been commissioned by EcOz Environmental Consultants to undertake data analysis, interpretation and reporting on physical and geochemical analysis results for drill core samples collected from the Core Lithium BP33 project. The BP33 proposal involves excavation of a box cut portal to a depth of 60 m and construction of a 400 m long decline from the base of the box cut to access the spodumene deposit located beneath the historically worked open pit. The total volume of material mined over the four-year life of mine will be 2,095 kt (comprising 99 kt ore and 1,996 kt of waste rock). Waste rock from BP33 will be stored in onsite waste rock dumps (WRD), including a box cut WRD and underground WRD. At the end of the mine life waste rock will be used to backfill the box cut and underground workings. Ore mined at BP33 will be transported to the Grants processing facility approximately 7 km to the north-west. Tailings will be deposited in the Tailings Storage Facility constructed as part of the Grants Project.

Sampling and analysis of waste rock was undertaken during the exploration drilling program. Fifty-four samples were selected by EcOz from holes drilled in July 2018 (FRC166 – FRC171) and submitted for a limited suite of analyses comprising Total S, paste pH and EC (1:5) and exchangeable cations. A further 48 samples were selected from holes drilled during September 2019 (NRC129 and FRC212 – FRC214). Four of these were surface (soil) samples submitted for paste pH and EC (1:5), KCl extractable S, bulk density, moisture, colour/texture/Emerson Class No, PSD, exchangeable cations, total metals, N & P and TOC analysis. The remaining 44 samples were submitted for a more comprehensive suite of analyses comprising Total S, acid neutralising capacity (ANC), net acid generation (NAG), paste pH and EC (1:2), exchangeable cations, soluble metals, leachable metals, and naturally occurring radioactive materials (NORM) measuring radiation dose.

The results for the four soil samples suggest that soil at the site is an infertile, gravelly sandy loam. The Emerson test indicates that the soil should be non-dispersive, but given the low organic matter level and sandy texture, the soil likely has poor structure and limited water-holding capacity, and therefore could be susceptible to erosion under wet conditions. It is expected successful rehabilitation will require increasing the physical and chemical fertility of the soil to some extent, consistent with the proposed final end use.

Excluding the four soil samples, the materials tested included 9 ore samples and 89 waste rock samples. Waste rock samples included highly weathered, transitional and fresh rock. All 9 ore samples, together with 35 of the 89 waste rock samples, underwent the full suite of testing, with the remaining waste rock samples submitted for limited testing.

Based on the results of tests conducted on the samples described above, the following conclusions can be made:

- The rock type and oxidation profiles for samples used for geochemical analysis indicate that these samples reasonably represent the lithology and oxidation profile of waste rock and ore from all drill holes and therefore the waste rock and ore in the BP33 deposit overall.
- The samples used for this initial geochemical study would appear to adequately cover variations in rock types and alterations that will be encountered during the mining operation.
- Oxidised waste rock samples are largely devoid of sulphur and are classified as non-acid forming (NAF). Water extracts have very low salinity. This indicates that oxidised waste rock, which will form the majority of rock excavated during development of the box cut and the majority of waste rock generated during the project as a whole, will present a very low risk of acid rock drainage (ARD) or saline drainage (SD). However, drainage from oxidised rock stored in the Box cut WRD may contain low concentrations of aluminium and zinc.
- Transitional waste rock, which will comprise a small portion of the rock removed during development of the box cut and the mine decline, is generally low in sulphur content and can, in the main, be classified as NAF. Transitional samples also gave water extracts with low salinity. These results show that transitional rock will present a low risk of ARD or SD.
- Fresh waste rock will comprise the major portion of rock removed during development of the underground mine and therefore of waste rock stored in the underground WRD. However, the volume of fresh waste rock mined will be relatively small (<10% of the total volume). Fresh waste rock is generally low in sulphur content, but with some areas of higher sulphur. Higher sulphur content appears to be associated with fresh phyllite. Most fresh waste rock can be classified as NAF, but there is evidence that fresh phyllite may include PAF material. This material appears to have limited readily

available ANC. Fresh waste rock samples also produced water extracts with low salinity, although salinity was higher than for other rock types. Fresh rock may also contain water leachable arsenic and zinc. These results show that fresh waste rock may present some risk of ARD and/or arsenic and zinc in drainage from the UG WRD, but further testing is required to confirm these findings and to quantify the likely volume of PAF material in fresh waste rock.

- Testing of ore samples showed that this material is devoid of sulphur and can be classified as NAF, indicating very low risk of ARD from tailings produced from processing of the ore. Water extracts from the ore also had relatively low salinity, but higher than any of the waste rock samples tested, indicating low risk of SD from tailings.
- The potential radiation dose from all of the samples tested was well below guidelines for occupational radiation exposure, indicating that these materials are unlikely to pose a risk from radiation exposure.

Based on these test results, there remains some uncertainty around the acid generating properties of fresh waste rock samples with higher sulphur content (>0.2% S). The current set of samples from holes drilled in 2018 and 2019 includes 8 samples with a total S >0.2%. However, only one of these samples was sourced from the 2019 drill hole samples which were used for ABA and NAG testing. Thus, the current geochemical test results are under-represented in samples with higher sulphur content, preventing better definition of the amount of PAF material present in fresh phyllite and development of potential segregation criteria, should this type of material require specific management to prevent ARD. Results also indicate that drainage from oxidised rock stored in the Box cut WRD may contain low concentrations of aluminium and zinc and some of the fresh rock stored on the UG WRD may contain water leachable arsenic and zinc. These waste storages will be temporary, with waste rock returned underground or into the box cut. However, the results to date provide no information on the kinetics of aluminium, arsenic and zinc leaching and whether this could be an issue during short-term surface storage.

Consequently, it is recommended that the following tests be undertaken to clarify these issues:

- Complete ANC and NAG testing on selected samples from drill holes FRC166 – FRC171, focusing on, but not exclusively, samples with sulphur content >0.2 %S. Ideally all fresh and transitional waste rock from the 2018 drill holes should be included in the test program.
- Kinetic testing (leach columns) of oxidised and fresh rock samples to confirm initial results of aluminium, arsenic and zinc leachability and to define the kinetics of this process. Kinetic leach column (KLC) testing should be conducted under oxic conditions to simulate conditions during storage in WRD and in the unsaturated zones within the backfilled UG mine and boxcut. Following a period of leaching under oxic conditions, KLC tests should be conducted under saturated conditions to simulate the leaching properties of backfilled waste which will be placed below the water table upon rebound.

Current test results suggest that the risk of ARD from surface storage of waste rock from the underground mine will be low, due to the likely low volume of PAF material present in fresh waste rock. However, currently there is insufficient evidence to say conclusively that there will be no PAF material removed from the underground mine which may require management to mitigate ARD. Depending on outcomes from the recommended follow-up tests, it may be necessary to undertake more detailed static testing to refine ARD classification of some waste rock, in addition to kinetic testing to provide better definition of the ARD properties of any PAF material identified. These more detailed tests, if required, would inform ARD management plans should the need arise.

# 1. Introduction

Environmental Geochemistry International Pty Ltd (EGi) have been commissioned by EcOz Environmental Consultants to undertake data analysis, interpretation and reporting on physical and geochemical analysis results for drill core samples collected from the Core Lithium BP33 project. Core are seeking to progress approvals for underground mining at their BP33 deposit. The first step in the approvals process is to submit a Notice of Intent (NOI) to the NT Environmental Protection Authority (NT EPA). EcOz have been engaged by Core Lithium to assist with environmental approvals for proposed spodumene (lithium) mining activities and this work is intended to inform environmental approvals for the current NOI.

The BP33 deposit is a part of Core's Finniss Lithium Project, located in the Northern Territory on the Cox Peninsula, approximately 23 km southwest of Darwin or 90 km by road (Figure 1). The BP33 proposal involves excavation of a box cut portal to a depth of 60 m and construction of a 400 m long decline from the base of the box cut to access the spodumene deposit located beneath the historically worked open pit. The total volume of material mined over the four-year life of mine will be 2,095 kt (comprising 99 kt ore and 1,996 kt of waste rock). Waste rock from BP33 will be stored in onsite waste rock dumps (Figure 2) and at the end of the mine life will be used to backfill the box cut and the underground mine. Ore mined at BP33 will be transported to the Grants processing facility approximately 7 km to the north-west. Tailings will be deposited in the Tailings Storage Facility constructed as part of the Grants Project.

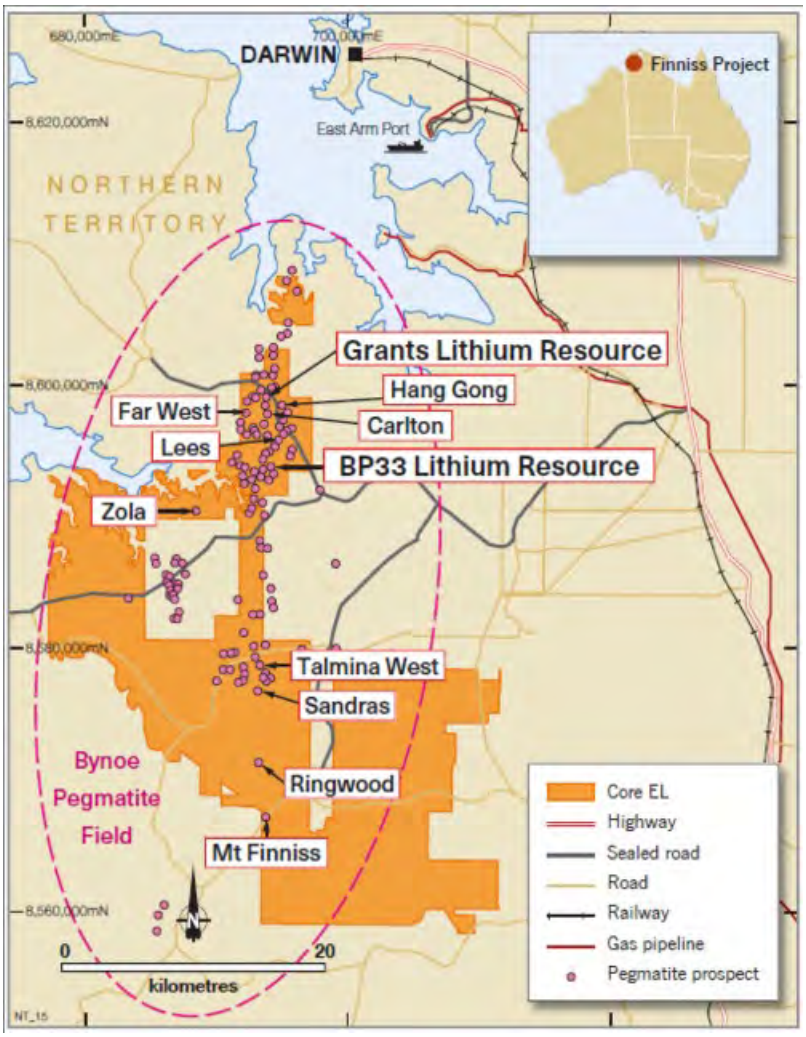
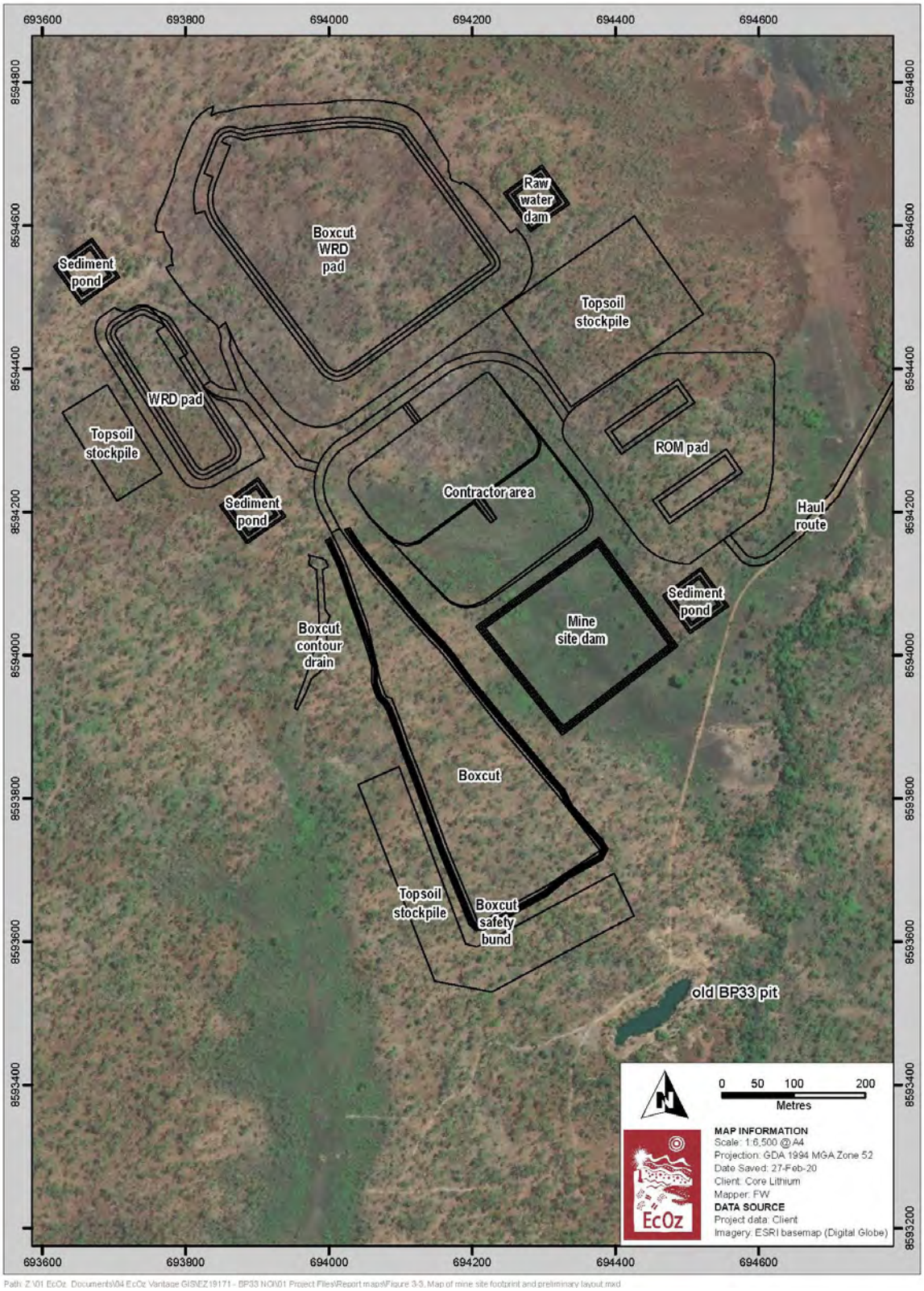



*Figure 1: BP33 Resource within the larger Bynoe Pegmatite Field and Core's Finniss Lithium Project*




Path: Z:\01 EcOz Documents\04 EcOz Vantage GIS\EZ19171 - BP33 NOI\01 Project Files\Report maps\Figure 3-3. Map of mine site footprint and preliminary layout.mxd

*Figure 2: Map of mine site footprint and preliminary layout*

Ore from the BP33 Lithium Deposit occurs in a rare element pegmatite that is a member of the Bynoe Pegmatite Field. Fresh pegmatite at BP33 is composed of coarse spodumene, quartz, albite, microcline and muscovite (in decreasing order of abundance). Spodumene, a lithium-bearing pyroxene ($LiAl(SiO_3)_2$), is the predominant lithium-bearing phase. The pegmatites are predominantly hosted within the early Proterozoic metasedimentary lithologies of the Burrell Creek Formation (BCF) and are usually conformable to the regional schistosity. The principal rock type of the BCF is phyllite, a low-grade metamorphic equivalent of an immature sandy siltstone. In fresh form, the phyllite is grey, finely bedded or cleaved, and is composed of quartz, feldspar, lithic fragments, micas and clay.

Fresh pegmatite hosting the ore is overlain by around 40 m of weathered rock and approximately 20 m of transitional rock. The box cut is required to provide geotechnically stable conditions for development of the UG portal and decline of the proposed UG mine. To achieve this, the portal needs to be developed in transitional and fresh rock requiring excavation of waste material down to at least 10 m below the oxidised zone. At BP33 the required depth of excavation is between 60 m and 70 m. This means that most of the waste rock excavated during this project will be sourced from the box cut, with a minor amount (<10%) sourced from the underground mine development. As the majority of the rock removed during construction of the box cut will be within the oxidised rock zone, a large proportion of rock stored in the Box cut WRD will be oxide material. In contrast, most waste stored in the UG WRD will comprise fresh rock. All waste rock will be used to refill the box cut and UG mine at completion of the mining operation. Some of the waste rock used for backfilling will also include some transitional and fresh rock which will have potentially undergone some atmospheric oxidation during surface storage.

As part of the mine planning and approvals process, physical and geochemical characterisation of the waste material and tailings is required to inform assessment of risks associated with acid, metalliferous (ARD), saline (SD) or neutral mine drainage (NMD); mine closure and rehabilitation. This report describes results from analysis of geochemical data provided by EcOz to EGi, and assessment of these results to determine the likelihood of acid and metalliferous, neutral mine or saline drainage as a consequence of the proposed BP33 mine project.

# 2. Samples

Sampling and analysis of waste rock was undertaken during the exploration drilling program. Fifty-four samples were selected by EcOz from holes drilled in July 2018 (FRC166 – FRC171) (Figure 3) and submitted for a limited suite of analyses comprising Total S, paste pH and EC (1:5) and exchangeable cations. A further 48 samples were selected from holes drilled during September 2019 (NRC129 and FRC212 – FRC214) (Figure 3). Four of these were surface (soil) samples submitted for paste pH and EC (1:5), KCl extractable S, bulk density, moisture, colour/texture/Emerson Class No, PSD, exchangeable cations, total metals, N & P and TOC analysis. The remaining 44 samples were submitted for a more comprehensive suite of analyses comprising Total S, acid neutralising capacity (ANC), net acid generation (NAG), paste pH and EC (1:2), exchangeable cations, soluble metals, leachable metals, and naturally occurring radioactive materials (NORM) measuring radiation dose.

Soil samples were collected from the topsoil prior to drilling. Waste rock samples were collected at each point where the material from the drill hole changed. Each lithology, and each alteration and each oxidation type within each lithology was sampled separately (compositing of samples was not undertaken) as encountered down hole. Samples were also collected from the ore zone, as well as the waste, to provide for geochemical characterisation of tailings. Field duplicates were collected at a frequency of 1 per 20 primary samples. The duplicates were taken from the same metre as the primary samples. Sufficient material to produce both the primary and duplicate sample was placed in a stainless steel bowl and thoroughly mixed to ensure a homogenous sample. The mixed sample was then split and distributed evenly amongst the required bags and jars for the primary and duplicate samples.

In addition to analysis results, EGi were also supplied with geology logs from the drilling program. Based on these logs, the spread of sample lithologies and degree of oxidation were determined. Materials with weathering codes CW, EW and HW were defined as oxide, MW and SW as transition, and FR as fresh. The results of this analysis are shown in Figure 4. Samples from drill holes FRC166 – FRC171 (2018), NRC129 and FRC212 – 214 (2019) are dominated by phyllite and pegmatite, with minor sandstone, quartz and quartz veining. Phyllite samples represented the full oxidation profile, while pegmatite samples were primarily fresh, including ore samples. The same analysis was conducted using only samples from drill holes NRC129 and FRC212 – 214, and from the sub-set of samples from these drill holes which were selected for geochemical analysis. These results are also shown in Figure 4. This analysis shows that the samples from the 2019 drill holes (Fig. 4 middle) showed similar rock type and oxidation profiles to that for the combined drill hole set (Fig. 4 top), albeit with a slightly higher representation of ore samples. Similarly, the rock type and oxidation profiles for samples used for geochemical analysis (Fig. 4 bottom) indicate that these samples reasonably represent the lithology and oxidation profile of waste rock and ore from all drill holes and therefore the waste rock and ore in the BP33 deposit overall.

Leading practice actions to minimise ARD risk through life of mine cycle suggest that during the resource definition phase of a project, geochemical testing, focusing on static testing (net acid producing potential (NAPP)/NAG), should include at least 5 – 10 samples for each key identified lithology/alteration type[1]. Given the relative homogeneity of the Burrell Creek Formation[2] and the limited number of major lithologies identified during the drilling program at BP33, the 44 samples used for this initial geochemical study would appear to adequately cover variations in rock types and alterations that will be encountered during the mining operation. As the project develops, further sampling and testing may be required to complement and verify the results of this study.

[1] Preventing Acid and Metalliferous Drainage, Leading Practice Sustainable Development Program for the Mining Industry, Commonwealth of Australia, 2016

[2] Grants Lithium Environmental Impact Statement, Appendix E Materials Characterisation Report, EcOz Environmental Consultants, October 2018

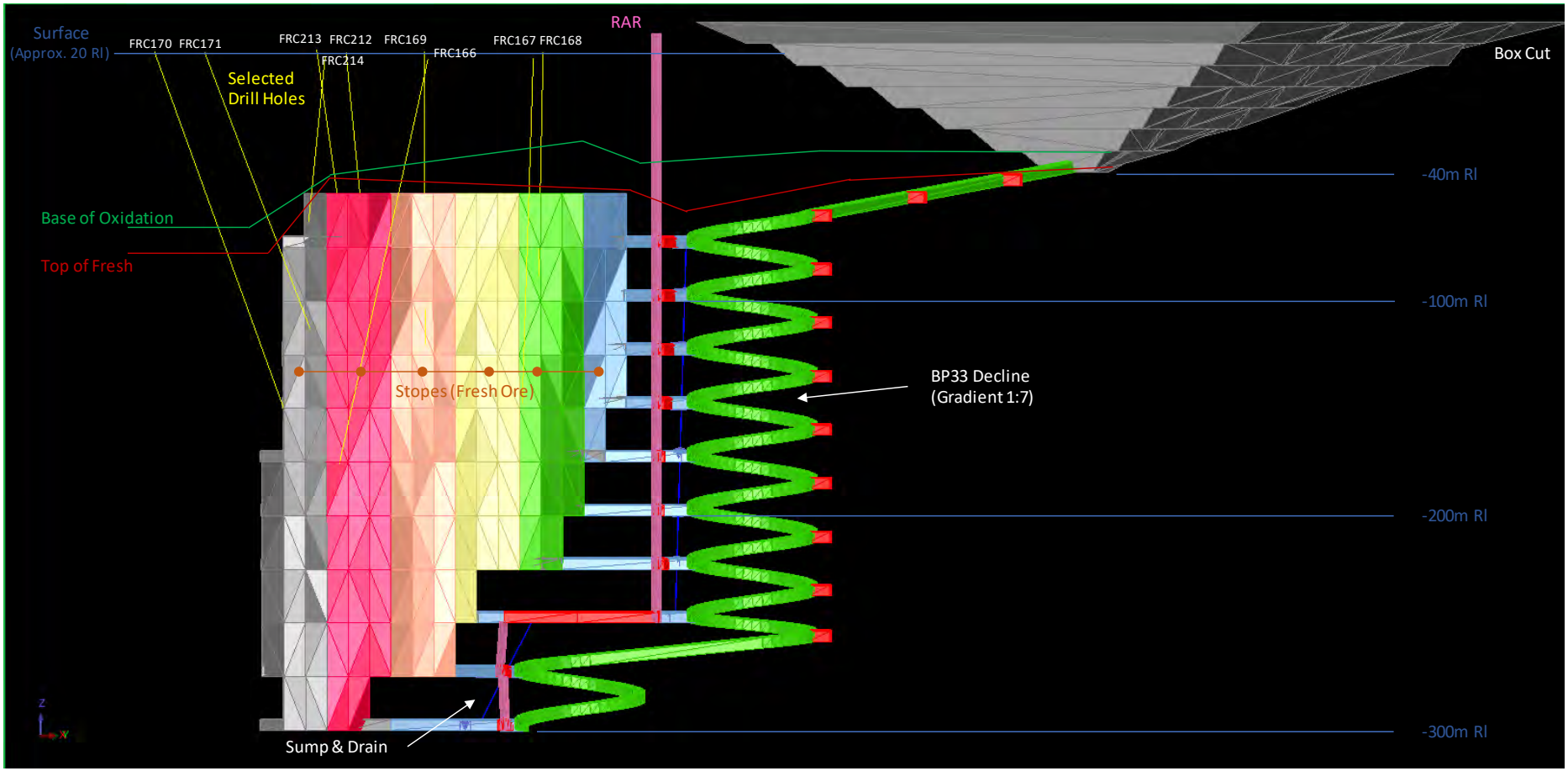



*Figure 3: Location of drill holes used for resource definition and waste rock characterisation of the BP33 deposit and relation to proposed box cut and mine development*

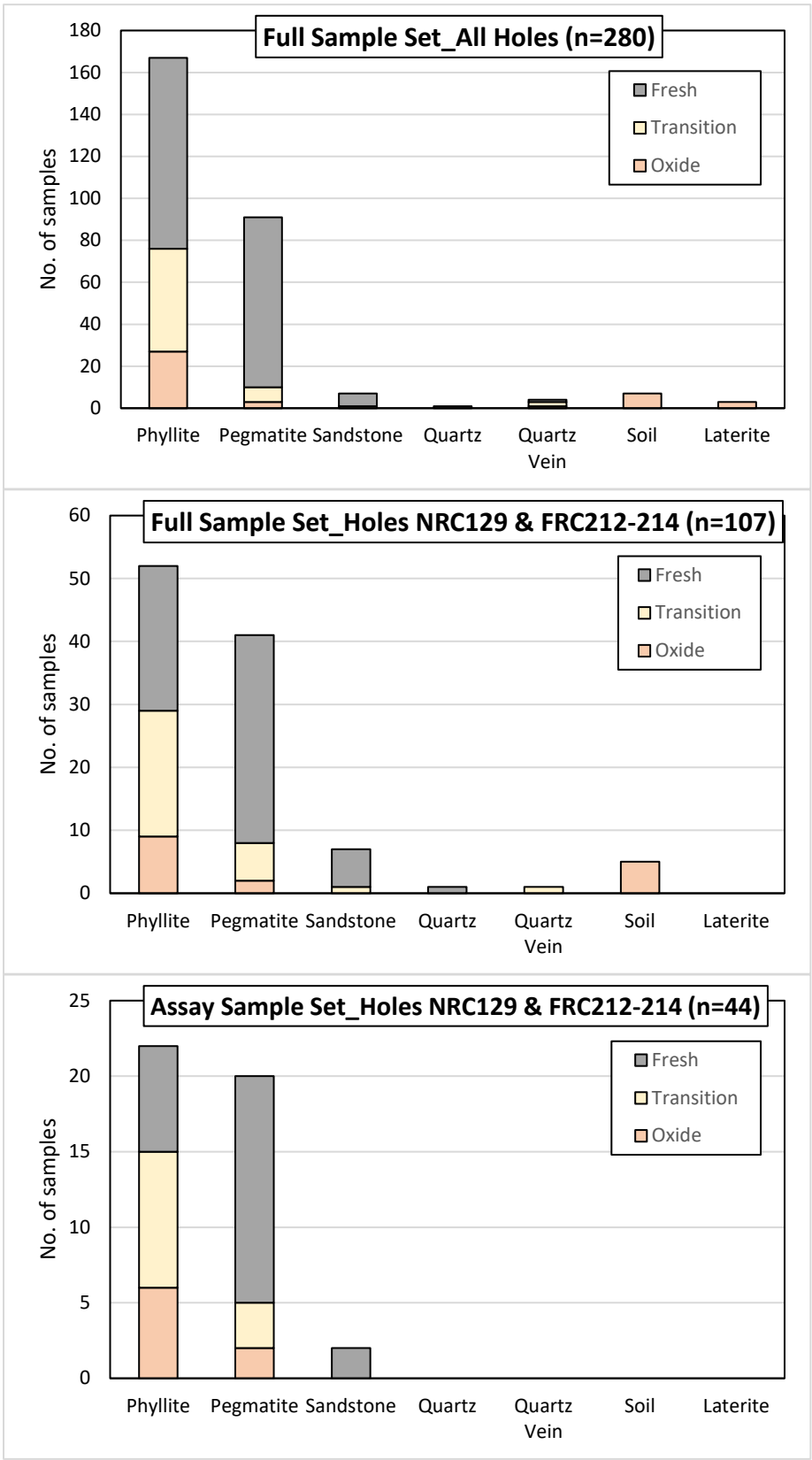



*Figure 4: Sample numbers by lithology and oxidation for the whole set of samples from drill holes from 2018/2019 (FRC166 – FRC 171, NRC129 and FRC212 – FRC214) for the BP33 project (top), all samples from the 2019 drill holes (NRC129 and FRC212 – FRC214) (middle) and samples from 2019 drill holes selected for geochemical testing (bottom).*

# 3. Results

## 3.1 Analytical Data Quality

Five field duplicate samples were submitted as a part of the analytical quality control process. These field duplicate samples were analysed for the same full suite of analyses as the 44 samples used for geochemical characterisation. Relative standard deviations (RSD) for all analyses conducted on duplicate samples were on average less than 6%, indicating that the whole analytical process including sample collection, preparation and analysis was providing acceptable precision for the analytical results. QC data reported by the analytical laboratory demonstrated satisfactory accuracy and precision in the analytical results with all duplicate analyses, laboratory spikes (QC standards) and matrix spikes providing acceptable values for repeatability and recovery.

## 3.2 ARD, NMD and SD characterisation

*ABA and NAG Testing*

Acid forming characterisation data are provided in Appendix A. Analyses included paste pH and EC, and Total S for all samples (drill holes NRC129 and FRC212 – FRC214 and FRC166 – FRC171), and also included ANC and NAG test results for samples from drill holes NRC129 and FRC212 – FRC214.

Figure 5 shows an ARD classification plot for the 44 samples for which both acid base accounting (ABA) (Total S and ANC) and NAG testing results were available. The ARD classification plot, plots NAGpH against NAPP. NAPP represents the balance between acid potential (MPA) and neutralising potential (ANC), i.e. NAPP = MPA – ANC. Where NAPP values are negative i.e. excess neutralising capacity, and NAGpH is greater than 4.5, samples are classified as non-acid forming (NAF). Conversely when samples are NAPP positive (excess acidity) and NAGpH is below 4.5, samples are classified as potentially acid forming (PAF). Where there is a conflict between NAPP and NAG results, samples are classified as uncertain (UC). In this case, further testing is usually required to resolve the uncertain classification.

For the BP33 drill hole samples, 40 of the 44 samples clearly plotted in the NAF classification. The remaining 4 samples were all NAPP negative, but with NAGpH<4.5, although two of these samples gave a NAGpH only just below 4.5. Three of the samples plotting in the UC classification were fresh or slightly weathered phyllite, with one fresh pegmatite sample.

The slightly acidic NAG liquors for the 4 samples plotting in the UC category, suggests that the neutralising capacity measured by the ANC test method (pH typically 1.5 – 2) overestimated the amount of neutralising capacity available during the NAG test (pH 3.4 – 4.4). Although the carbonate content was not determined for these samples, these results indicate there are negligible or limited carbonate neutralising minerals in these rocks and that the majority of ANC is probably derived from silicate minerals. During NAG testing of the 4 UC samples, the pH has not dropped sufficiently to result in dissolution of these silicates at a rate fast enough to provide significant neutralising capacity. This has likely resulted in the UC classification.

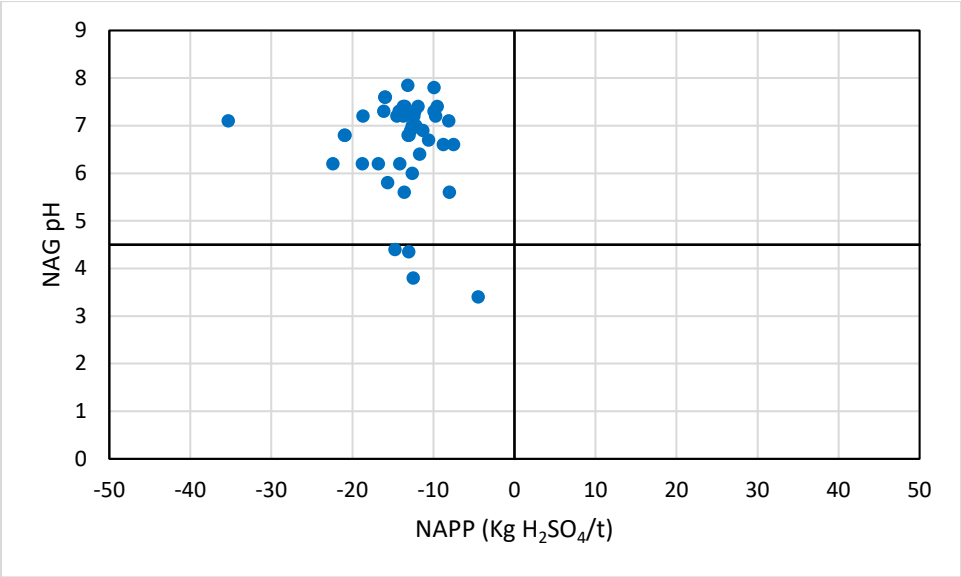



*Figure 5: ARD classification plot for samples from drill holes NRC129 and FRC212 – FRC 214*

Figure 6 shows NAGpH plotted against Total S for the ARD classification samples set. This plot shows that the majority of these materials contain very little sulphur and consequently NAGpH are circum-neutral. The plot also suggests that for samples with a Total S content above around 0.2% may have a NAGpH below 4.5, although this relationship is based on a very limited number of samples.

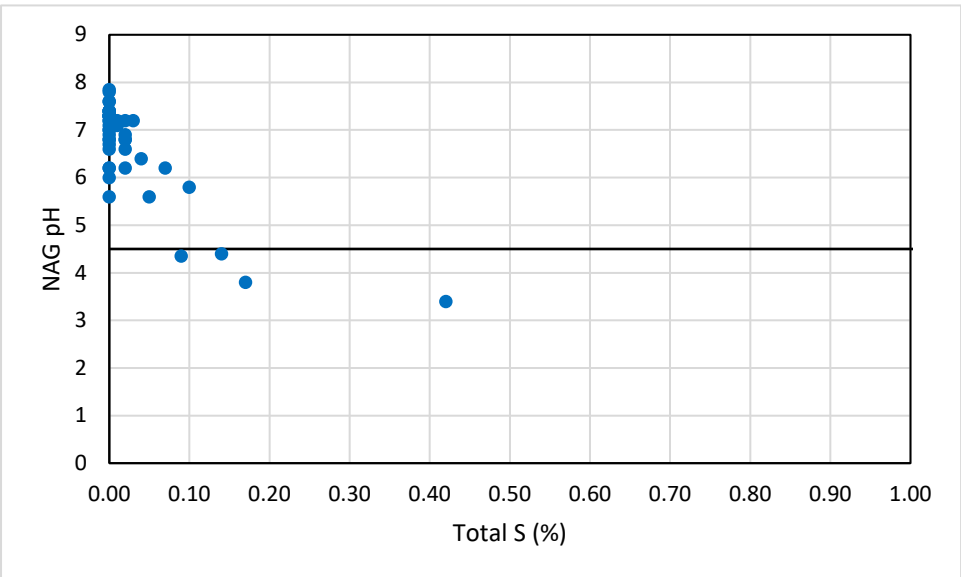



*Figure 6: NAGpH vs Total S for samples from drill holes NRC129 and FRC212 – FRC 214*

Figure 7 shows Total S results for 98 samples from drill holes NRC129 and FRC212 – FRC214 and FRC166 – FRC171. While only one sample from the 44 samples which underwent NAG testing had a Total S content above 0.2% (NAGpH 3.4), a somewhat higher percentage of samples from the samples which did not undergo NAG testing had a Total S content above 0.2%, although the number is still relatively small (8% of all samples). This suggests that while the majority of samples from these drill holes have very limited sulphur content and no potential for acidic drainage, there are a small but significant number of samples which have higher sulphur content and therefore could be potentially acid forming. The potential for limited neutralising capacity derived principally from silicate minerals in these samples, also indicates that even slightly elevated sulphur may result in acid generation. Further analysis is required to investigate the acid generating potential of these higher sulphur samples.

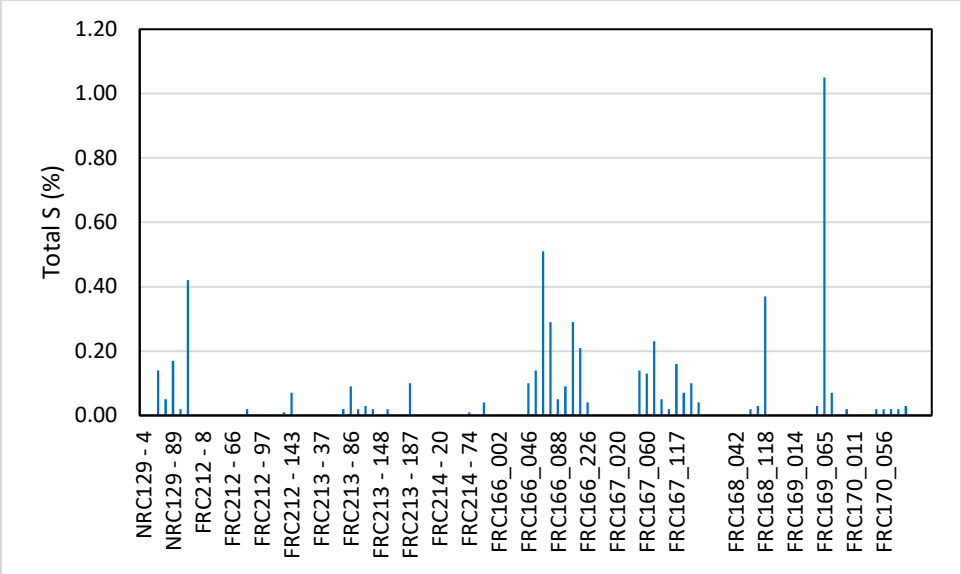



*Figure 7: Total S for samples from drill holes NRC129 and FRC212 – FRC 214 and FRC166 – FRC171*

A summary of acid base accounting (Total S and ANC) and NAG test results as a function of rock type (lithology and weathering) are provided in Table 1 and Table 2 below. Results show that oxidised phyllite is generally devoid of sulphur and therefore does not contain sulphides or metal sulphate salts that on (oxidative) dissolution will produce acidity. This is borne out by NAG test results for oxidised phyllite samples which confirm the lack of acid generation from these samples.

As the degree of oxidation decreases, the concentration of sulphur in the phyllite samples increase, as does the neutralising capacity. NAG test results suggest that the increasing sulphur content is more influential than increasing ANC on NAGpH, since NAGpH tends to decrease and NAG values increase as oxidation decreases. These results indicate that the vast majority of waste rock stored in the box cut WRD during operations will not produce acidity as most of this material will be oxidised rock. However, rock from the underground development stored in the UG WRD (Figure 2), is more likely to contain material with higher sulphur content and might therefore contain some PAF material.

Fresh pegmatite which hosts the ore (spodumene) is, like oxidised phyllite, generally barren with respect to sulphur (Table 1) and the NAG test results (Table 2) confirm the lack of acid generating potential. As ore samples appear to be exclusively NAF, tailings produced during processing of the ore is also likely to be non-acid forming.

*Table 1: Total S and ANC by rock type and weathering*

| Rock Type | Totals S (%) | | ANC (kg $H_2SO_4$/t) | |
|---|---|---|---|---|
| | Mean | Maximum | Mean | Maximum |
| Oxidised phyllite | <0.01 | <0.01 | 10 | 14 |
| Transitional phyllite | 0.05 | 0.51 | 15 | 19 |
| Fresh phyllite | 0.14 | 1.05 | 18 | 23 |
| Fresh pegmatite[1] | 0.03 | 0.09 | 18 | 36 |
| Ore | <0.01 | 0.02 | 13 | 19 |

1. Excludes ore samples

*Table 2: NAGpH and $NAG_{4.5}$ and $NAG_7$ by rock type and weathering*

| Rock Type | NAGpH | | $NAG_{4.5}$ (kg $H_2SO_4$/t) | | $NAG_7$ (kg $H_2SO_4$/t) | |
|---|---|---|---|---|---|---|
| | Mean | Minimum | Mean | Maximum | Mean | Maximum |
| Oxidised phyllite | 6.9 | 5.6 | <0.1 | <0.1 | 0.4 | 1.3 |
| Transitional phyllite | 6.8 | 4.4 | <0.1 | 0.2 | 1.1 | 4.3 |
| Fresh phyllite | 5.7 | 3.4 | 1.0 | 2.8 | 5.5 | 8.2 |
| Fresh pegmatite[1] | 6.4 | 4.4 | <0.1 | 0.3 | 0.7 | 2.4 |
| Ore | 7.1 | 6.0 | <0.1 | <0.1 | 0.7 | 3.8 |

1. Excludes ore samples

*Paste pH & EC and Soluble and Leachable Metals*

Figure 8 shows results for paste pH and EC (1:2) analysis of samples from the NRC129 and FRC212 – FRC214 drill holes. Figure 9 shows similar results (paste pH and EC (1:5)) for samples from the FRC166 – FRC171 drill holes. The only difference between the methods used for the two sample sets is the solid to water ratio (1:2 or 1:5) used to make the slurries in which pH and conductivity are measured. More dilution at the higher solid:water ratio in the 1:5 method may result in a decrease in measured conductivity but will not generally affect the measured pH to any great extent.

Results show that paste pH increases as sample depth increases with oxidised samples providing circum-neutral to slightly alkaline paste pH, increasing through transitional rock, with fresh rock paste pH generally mildly alkaline. Paste conductivities show a similar trend, with increasing conductivity as sample depth increases.

There was one sample which proved to be an exception to the above. This sample (NRC129-55), described as a transitional phyllite, gave a mildly acidic paste pH (4) and somewhat elevated EC (≈800 µS/cm). Although this sample is classified as UC (NAPP = -15 kg H2SO4/t and NAGpH = 4.4), the low Total S content of 0.14% suggests

acid generation in the longer term unlikely. Nevertheless, the short-term appearance of mildly acidic conditions suggests the presence of acidic salts resulting from sulphide oxidation, and the paste pH of around 4 is consistent with buffering from dissolution of iron hydroxy sulphate salts such as schwertmannite or jarosite.

These results indicate that highly weathered rock is likely to be quite inert, producing no acidity (sulphur content negligible) and very low salinity in any drainage from storage in the Box cut WRD. Fresh waste rock (UG WRD) and ore (tailings) are likely to produce more saline drainage in the short term, but salinities do not appear to be high for any of the samples (with one exception) examined.

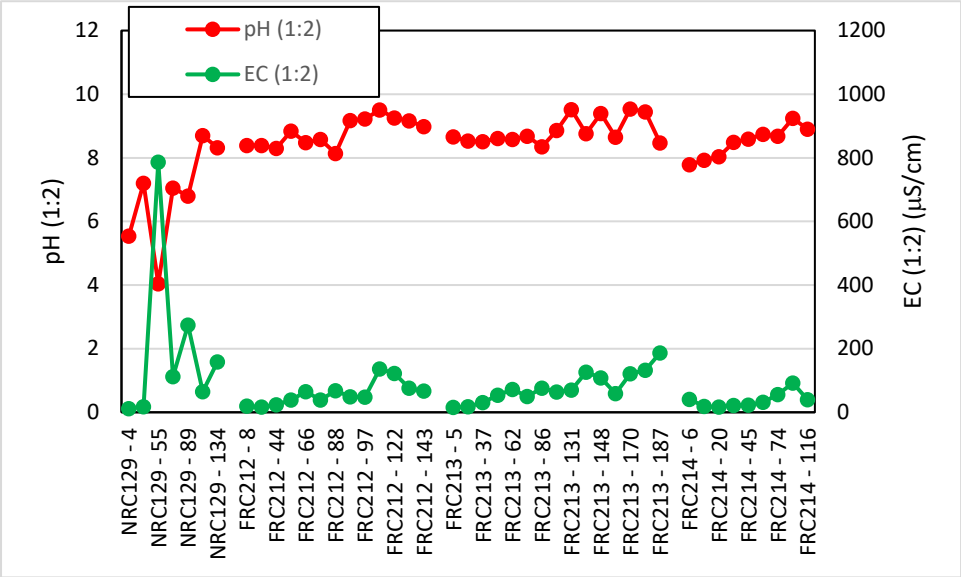



*Figure 8: Paste pH and EC (1:2) for samples from drill holes NRC129 and FRC212 – FRC 214*

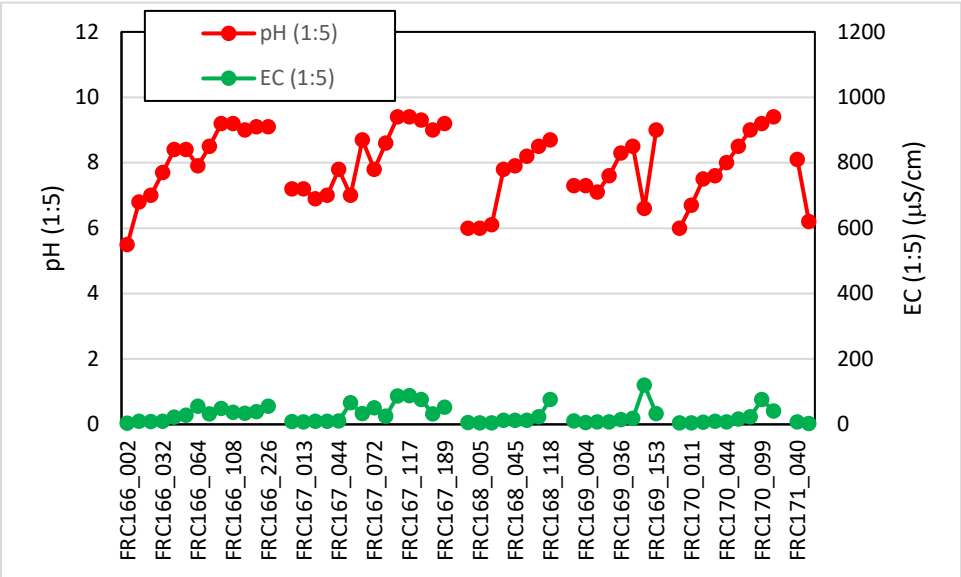



*Figure 9: Paste pH and EC (1:5) for samples from drill holes FRC166 – FRC171*

In addition to paste pH and EC measurements, the water-soluble metals and leachable metals content of selected samples from drill holes NRC129 and FRC212 – FRC214 were measured. Soluble metals were determined by mixing 10 g of solid with 50 mL of water for 1 h. The mixture was then allowed to settle and the supernatant filtered using a 0.45 μm cellulose acetate membrane. The water extract was then analysed by ICP to determine metal concentrations. Results were reported as mg/kg soluble metals. Leachable metals were determined using the toxicity characteristic leaching procedure (TCLP) method. 100 g of solid were extracted with 2 L of extraction solution #1 (sodium acetate buffer pH 4.9) for 20 h, before filtration and analysis by ICP. Results were reported as mg/L leachable metals.

In order to compare the results from soluble and leachable metals with paste pH and EC results, soluble metal results were back calculated to concentrations in mg/L in the 1:5 solid to water extract. Leachable metal concentrations were multiplied by a factor of 4 to account for the higher dilution at the 1:20 solid to liquid ratio used in the TCLP method. The adjusted results can then be correlated with paste pH and EC results, which were conducted at 1:2 solid to liquid ratio for the same samples.

Full results are provided in Appendix B (Soluble Metals) and Appendix C (Leachable Metals).

Water extracts showed that oxidised and transitional rock contain soluble iron and aluminium species, with fresh rock giving lower concentrations of these metals (Figure 10). Similarly, aluminium and iron concentrations in the water extracts of waste rock samples were generally higher than in ore samples (Table 3). These concentrations are higher than would generally be found in water extracts unless the water extract has low pH. However, solution speciation modelling suggests that the slightly alkaline pH of many of the extracts (pH ≈8.5) means that $Al(OH)_4^-$ is likely to be the dominant aluminium species, providing elevated concentrations. Without redox measurements, it is difficult to accurately model the speciation of iron in the extracts. However, results suggest that the higher than normal concentrations of iron in the water extract may result from colloidal iron that was not effectively filtered from the extract prior to analysis.

In contrast to the aluminium and iron results, lithium concentrations were higher in water extracts of fresh rock, especially for ore samples (Figure 10, Table 3). Heavy metal concentrations in water extracts were generally very low with the exception of the one sample (NRC129-55) with lower pH, which contained slightly elevated Co, Cu and Ni (Figure 11 and Figure 12). Water extracts of some fresh phyllite and siltstone samples also contained elevated concentrations of arsenic, suggesting that leachable arsenic will more likely be an issue in waste rock than in ore or tailings (Figure 13, Table 3). A few samples also displayed slightly elevated concentrations of zinc, with no distinction between waste rock and ore samples (Table 3).

*Table 3: Average soluble metals concentrations from waste and ore samples*

| Element | Average Soluble Metals (mg/L) | |
|---|---|---|
| | Waste | Ore |
| Al | 2.3 | 0.9 |
| As | 0.13 | 0.07 |
| Fe | 2.9 | 0.3 |
| Li | 0.1 | 2.1 |
| Zn | 0.1 | 0.1 |

The toxicity characteristic leaching procedure (TCLP) is an extraction method usually used to simulate leaching through a landfill. In this case, the TCLP test utilised an extraction solution buffered at pH 4.9. Paste pH results show that in most cases the pH of water in contact with these materials would be considerably higher than 4.9. Consequently, it is difficult to interpret the results of the TCLP tests in the context of the behaviour of waste rock and ore from the BP33 project. Nevertheless, the TCLP (leachable metals) results are generally in agreement with water extract results. The lower pH and longer extraction time of the TCLP procedure has

resulted in higher concentrations of aluminium and much higher concentrations of extractable iron from fresh rock samples (Figure 10). Concentrations of manganese and zinc were also higher in the TCLP leachates (Figure 12). Results from TCLP tests also support the leachability of arsenic from some fresh rock samples (Figure 13).

Whilst the results of batch extraction tests provide an insight into seepage water quality, they are not kinetic based, and the results should be considered as qualitative rather than quantitative. Factors that affect the chemistries of batch test extracts include the solid to liquid ratio used (1:5 for water and 1:20 for TCLP) and the contact time between sample and extractant (typically 1 - 24 hours). Under field conditions within a waste rock emplacement, the solid to pore water ratio at any given time will be significantly lower than the ratios used in the batch tests, but leaching will be an ongoing progression through time. Also, under field conditions only a fraction of the rock surface will be in contacted with water as it flows through waste rock pile, while in the leach tests, the rock is finely ground increasing surface area and all of the sample is contacted by extractant. Under batch leach conditions, while dissolution reactions are occurring, precipitation reactions which are likely to take place in waste rock emplacements, will be non-existent or limited. Consequently, comparisons between metal/metalloid concentrations in batch extracts as indicative of WRD drainage and water quality trigger values should be undertaken with caution.

Notwithstanding the above restraints, concentrations of soluble metals were compared with ANZECC freshwater toxicant default guideline values (DGV)[3]. The results of this comparison indicate that only aluminium and arsenic concentrations in water extracts exceed the DGV for the majority of samples tested and for a significant number of samples in the case of zinc (Figure 14). It should be noted that these guideline values apply to surface water as the receptor for the toxicant. It may be that during the short storage period (up to 3 years) of these materials in the WRDs, little or no drainage will discharge from the waste rock piles, as water hold-up times in waste rock dumps can be up to decades in length. Consequently, there may be no impact on surface water bodies in the vicinity of the WRDs. However, even if there is little or no leachate draining from the WRD, weathering during the period of surface storage may result in production of soluble or partially soluble salts. Following backfilling and rebound of the water table in the underground workings, the products of these weathering reactions may dissolve and metal/metalloids mobilised under the anoxic conditions which will prevail in saturated rock. In this case the likely receptor is groundwater. Therefore, comparison with background groundwater concentrations of aluminium, arsenic and zinc would be more appropriate, but this information is currently unavailable.

In summary, leachate test results suggest that, in general, drainage from these materials will have circum-neutral to alkaline pH and low salinity. However, results also indicate that drainage from oxidised rock stored in the Box cut WRD may contain low concentrations of aluminium and zinc. In addition, some of the fresh rock stored on the UG WRD may contain water leachable arsenic species and possibly zinc, resulting in elevated arsenic and zinc in drainage from this waste storage facility. These preliminary results suggest that further testing should be undertaken to investigate aluminium, arsenic and zinc leaching from fresh and oxidised waste rock.

Additional testing should comprise kinetic leach column (KLC) testing, which provides conditions closer to those within a WRD, with both dissolution and precipitation reactions occurring. KLC tests should be conducted under oxic conditions to simulate conditions during storage in WRD. Following a period (≈6 months) of oxic weathering , testing should be continued under saturated conditions to simulate saturated zones within the backfilled UG mine and Box cut. Samples should include oxide and transitional waste rock to investigate leaching of aluminium and zinc, and transitional and fresh waste rock samples which gave elevated arsenic and zinc levels in water extracts. Results can then be compared with background groundwater metal concentrations, which are likely to be available by this time.

[3] Australian & New Zealand Guidelines for Fresh & Marine Water Quality 2018: Toxicant default guideline values, https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/search#tox-293

Oxide/transitional waste rock for KLC testing should be made by generating composite samples from the following:

- NRC129-20 to 68 plus
- FRC212-15 to 81 plus
- FRC213-5 to 67 plus
- FRC214-6 to 45

Transitional/fresh waste rock for KLC testing should be made by generating composite samples from the following:

- NRC129-34 plus
- FRC212- 66 to 88 plus
- FRC213-86 to 131 plus
- FRC214-50 to 74

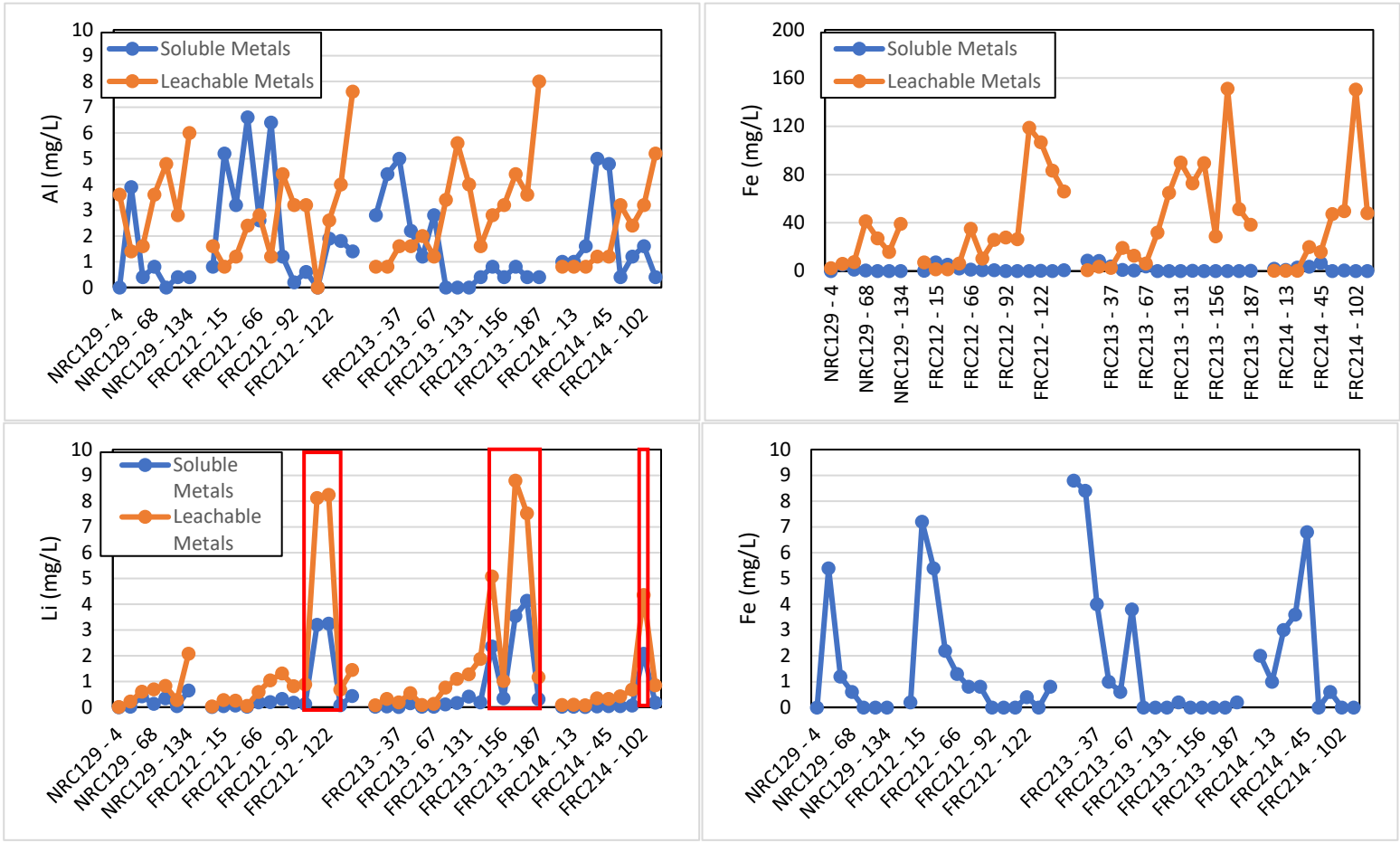



*Figure 10: Soluble and leachable Al (top left), Fe (top right), soluble Fe (expanded axis, bottom right) and soluble and leachable Li (bottom left) for samples from drill holes NRC129 and FRC212 – FRC214. Red boxes highlight ore samples. Note, soluble metals are plotted as concentrations in the extract (mg/L) only, but are reported as amount extracted (mg/kg) and concentrations (mg/L) in Appendix B. Leachable metals are plotted as the original leachate concentrations (Appendix C) multiplied by a factor of 4 to allow comparison with soluble metals. See text for explanation.*

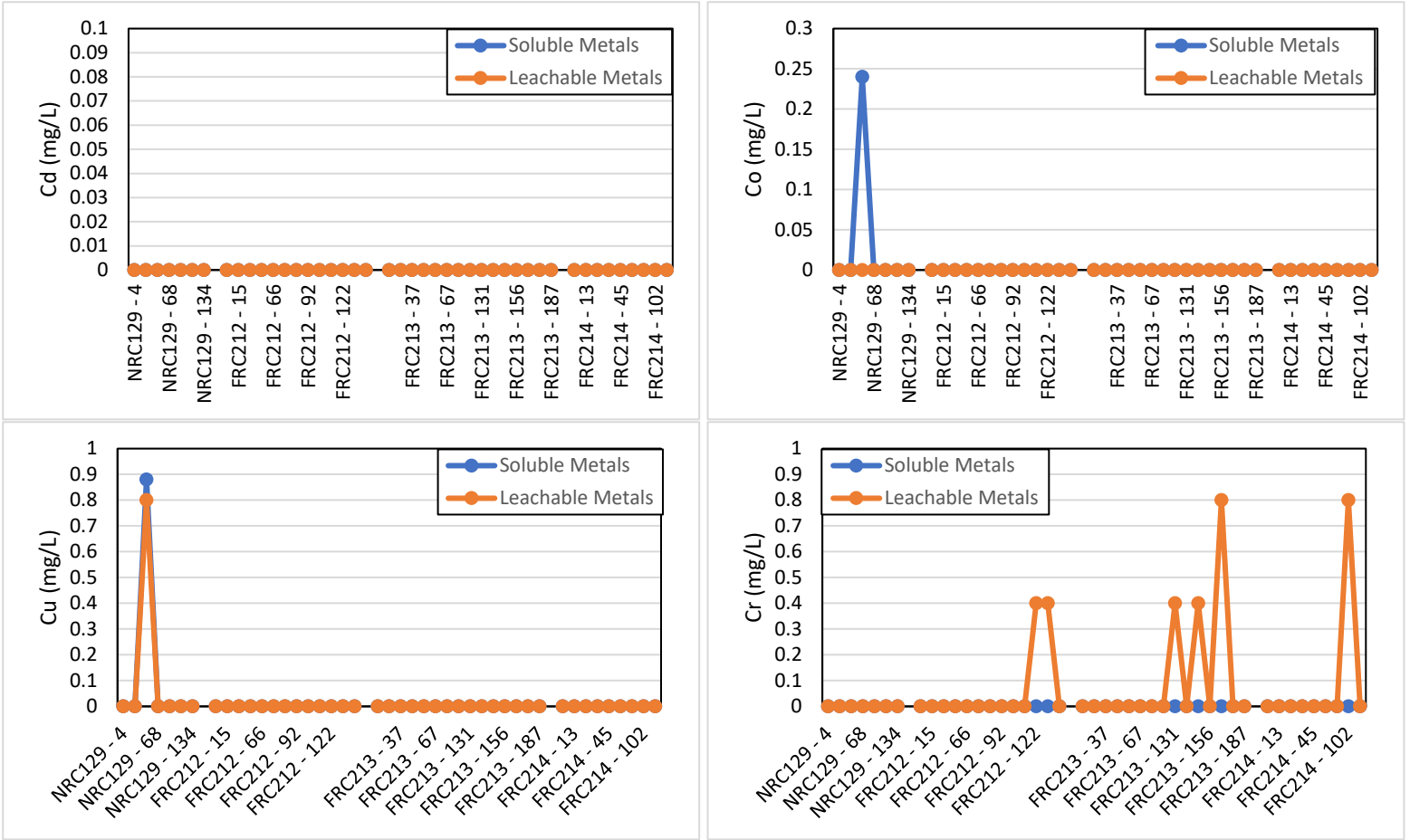



*Figure 11: Soluble and leachable heavy metals for samples from drill holes NRC129 and FRC212 – FRC214. Note, soluble metals are plotted as concentrations in the extract (mg/L) only, but are reported as amount extracted (mg/kg) and concentrations (mg/L) in Appendix B. Leachable metals are plotted as the original leachate concentrations (Appendix C) multiplied by a factor of 4 to allow comparison with soluble metals. See text for explanation.*

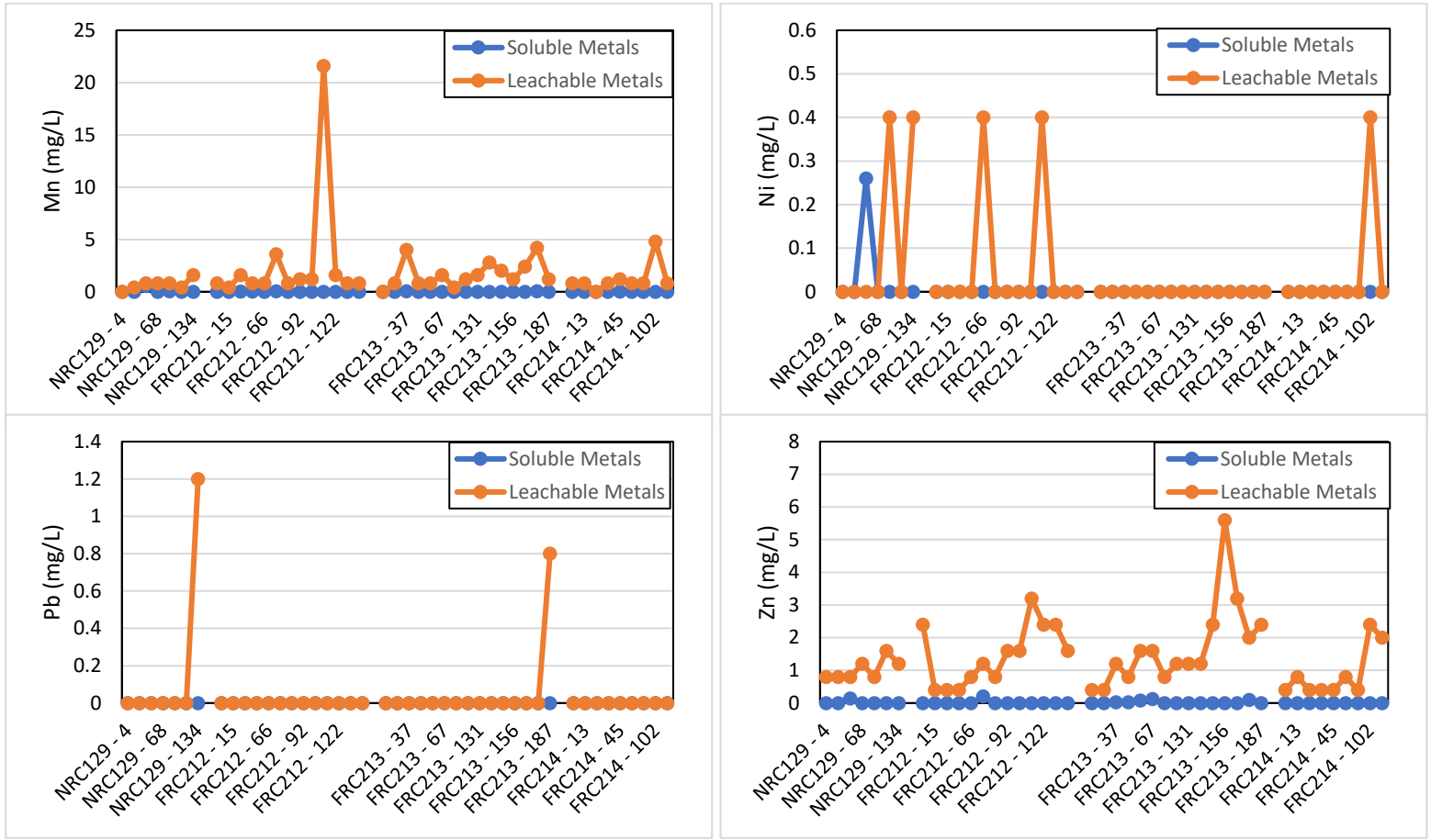



*Figure 12: Soluble and leachable heavy metals for samples from drill holes NRC129 and FRC212 – FRC214. Note, soluble metals are plotted as concentrations in the extract (mg/L) only, but are reported as amount extracted (mg/kg) and concentrations (mg/L) in Appendix B. Leachable metals are plotted as the original leachate concentrations (Appendix C) multiplied by a factor of 4 to allow comparison with soluble metals. See text for explanation.*

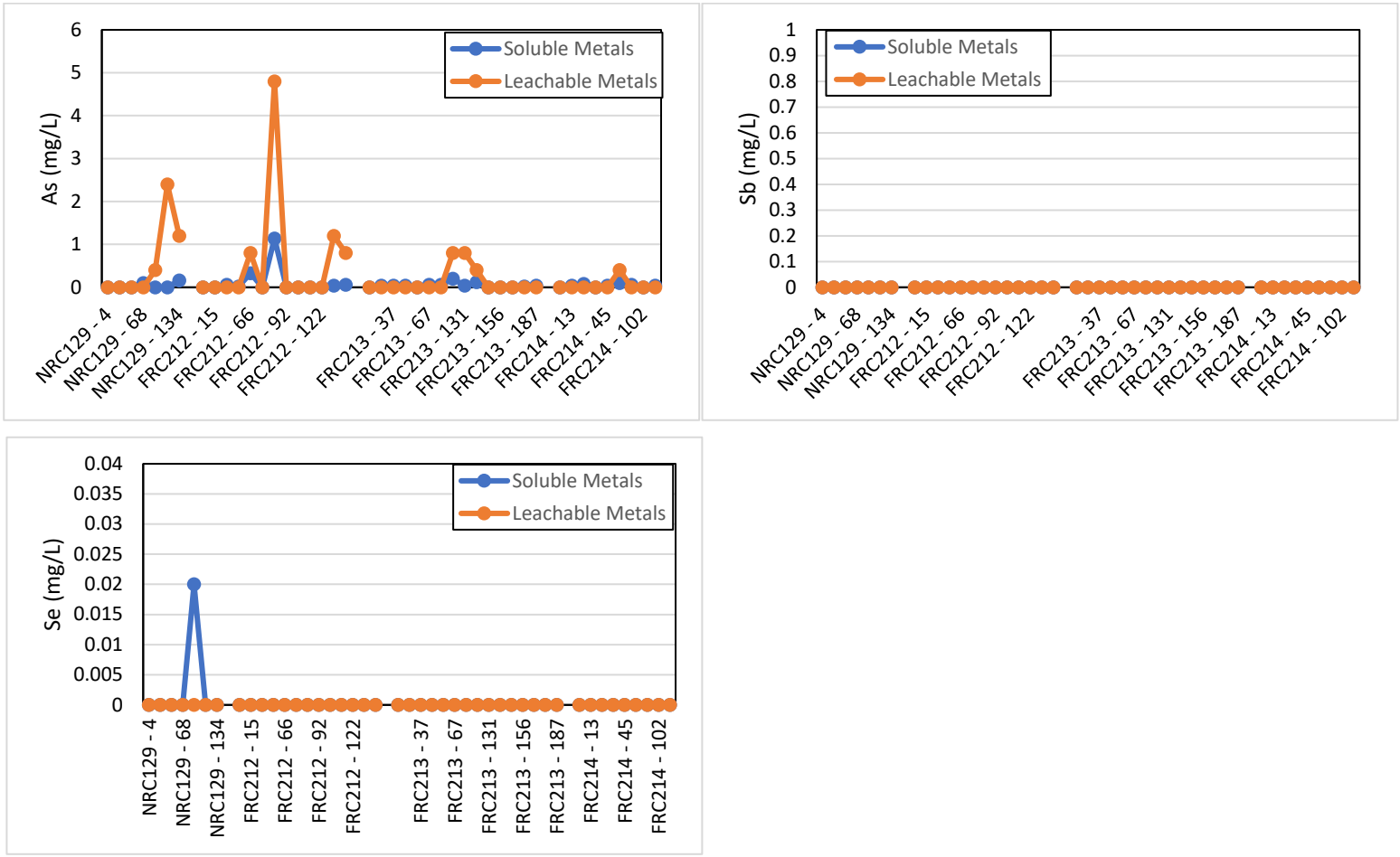



*Figure 13: Soluble and leachable metalloids for samples from drill holes NRC129 and FRC212 – FRC214. Note, soluble metalloids are plotted as concentrations in the extract (mg/L) only, but are reported as amount extracted (mg/kg) and concentrations (mg/L) in Appendix B. Leachable metalloids are plotted as the original leachate concentrations (Appendix C) multiplied by a factor of 4 to allow comparison with soluble metalloids. See text for explanation.*

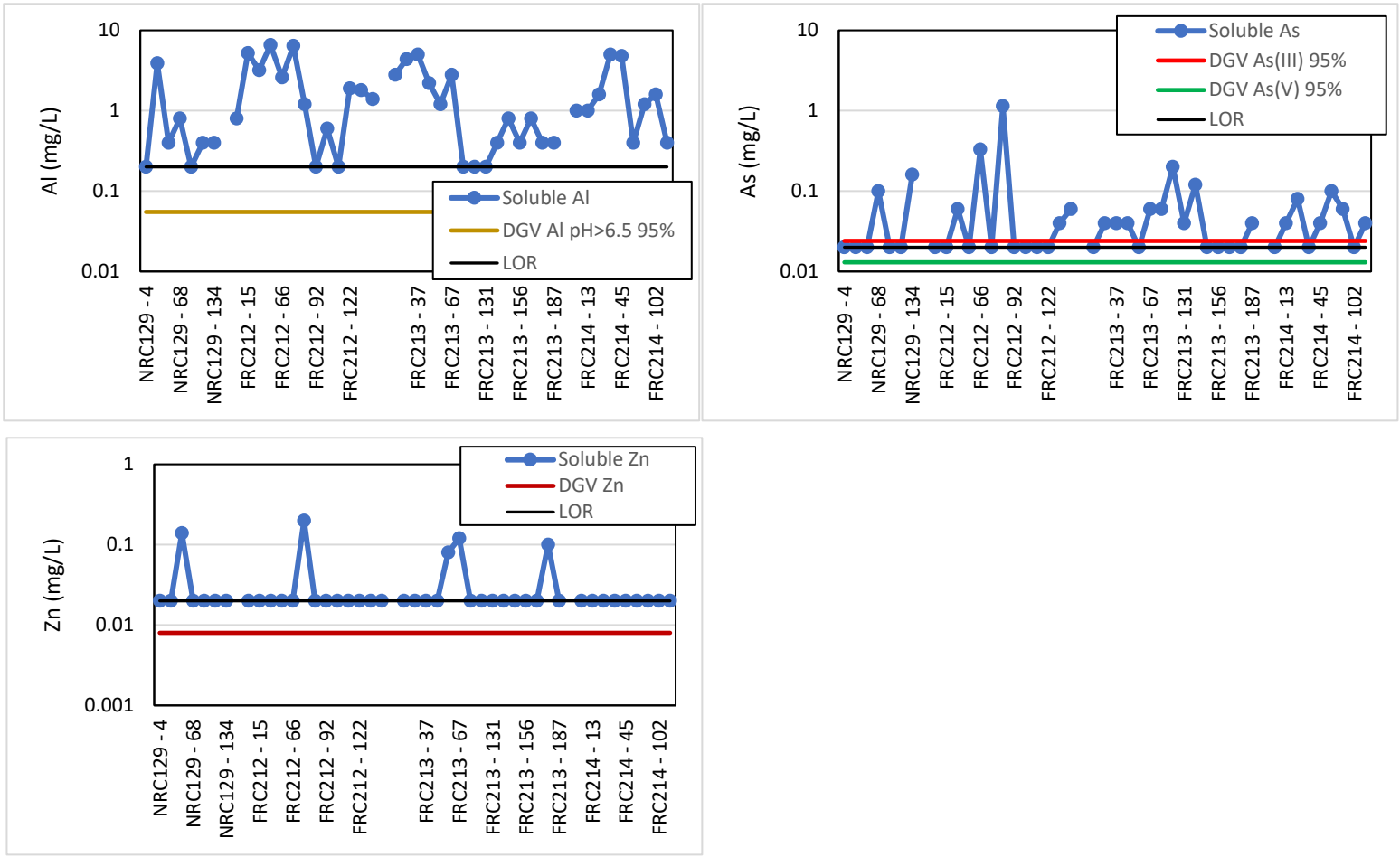



*Figure 14: Soluble Al, As and Zn for samples from drill holes NRC129 and FRC212 – FRC214 and corresponding ANZECC freshwater default guideline values and method reporting limits (LOR). Note, soluble metalloids are plotted as concentrations in the extract (mg/L) only, but are reported as amount extracted (mg/kg) and concentrations (mg/L) in Appendix B. See text for explanation.*

## 3.3 Naturally Occurring Radioactive Material (NORM)

Naturally occurring radioactive material (NORM) was assessed on samples from the NRC129 and FRC212 – FRC214 drill holes used in the waste characterisation. All testing was undertaken using RadEye B20 – ER contamination meter (SN 32215 Calibrated 15/04/2019) by registered NT Radiation Advisor Accreditation Number 10/00054A. This meter characterises alpha, beta and gamma radiation. The results are recorded in μSv/h and are provided in Appendix D.

The average radiation dose in Australia over a one year period is around 1.5 mSv[4]. Assuming exposure to the materials tested here for an average of 45 h per week (average working hours for Australian mine workers), this would provide an additional dose of 0.3 mSv. The recommended dose limit for occupational exposure in Australia is 20 mSv/year (averaged over a period of 5 years)[5]. The results from radiation dose measurements for the drill core samples from the BP33 deposit measured here, indicate that these materials are unlikely to contribute significantly to workers radiation exposure and that further testing is unwarranted.

## 3.4 Soil Characterisation

Soil characterisation results for four soil samples taken at the surface of drill holes NRC129-0, FRC212-0, FRC213-0 and FRC214-0 are given in Appendix E.

The four samples were logged as completely weathered, and they were variously described as sandy loam, sandy clay loam or clay loam. However, the clay fractions were relatively low (i.e. between 7 to 11% of the minus 2 mm sized material) and the particle size distributions indicate that typical surface soil at the site is a sandy loam that in some locations also has a significant gravel content. Soil stability was assessed using the Emerson test, which measures the tendency of the clay fraction of a soil to go into colloidal suspension (i.e. disperse). All four soils were classed at 7, which means the soil samples were non-dispersive.

In addition to particle size analysis, the soil characterisation program included measurements of a number of parameters pertaining to soil fertility. They included pH and electrical conductivity (EC), cation exchange capacity (CEC) and exchangeable cations, analysis of trace metals, determination of soil nitrogen, potassium and phosphorus, and measurements of carbon and soil organic matter. The main findings with respect to soil fertility, based on guidelines by Agriculture Victoria[6], are as follows:

*Slightly Acidic Soil pH*

Values ranged from 5.3 to 5.8, which indicate the soil is slightly acidic, but within the range that is generally acceptable for plant growth.

*Non-Saline*

The ECs ranged from 14 to 33 μS/cm, which is at the low end of the typical range for soil. The EC values are indicative of low contents of soluble salts and hence the soils can be considered non-saline. Also, as exchangeable sodium values were negligible the soils can be considered non-sodic.

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[4] Radiation Information sheet, Naturally occurring radioactive material (NORM), Environmental Protection Authority South Australia, Issued December 2017

[5] Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005) Radiation Protection Series Publication No. 9, ARPANSA 2005

[6] Agriculture Victoria, Victoria State Government (2020). Accessed 20 February 2020. < http://agriculture.vic.gov.au/agriculture/farm-management/business-management/ems-in-victorian-agriculture/environmental-monitoring-tools/soil-fertility >

*Low CEC and Exchangeable Cations*

The soils CECs were less than 1, which signifies they have minimal capacity for cation exchange. The low CECs are consistent with the soils being sandy and containing little organic matter (i.e. clay and organic matter are the two main contributors of CEC in typical fertile soil; a loam typically has an CEC around 5 meq/100 gm and a clay up to 20 meq/100g). Calcium and magnesium were the dominant exchange cations. There was no evidence of exchangeable sodium or aluminium, which are not plant nutrients, and can be detrimental to growth if present in excess. Exchangeable sodium and exchangeable aluminium were both less than the 0.1 meq/100g limit of analytical detection.

*Low Fertility*

Extractable phosphorus was determined by the Colwell test. The extractable phosphorus contents of the four soil samples were less than the 5 mg/kg detection limit. As a guide, an available P content of around 20 mg/kg is generally considered adequate for good plant growth.

Extractable potassium was also determined by the Colwell test. The extractable potassium contents varied. One sample (FRC213-0) contained 341 mg/kg, which is relatively high for a sandy loam. However, the other three samples contained less than 140 mg/kg extractable potassium, which rates as low to marginal for plant growth.

Nitrogen is also essential for plant growth but nitrogen testing is generally of limited value when assessing soil fertility as the levels of soil nitrate and ammonium (which plants adsorbed) fluctuate widely with soil and weather conditions over short periods of time. Total N contents for the soils ranged from 410 to 790 mg/kg but most was likely present as organic matter. Nitrate which can be utilise by plants was low (<1 mg/kg).

*Low Trace Elements*

One sample had a marginally elevated arsenic content of 15 mg/kg, but otherwise the concentrations of trace metals (Cd, Cr, Cu, Ni, Pb, Zn, Li, Sn and Hg) were at, or in most cases much less than, the respective median concentrations typically reported for soils from non-mineralised areas.

*Low Organic Matter*

The total carbon contents ranged from 0.6 to 1.1 %C, which converts to between 1 to 2 % organic matter. An organic matter content exceeding 2% is generally desirable for plant growth and to maintain good soil physical structure.

*Summary*

Overall, the results for the four samples suggest that soil at the site is an infertile, gravelly sandy loam. The Emerson test indicates that the soil should be non-dispersive, but given the low organic matter level and sandy texture the soil likely has poor structure and limited water-holding capacity, and therefore could be susceptible to erosion under wet conditions. It is expected successful rehabilitation will require increasing the physical and chemical fertility of the soil to some extent, consistent with the proposed final end use.

# APPENDIX A - ABA & NAG Test Results

| Sample details | | | | | | | | Net Acid Generation | | | Acid Base Accouting | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Sample ID | Depth | Lithology | Weathering | Sample Type | pH (1:2)[1] or (1:5)[2] | EC (1:2)$_1$ or (1:5)[2] | NAGpH | NAG (pH 4.5) | NAG (pH 7.0) | NAPP | MPA | Total S (LECO) | ANC | Fizz Rating | ANC/MPA |
| | | | | | | pH Unit | µS/cm | pH Unit | kg H2SO4/t | kg H2SO4/t | kg H2SO4/t | kg H2SO4/t | % | kg H2SO4/t | Fizz Unit | |
| | | | | | | 0.1 | 1 | 0.1 | 0.1 | 0.1 | 0.5 | 0.3 | 0.01 | 0.5 | | |
| 10/09/2019 | NRC129 - 4 | 4 | Py | EW | Waste | 5.5 | 12 | 5.6 | <0.1 | 1.3 | -8 | <0.3 | <0.01 | 8 | 1 | >27 |
| 10/09/2019 | NRC129 - 20 | 20 | Py | MW | Waste | 7.2 | 18 | 7.3 | <0.1 | <0.1 | -12 | <0.3 | <0.01 | 12 | 1 | >41 |
| 10/09/2019 | NRC129 - 55 | 55 | Py | SW | Waste | 4.0 | 786 | 4.4 | 0.2 | 2.5 | -15 | 4.3 | 0.14 | 19 | 1 | 4.4 |
| 10/09/2019 | NRC129 - 68 | 68 | Sst | Fr | Waste | 7.1 | 112 | 5.6 | <0.1 | 3 | -14 | 1.5 | 0.05 | 15 | 1 | 10 |
| 10/09/2019 | NRC129 - 89 | 89 | Py | Fr | Waste | 6.8 | 274 | 3.8 | 1.7 | 6.7 | -12 | 5.2 | 0.17 | 18 | 1 | 3.4 |
| 10/09/2019 | NRC129 - 98 | 98 | Pg | Fr | Waste | 8.7 | 65 | 6.9 | <0.1 | 0.4 | -13 | 0.6 | 0.02 | 13 | 1 | 22 |
| 10/09/2019 | NRC129 - 134 | 134 | Py | Fr | Waste | 8.3 | 159 | 3.4 | 5.5 | 8.2 | -4 | 13 | 0.42 | 17 | 1 | 1.3 |
| | | | | | | | | | | | | | | | | |
| 10/09/2019 | FRC212 - 8 | 8 | Pg | HW | Waste | 8.4 | 19 | 6.6 | <0.1 | 0.7 | -8 | <0.3 | <0.01 | 8 | 1 | >25 |
| 10/09/2019 | FRC212 - 15 | 15 | Py | MW | Waste | 8.4 | 17 | 7.4 | <0.1 | <0.1 | -12 | <0.3 | <0.01 | 12 | 1 | >40 |
| 10/09/2019 | FRC212 - 44 | 44 | Py | MW | Waste | 8.3 | 24 | 7.3 | <0.1 | <0.1 | -16 | <0.3 | <0.01 | 16 | 1 | >54 |
| 10/09/2019 | FRC212 - 53 | 53 | Pg | MW | Waste | 8.8 | 39 | 7.0 | <0.1 | <0.1 | -13 | <0.3 | <0.01 | 13 | 1 | >42 |
| 11/09/2019 | FRC212 - 66 | 66 | Py | SW | Waste | 8.5 | 65 | 6.2 | <0.1 | 4.3 | -14 | <0.3 | <0.01 | 14 | 1 | >47 |
| 11/09/2019 | FRC212 - 81 | 81 | Pg | Fr | Waste | 8.6 | 39 | 6.8 | <0.1 | 1 | -13 | <0.3 | <0.01 | 13 | 1 | >44 |
| 11/09/2019 | FRC212 - 88 | 88 | Py | Fr | Waste | 8.1 | 68 | 6.2 | <0.1 | 2.4 | -22 | 0.6 | 0.02 | 23 | 1 | 38 |
| 11/09/2019 | FRC212 - 92 | 92 | Pg | Fr | Waste | 9.2 | 49 | 7.2 | <0.1 | <0.1 | -12 | <0.3 | <0.01 | 12 | 1 | >41 |
| 11/09/2019 | FRC212 - 97 | 97 | Pg | Fr | Ore | 9.2 | 48 | 6.0 | <0.1 | 3.8 | -13 | <0.3 | <0.01 | 13 | 1 | >42 |
| 11/09/2019 | FRC212 - 109 | 109 | Pg | Fr | Ore | 9.5 | 136 | 7.6 | <0.1 | <0.1 | -16 | <0.3 | <0.01 | 16 | 1 | >53 |
| 11/09/2019 | FRC212 - 122 | 122 | Pg | Fr | Ore | 9.3 | 122 | 7.0 | <0.1 | 0.9 | -12 | <0.3 | <0.01 | 12 | 1 | >41 |
| 11/09/2019 | FRC212 - 131 | 131 | Pg | Fr | Waste | 9.2 | 76 | 7.1 | <0.1 | <0.1 | -35 | 0.3 | 0.01 | 36 | 1 | 116 |
| 11/09/2019 | FRC212 - 143 | 143 | Py | Fr | Waste | 9.0 | 68 | 6.2 | <0.1 | 1.1 | -19 | 2.1 | 0.07 | 21 | 1 | 10 |
| | | | | | | | | | | | | | | | | |
| 11/09/2019 | FRC213 - 5 | 5 | Py | HW | Waste | 8.7 | 15 | 6.7 | <0.1 | 0.9 | -11 | <0.3 | <0.01 | 11 | 1 | >35 |
| 11/09/2019 | FRC213 - 26 | 26 | Py | MW | Waste | 8.5 | 18 | 7.4 | <0.1 | <0.1 | -14 | <0.3 | <0.01 | 14 | 1 | >45 |
| 11/09/2019 | FRC213 - 37 | 37 | Pg | HW | Waste | 8.5 | 31 | 7.6 | <0.1 | <0.1 | -16 | <0.3 | <0.01 | 16 | 1 | >53 |
| 11/09/2019 | FRC213 - 58 | 58 | Py | SW | Waste | 8.6 | 54 | 6.2 | <0.1 | 3 | -17 | <0.3 | <0.01 | 17 | 1 | >56 |
| 11/09/2019 | FRC213 - 62 | 62 | Pg | SW | Waste | 8.6 | 72 | 6.8 | <0.1 | 0.9 | -13 | <0.3 | <0.01 | 13 | 1 | >43 |
| 11/09/2019 | FRC213 - 67 | 67 | Pg | SW | Waste | 8.7 | 50 | 6.8 | <0.1 | 0.9 | -21 | 0.6 | 0.02 | 22 | 1 | 35 |
| 11/09/2019 | FRC213 - 86 | 86 | Pg | Fr | Waste | 8.3 | 76 | 4.4 | 0.25 | 2.4 | -13 | 2.8 | 0.09 | 16 | 1 | 5.7 |
| 11/09/2019 | FRC213 - 107 | 107 | Sst | Fr | Waste | 8.9 | 64 | 6.8 | <0.1 | 0.6 | -21 | 0.6 | 0.02 | 22 | 1 | 35 |
| 11/09/2019 | FRC213 - 131 | 131 | Py | Fr | Waste | 9.5 | 70 | 7.2 | <0.1 | <0.1 | -14 | 0.9 | 0.03 | 15 | 1 | 17 |
| 14/09/2019 | FRC213 - 142 | 142 | Pg | Fr | Ore | 8.8 | 126 | 7.2 | <0.1 | <0.1 | -19 | 0.6 | 0.02 | 19 | 1 | 32 |
| 14/09/2019 | FRC213 - 148 | 148 | Pg | Fr | Ore | 9.4 | 109 | 7.8 | <0.1 | <0.1 | -10 | <0.3 | <0.01 | 10 | 1 | >33 |
| 14/09/2019 | FRC213 - 156 | 156 | Pg | Fr | Ore | 8.7 | 59 | 6.6 | <0.1 | 0.8 | -9 | 0.6 | 0.02 | 9 | 1 | 15 |
| 14/09/2019 | FRC213 - 170 | 170 | Pg | Fr | Ore | 9.5 | 121 | 7.3 | <0.1 | <0.1 | -10 | <0.3 | <0.01 | 10 | 1 | >33 |
| 14/09/2019 | FRC213 - 178 | 178 | Pg | Fr | Ore | 9.4 | 132 | 7.9 | <0.1 | <0.1 | -13 | <0.3 | <0.01 | 13 | 1 | >44 |
| 14/09/2019 | FRC213 - 187 | 187 | Py | Fr | Waste | 8.5 | 186 | 5.8 | <0.1 | 0.9 | -16 | 3.1 | 0.10 | 19 | 1 | 6.1 |

| Sample details | | | | | | | | Net Acid Generation | | | Acid Base Accouting | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Sample ID | Depth | Lithology | Weathering | Sample Type | pH (1:2)[1] or (1:5)[2] | EC (1:2)$_1$ or (1:5)[2] | NAGpH | NAG (pH 4.5) | NAG (pH 7.0) | NAPP | MPA | Total S (LECO) | ANC | Fizz Rating | ANC/MPA |
| | | | | | | pH Unit | µS/cm | pH Unit | kg H2SO4/t | kg H2SO4/t | kg H2SO4/t | kg H2SO4/t | % | kg H2SO4/t | Fizz Unit | |
| | | | | | | 0.1 | 1 | 0.1 | 0.1 | 0.1 | 0.5 | 0.3 | 0.01 | 0.5 | | |
| 14/09/2019 | FRC214 - 6 | 6 | Py | CW | Waste | 7.8 | 41 | 7.4 | <0.1 | <0.1 | -10 | <0.3 | <0.01 | 10 | 1 | >32 |
| 14/09/2019 | FRC214 - 13 | 13 | Py/Qv | HW | Waste | 7.9 | 19 | 7.1 | <0.1 | <0.1 | -8 | <0.3 | <0.01 | 8 | 1 | >27 |
| 14/09/2019 | FRC214 - 20 | 20 | Py | CW | Waste | 8.0 | 17 | 7.2 | <0.1 | <0.1 | -10 | <0.3 | <0.01 | 10 | 1 | >32 |
| 14/09/2019 | FRC214 - 34 | 34 | Py | HW | Waste | 8.5 | 22 | 7.4 | <0.1 | <0.1 | -14 | <0.3 | <0.01 | 14 | 1 | >46 |
| 14/09/2019 | FRC214 - 45 | 45 | Py | MW | Waste | 8.6 | 23 | 7.3 | <0.1 | <0.1 | -14 | <0.3 | <0.01 | 14 | 1 | >47 |
| 14/09/2019 | FRC214 - 50 | 50 | Py | SW | Waste | 8.7 | 32 | 7.3 | <0.1 | <0.1 | -14 | <0.3 | <0.01 | 14 | 1 | >46 |
| 14/09/2019 | FRC214 - 74 | 74 | Py | Fr | Waste | 8.7 | 56 | 7.2 | <0.1 | <0.1 | -14 | 0.3 | 0.01 | 14 | 1 | 46 |
| 14/09/2019 | FRC214 - 102 | 102 | Pg | Fr | Ore | 9.2 | 92 | 6.9 | <0.1 | 0.5 | -11 | <0.3 | <0.01 | 11 | 1 | >38 |
| 14/09/2019 | FRC214 - 116 | 116 | Pg | Fr | Waste | 8.9 | 40 | 6.4 | <0.1 | 0.4 | -12 | 1.2 | 0.04 | 13 | 1 | 11 |
| | | | | | | | | | | | | | | | | |
| 6/07/2018 | FRC166_002 | 2 | Laterite | CW | Waste | 5.5 | 3 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_008 | 8 | Py | CW | Waste | 6.8 | 9 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_018 | 18 | Py | HW | Waste | 7.0 | 8 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_032 | 32 | Py | HW | Waste | 7.7 | 9 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_046 | 46 | Py | MW | Waste | 8.4 | 22 | N/D | N/D | N/D | N/D | 3.1 | 0.1 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_052 | 52 | Py | SW | Waste | 8.4 | 28 | N/D | N/D | N/D | N/D | 4.3 | 0.14 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_064 | 64 | Py | SW | Waste | 7.9 | 55 | N/D | N/D | N/D | N/D | 16 | 0.51 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_075 | 75 | Py | FR | Waste | 8.5 | 32 | N/D | N/D | N/D | N/D | 8.9 | 0.29 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_088 | 88 | Py | FR | Waste | 9.2 | 48 | N/D | N/D | N/D | N/D | 1.5 | 0.05 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_108 | 108 | Py | FR | Waste | 9.2 | 37 | N/D | N/D | N/D | N/D | 2.8 | 0.09 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_144 | 144 | Py | FR | Waste | 9.00 | 34 | N/D | N/D | N/D | N/D | 8.9 | 0.29 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_152 | 152 | Py | FR | Waste | 9.1 | 39 | N/D | N/D | N/D | N/D | 6.4 | 0.21 | N/D | N/D | N/D |
| 7/07/2018 | FRC166_226 | 226 | Py | FR | Waste | 9.1 | 55 | N/D | N/D | N/D | N/D | 1.2 | 0.04 | N/D | N/D | N/D |
| | | | | | | | | | | | | | | | | |
| 8/07/2018 | FRC167_004 | 4 | Py | CW | Waste | 7.2 | 8 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_013 | 13 | Py | HW | Waste | 7.2 | 7 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_020 | 20 | Py | HW | Waste | 6.9 | 9 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_031 | 31 | Py | HW | Waste | 7.0 | 9 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_044 | 44 | Py | MW | Waste | 7.8 | 10 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_049 | 49 | Py | MW | Waste | 7.00 | 66 | N/D | N/D | N/D | N/D | 4.3 | 0.14 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_060 | 60 | Py | SW | Waste | 8.7 | 33 | N/D | N/D | N/D | N/D | 4.0 | 0.13 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_072 | 72 | Py/SST | FR | Waste | 7.8 | 50 | N/D | N/D | N/D | N/D | 7.0 | 0.23 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_076 | 76 | Py/QV | FR | Waste | 8.6 | 25 | N/D | N/D | N/D | N/D | 1.5 | 0.05 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_098 | 98 | Py/QV | FR | Waste | 9.4 | 87 | N/D | N/D | N/D | N/D | 0.6 | 0.02 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_117 | 117 | Py/SST | FR | Waste | 9.4 | 88 | N/D | N/D | N/D | N/D | 4.9 | 0.16 | N/D | N/D | N/D |
| 9/07/2018 | FRC167_126 | 126 | PEG/PY | FR | Waste | 9.3 | 76 | N/D | N/D | N/D | N/D | 2.1 | 0.07 | N/D | N/D | N/D |
| 9/07/2018 | FRC167_140 | 140 | Py/SST | FR | Waste | 9.00 | 32 | N/D | N/D | N/D | N/D | 3.1 | 0.1 | N/D | N/D | N/D |
| 9/07/2018 | FRC167_189 | 189 | Py/SST | FR | Waste | 9.2 | 52 | N/D | N/D | N/D | N/D | 1.2 | 0.04 | N/D | N/D | N/D |
| 10/07/2018 | FRC168_001 | 1 | laterite | CW | Waste | 6.0 | 5 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 10/07/2018 | FRC168_005 | 5 | PY | CW | Waste | 6.0 | 4 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 10/07/2018 | FRC168_017 | 17 | PY | HW | Waste | 6.1 | 4 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 10/07/2018 | FRC168_042 | 42 | PY | MW | Waste | 7.8 | 12 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 10/07/2018 | FRC168_045 | 45 | PY | MW | Waste | 7.9 | 12 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |

| Sample details | | | | | | | | Net Acid Generation | | | Acid Base Accouting | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Sample ID | Depth | Lithology | Weathering | Sample Type | pH (1:2)[1] or (1:5)[2] | EC (1:2)$_1$ or (1:5)[2] | NAGpH | NAG (pH 4.5) | NAG (pH 7.0) | NAPP | MPA | Total S (LECO) | ANC | Fizz Rating | ANC/MPA |
| | | | | | | pH Unit | µS/cm | pH Unit | kg H2SO4/t | kg H2SO4/t | kg H2SO4/t | kg H2SO4/t | % | kg H2SO4/t | Fizz Unit | |
| | | | | | | 0.1 | 1 | 0.1 | 0.1 | 0.1 | 0.5 | 0.3 | 0.01 | 0.5 | | |
| 11/07/2018 | FRC168_052 | 52 | PY | SW | Waste | 8.2 | 12 | N/D | N/D | N/D | N/D | 0.6 | 0.02 | N/D | N/D | N/D |
| 11/07/2018 | FRC168_060 | 60 | PY | MW | Waste | 8.5 | 23 | N/D | N/D | N/D | N/D | 0.9 | 0.03 | N/D | N/D | N/D |
| 11/07/2018 | FRC168_118 | 118 | PY | FR | Waste | 8.7 | 76 | N/D | N/D | N/D | N/D | 11 | 0.37 | N/D | N/D | N/D |
| | | | | | | | | | | | | | | | | |
| 12/07/2018 | FRC169_002 | 2 | Laterite | CW | Waste | 7.3 | 10 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 12/07/2018 | FRC169_004 | 4 | PY | CW | Waste | 7.3 | 5 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 12/07/2018 | FRC169_014 | 14 | PY | HW | Waste | 7.1 | 7 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 12/07/2018 | FRC169_026 | 26 | PY | HW | Waste | 7.6 | 7 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 12/07/2018 | FRC169_036 | 36 | PY/SST | MW | Waste | 8.3 | 14 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 12/07/2018 | FRC169_057 | 57 | PY/SST | SW | Waste | 8.5 | 18 | N/D | N/D | N/D | N/D | 0.9 | 0.03 | N/D | N/D | N/D |
| 12/07/2018 | FRC169_065 | 65 | PY | FR | Waste | 6.6 | 120 | N/D | N/D | N/D | N/D | 32 | 1.05 | N/D | N/D | N/D |
| 14/07/2018 | FRC169_153 | 153 | PY | FR | Waste | 9.0 | 33 | N/D | N/D | N/D | N/D | 2.1 | 0.07 | N/D | N/D | N/D |
| | | | | | | | | | | | | | | | | |
| 15/07/2018 | FRC170_004 | 4 | SOIL | CW | Waste | 6.0 | 4 | N/D | N/D | N/D | N/D | 0.6 | 0.02 | N/D | N/D | N/D |
| 15/07/2018 | FRC170_011 | 11 | PY | CW | Waste | 6.7 | 4 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 15/07/2018 | FRC170_023 | 23 | PY | HW | Waste | 7.5 | 6 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 15/07/2018 | FRC170_035 | 35 | PY | HW | Waste | 7.6 | 9 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 15/07/2018 | FRC170_044 | 44 | PY | MW | Waste | 8.0 | 7 | N/D | N/D | N/D | N/D | 0.6 | 0.02 | N/D | N/D | N/D |
| 15/07/2018 | FRC170_056 | 56 | PY | SW | Waste | 8.5 | 16 | N/D | N/D | N/D | N/D | 0.6 | 0.02 | N/D | N/D | N/D |
| 15/07/2018 | FRC170_064 | 64 | PY | FR | Waste | 9.0 | 23 | N/D | N/D | N/D | N/D | 0.6 | 0.02 | N/D | N/D | N/D |
| 15/07/2018 | FRC170_099 | 99 | PY | FR | Waste | 9.2 | 76 | N/D | N/D | N/D | N/D | 0.6 | 0.02 | N/D | N/D | N/D |
| 16/07/2018 | FRC170_142 | 142 | PY | FR | Waste | 9.4 | 41 | N/D | N/D | N/D | N/D | 0.9 | 0.03 | N/D | N/D | N/D |
| | | | | | Waste | | | | | | | | | | | |
| 18/07/2018 | FRC171_040 | 40 | PY | MW | Waste | 8.1 | 7 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 14/07/2018 | FRC171_065 | 65 | PY/QV | SW | Waste | 6.2 | 2 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |

1. pH and EC (1:2) conducted samples from drill holes NRC129 and FRC212-214
2. pH and EC (1:5) conducted samples from drill holes FRC166-171

# APPENDIX B – Water Soluble Metals

| Sample details | | | | | | Soluble Metals by ICPAES | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Sample ID | Depth | Lithology | Weathering | Sample Type | Aluminium | | Antimony | | Arsenic | | Cadmium | | Chromium | | Cobalt | | Copper | | Iron | | Lead | | Manganese | | Nickel | | Selenium | |
| | | | | | | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L |
| | | | | | | 1 | | 0.1 | | 0.1 | | 0.1 | | 0.1 | | 0.1 | | 0.1 | | 1 | | 0.1 | | 0.1 | | 0.1 | | 0.1 | |
| 10/09/2019 | NRC129 - 4 | 4 | Py | EW | Waste | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 10/09/2019 | NRC129 - 20 | 20 | Py | MW | Waste | 20 | 3.9 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 27 | 5.4 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 10/09/2019 | NRC129 - 55 | 55 | Py | SW | Waste | 2 | 0.4 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 1.2 | 0.2 | 4.4 | 0.9 | 6 | 1.2 | <0.1 | <0.02 | 2.8 | 0.6 | 1.3 | 0.3 | <0.1 | <0.02 |
| 10/09/2019 | NRC129 - 68 | 68 | Sst | Fr | Waste | 4 | 0.8 | <0.1 | <0.02 | 0.5 | 0.10 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 3 | 0.6 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 10/09/2019 | NRC129 - 89 | 89 | Py | Fr | Waste | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | 0.3 | 0.06 | <0.1 | <0.02 | 0.1 | 0.02 |
| 10/09/2019 | NRC129 - 98 | 98 | Pg | Fr | Waste | 2 | 0.4 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 10/09/2019 | NRC129 - 134 | 134 | Py | Fr | Waste | 2 | 0.4 | <0.1 | <0.02 | 0.8 | 0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10/09/2019 | FRC212 - 8 | 8 | Pg | HW | Waste | 4 | 0.8 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 1 | 0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 10/09/2019 | FRC212 - 15 | 15 | Py | MW | Waste | 26 | 5.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 36 | 7.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 10/09/2019 | FRC212 - 44 | 44 | Py | MW | Waste | 16 | 3.2 | <0.1 | <0.02 | 0.3 | 0.1 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 27 | 5.4 | <0.1 | <0.02 | 0.1 | 0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 10/09/2019 | FRC212 - 53 | 53 | Pg | MW | Waste | 33 | 6.6 | <0.1 | <0.02 | 0.1 | 0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 11 | 2.2 | <0.1 | <0.02 | 0.1 | 0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 66 | 66 | Py | SW | Waste | 13.0 | 2.6 | <0.1 | <0.02 | 1.7 | 0.3 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 6.5 | 1.3 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 81 | 81 | Pg | Fr | Waste | 32 | 6.4 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 4 | 0.8 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 88 | 88 | Py | Fr | Waste | 6 | 1.2 | <0.1 | <0.02 | 5.7 | 1.1 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 4 | 0.8 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 92 | 92 | Pg | Fr | Waste | 1 | 0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 97 | 97 | Pg | Fr | Ore | 3 | 0.6 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 109 | 109 | Pg | Fr | Ore | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 122 | 122 | Pg | Fr | Ore | 10 | 1.9 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 2 | 0.4 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 131 | 131 | Pg | Fr | Waste | 9 | 1.8 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 143 | 143 | Py | Fr | Waste | 7 | 1.4 | <0.1 | <0.02 | 0.3 | 0.06 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 4 | 0.8 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11/09/2019 | FRC213 - 5 | 5 | Py | HW | Waste | 14 | 2.8 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 44 | 8.8 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC213 - 26 | 26 | Py | MW | Waste | 22 | 4.4 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 42 | 8.4 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC213 - 37 | 37 | Pg | HW | Waste | 25 | 5.0 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 20 | 4.0 | <0.1 | <0.02 | 0.3 | 0.06 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC213 - 58 | 58 | Py | SW | Waste | 11 | 2.2 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 5 | 1.0 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC213 - 62 | 62 | Pg | SW | Waste | 6 | 1.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 3 | 0.6 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC213 - 67 | 67 | Pg | SW | Waste | 14 | 2.8 | <0.1 | <0.02 | 0.3 | 0.1 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 19 | 3.8 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC213 - 86 | 86 | Pg | Fr | Waste | <1 | <0.2 | <0.1 | <0.02 | 0.3 | 0.06 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC213 - 107 | 107 | Sst | Fr | Waste | <1 | <0.2 | <0.1 | <0.02 | 1 | 0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC213 - 131 | 131 | Py | Fr | Waste | <1 | <0.2 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC213 - 142 | 142 | Pg | Fr | Ore | 2 | 0.4 | <0.1 | <0.02 | 0.6 | 0.1 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 1 | 0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC213 - 148 | 148 | Pg | Fr | Ore | 4 | 0.8 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC213 - 156 | 156 | Pg | Fr | Ore | 2 | 0.4 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC213 - 170 | 170 | Pg | Fr | Ore | 4 | 0.8 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC213 - 178 | 178 | Pg | Fr | Ore | 2 | 0.4 | <0.1 | <0.02 | 0.1 | 0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | 0.3 | 0.05 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC213 - 187 | 187 | Py | Fr | Waste | 2 | 0.4 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 1 | 0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 14/09/2019 | FRC214 - 6 | 6 | Py | CW | Waste | 5 | 1.0 | <0.1 | <0.02 | 0.2 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 10 | 2.0 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC214 - 13 | 13 | Py/Qv | HW | Waste | 5 | 1.0 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 5 | 1.0 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC214 - 20 | 20 | Py | CW | Waste | 8 | 1.6 | <0.1 | <0.02 | 0.4 | 0.08 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 15 | 3.0 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC214 - 34 | 34 | Py | HW | Waste | 25 | 5.0 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 18 | 3.6 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC214 - 45 | 45 | Py | MW | Waste | 24 | 4.8 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 34 | 6.8 | <0.1 | <0.02 | 0.1 | 0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC214 - 50 | 50 | Py | SW | Waste | 2 | 0.4 | <0.1 | <0.02 | 0.5 | 0.1 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC214 - 74 | 74 | Py | Fr | Waste | 6 | 1.2 | <0.1 | <0.02 | 0.3 | 0.06 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 3 | 0.6 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC214 - 102 | 102 | Pg | Fr | Ore | 8 | 1.6 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC214 - 116 | 116 | Pg | Fr | Waste | 2 | 0.4 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |

| Sample details | | | | | | Tin | | Zinc | | Soluble Metals by ICPMS - Lithium | | Soluble Mercury by FIMS - Mercury | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Sample ID | Depth | Lithology | Weathering | Sample Type | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L |
| | | | | | | 0.1 | | 0.1 | | 0.01 | | 0.0005 | |
| 10/09/2019 | NRC129 - 4 | 4 | Py | EW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | <0.01 | <0.002 | <0.0005 | <0.0001 |
| 10/09/2019 | NRC129 - 20 | 20 | Py | MW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.09 | 0.02 | <0.0005 | <0.0001 |
| 10/09/2019 | NRC129 - 55 | 55 | Py | SW | Waste | <0.1 | <0.02 | 0.7 | 0.14 | 2.1 | 0.43 | <0.0005 | <0.0001 |
| 10/09/2019 | NRC129 - 68 | 68 | Sst | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.66 | 0.13 | <0.0005 | <0.0001 |
| 10/09/2019 | NRC129 - 89 | 89 | Py | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 1.7 | 0.35 | <0.0005 | <0.0001 |
| 10/09/2019 | NRC129 - 98 | 98 | Pg | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.2 | 0.04 | <0.0005 | <0.0001 |
| 10/09/2019 | NRC129 - 134 | 134 | Py | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 3.2 | 0.64 | <0.0005 | <0.0001 |
| | | | | | | | | | | | | | |
| 10/09/2019 | FRC212 - 8 | 8 | Pg | HW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.02 | 0.004 | <0.0005 | <0.0001 |
| 10/09/2019 | FRC212 - 15 | 15 | Py | MW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.19 | 0.04 | <0.0005 | <0.0001 |
| 10/09/2019 | FRC212 - 44 | 44 | Py | MW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.31 | 0.06 | <0.0005 | <0.0001 |
| 10/09/2019 | FRC212 - 53 | 53 | Pg | MW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.10 | 0.02 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 66 | 66 | Py | SW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.92 | 0.18 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 81 | 81 | Pg | Fr | Waste | 0.2 | 0.04 | 1 | 0.20 | 0.97 | 0.19 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 88 | 88 | Py | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 1.6 | 0.32 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 92 | 92 | Pg | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.90 | 0.18 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 97 | 97 | Pg | Fr | Ore | <0.1 | <0.02 | <0.1 | <0.02 | 0.61 | 0.12 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 109 | 109 | Pg | Fr | Ore | <0.1 | <0.02 | <0.1 | <0.02 | 16 | 3.2 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 122 | 122 | Pg | Fr | Ore | <0.1 | <0.02 | <0.1 | <0.02 | 16 | 3.2 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 131 | 131 | Pg | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.39 | 0.08 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 143 | 143 | Py | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 2.2 | 0.44 | <0.0005 | <0.0001 |
| | | | | | | | | | | | | | |
| 11/09/2019 | FRC213 - 5 | 5 | Py | HW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.07 | 0.01 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC213 - 26 | 26 | Py | MW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.15 | 0.03 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC213 - 37 | 37 | Pg | HW | Waste | <0.1 | <0.02 | 0.1 | 0.02 | 0.06 | 0.01 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC213 - 58 | 58 | Py | SW | Waste | <0.1 | <0.02 | 0.1 | 0.02 | 0.75 | 0.15 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC213 - 62 | 62 | Pg | SW | Waste | <0.1 | <0.02 | 0.4 | 0.08 | 0.10 | 0.02 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC213 - 67 | 67 | Pg | SW | Waste | <0.1 | <0.02 | 0.6 | 0.12 | 0.09 | 0.02 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC213 - 86 | 86 | Pg | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.53 | 0.11 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC213 - 107 | 107 | Sst | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.84 | 0.17 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC213 - 131 | 131 | Py | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 2.1 | 0.41 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC213 - 142 | 142 | Pg | Fr | Ore | <0.1 | <0.02 | <0.1 | <0.02 | 0.91 | 0.18 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC213 - 148 | 148 | Pg | Fr | Ore | <0.1 | <0.02 | <0.1 | <0.02 | 12 | 2.4 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC213 - 156 | 156 | Pg | Fr | Ore | <0.1 | <0.02 | <0.1 | <0.02 | 1.7 | 0.34 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC213 - 170 | 170 | Pg | Fr | Ore | <0.1 | <0.02 | <0.1 | <0.02 | 18 | 3.5 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC213 - 178 | 178 | Pg | Fr | Ore | <0.1 | <0.02 | 0.5 | 0.10 | 21 | 4.1 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC213 - 187 | 187 | Py | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 1.6 | 0.32 | <0.0005 | <0.0001 |
| | | | | | | | | | | | | | |
| 14/09/2019 | FRC214 - 6 | 6 | Py | CW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.08 | 0.02 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC214 - 13 | 13 | Py/Qv | HW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.07 | 0.01 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC214 - 20 | 20 | Py | CW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.06 | 0.01 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC214 - 34 | 34 | Py | HW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.16 | 0.03 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC214 - 45 | 45 | Py | MW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.20 | 0.04 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC214 - 50 | 50 | Py | SW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.20 | 0.04 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC214 - 74 | 74 | Py | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.31 | 0.06 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC214 - 102 | 102 | Pg | Fr | Ore | <0.1 | <0.02 | <0.1 | <0.02 | 10 | 2.1 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC214 - 116 | 116 | Pg | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.86 | 0.17 | <0.0005 | <0.0001 |

# APPENDIX C – TCLP Results

| Sample details | | | | | | TCLP Leach | | | | Leachable Metals by ICPAES | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Sample ID | Depth | Lithology | Weathering | Sample Type | Initial pH | After HCl pH | Extraction Fluid Number | Final pH | Aluminium | Antimony | Arsenic | Cadmium | Chromium | Cobalt | Copper | Iron | Lead | Manganese | Nickel | Selenium | Tin | Zinc | Lithium | Mercury |
| | | | | | | pH Unit | pH Unit | | pH Unit | 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 |
| | | | | | | **0.1** | **0.1** | **1** | **0.1** | **0.1** | **0.1** | **0.1** | **0.05** | **0.1** | **0.1** | **0.1** | **0.1** | **0.1** | **0.1** | **0.1** | **0.05** | **0.1** | **0.1** | **0.001** | **0.001** |
| 10/09/2019 | NRC129 - 4 | 4 | Py | EW | Waste | 6.5 | 1.6 | 1 | 4.9 | 0.9 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.6 | <0.1 | <0.1 | <0.1 | <0.05 | <0.1 | 0.2 | 0.002 | <0.0010 |
| 10/09/2019 | NRC129 - 20 | 20 | Py | MW | Waste | 7.05 | 1.7 | 1 | 4.9 | 0.35 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 1.5 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | 0.2 | 0.0565 | <0.1 |
| 10/09/2019 | NRC129 - 55 | 55 | Py | SW | Waste | 8.5 | 1.7 | 1 | 4.9 | 0.4 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | 0.2 | 1.9 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.2 | 0.151 | <0.0010 |
| 10/09/2019 | NRC129 - 68 | 68 | Sst | Fr | Waste | 8.7 | 1.8 | 1 | 4.9 | 0.9 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 10.3 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.3 | 0.174 | <0.0010 |
| 10/09/2019 | NRC129 - 89 | 89 | Py | Fr | Waste | 8.5 | 1.7 | 1 | 4.9 | 1.2 | <0.1 | 0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 6.8 | <0.1 | 0.2 | 0.1 | <0.05 | <0.1 | 0.2 | 0.206 | <0.0010 |
| 10/09/2019 | NRC129 - 98 | 98 | Pg | Fr | Waste | 8.7 | 1.7 | 1 | 4.9 | 0.7 | <0.1 | 0.6 | <0.05 | <0.1 | <0.1 | <0.1 | 4 | <0.1 | 0.1 | <0.1 | <0.05 | <0.1 | 0.4 | 0.068 | <0.0010 |
| 10/09/2019 | NRC129 - 134 | 134 | Py | Fr | Waste | 9.2 | 1.5 | 1 | 4.9 | 1.5 | <0.1 | 0.3 | <0.05 | <0.1 | <0.1 | <0.1 | 9.8 | 0.3 | 0.4 | 0.1 | <0.05 | <0.1 | 0.3 | 0.519 | <0.0010 |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10/09/2019 | FRC212 - 8 | 8 | Pg | HW | Waste | 8 | 1.4 | 1 | 4.9 | 0.4 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 1.8 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.6 | 0.008 | <0.0010 |
| 10/09/2019 | FRC212 - 15 | 15 | Py | MW | Waste | 8.1 | 1.7 | 1 | 4.9 | 0.2 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.4 | <0.1 | 0.1 | <0.1 | <0.05 | <0.1 | 0.1 | 0.069 | <0.0010 |
| 10/09/2019 | FRC212 - 44 | 44 | Py | MW | Waste | 8.1 | 1.6 | 1 | 4.9 | 0.3 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.4 | <0.1 | 0.4 | <0.1 | <0.05 | <0.1 | 0.1 | 0.064 | <0.0010 |
| 10/09/2019 | FRC212 - 53 | 53 | Pg | MW | Waste | 8 | 1.5 | 1 | 4.9 | 0.6 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 1.6 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.1 | 0.014 | <0.0010 |
| 11/09/2019 | FRC212 - 66 | 66 | Py | SW | Waste | 8.5 | 1.6 | 1 | 4.9 | 0.7 | <0.1 | 0.2 | <0.1 | <0.1 | <0.1 | <0.1 | 8.75 | <0.1 | 0.2 | 0.1 | <0.1 | <0.1 | 0.2 | 0.148 | <0.1 |
| 11/09/2019 | FRC212 - 81 | 81 | Pg | Fr | Waste | 8.5 | 1.6 | 1 | 4.9 | 0.3 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 2.6 | <0.1 | 0.9 | <0.1 | <0.05 | <0.1 | 0.3 | 0.259 | <0.0010 |
| 11/09/2019 | FRC212 - 88 | 88 | Py | Fr | Waste | 8.5 | 1.6 | 1 | 4.9 | 1.1 | <0.1 | 1.2 | <0.05 | <0.1 | <0.1 | <0.1 | 6.5 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.2 | 0.329 | <0.0010 |
| 11/09/2019 | FRC212 - 92 | 92 | Pg | Fr | Waste | 9 | 1.5 | 1 | 4.9 | 0.8 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 7 | <0.1 | 0.3 | <0.1 | <0.05 | <0.1 | 0.4 | 0.205 | <0.0010 |
| 11/09/2019 | FRC212 - 97 | 97 | Pg | Fr | Ore | 9 | 1.5 | 1 | 4.9 | 0.8 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 6.6 | <0.1 | 0.3 | <0.1 | <0.05 | <0.1 | 0.4 | 0.221 | <0.0010 |
| 11/09/2019 | FRC212 - 109 | 109 | Pg | Fr | Ore | 9.2 | 1.5 | 1 | 4.9 | <0.1 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 29.7 | <0.1 | 5.4 | 0.1 | <0.05 | <0.1 | 0.8 | 2.03 | <0.0010 |
| 11/09/2019 | FRC212 - 122 | 122 | Pg | Fr | Ore | 9.3 | 1.5 | 1 | 4.9 | 0.65 | <0.1 | <0.1 | <0.05 | 0.1 | <0.1 | <0.1 | 26.7 | <0.1 | 0.4 | <0.1 | <0.05 | <0.1 | 0.6 | 2.06 | <0.0010 |
| 11/09/2019 | FRC212 - 131 | 131 | Pg | Fr | Waste | 9.1 | 1.5 | 1 | 4.9 | 1 | <0.1 | 0.3 | <0.05 | 0.1 | <0.1 | <0.1 | 20.8 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.6 | 0.17 | <0.0010 |
| 11/09/2019 | FRC212 - 143 | 143 | Py | Fr | Waste | 9 | 1.5 | 1 | 4.9 | 1.9 | <0.1 | 0.2 | <0.05 | <0.1 | <0.1 | <0.1 | 16.5 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.4 | 0.362 | <0.0010 |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11/09/2019 | FRC213 - 5 | 5 | Py | HW | Waste | 8 | 1.6 | 1 | 4.9 | 0.2 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.2 | <0.1 | <0.1 | <0.1 | <0.05 | <0.1 | 0.1 | 0.019 | <0.0010 |
| 11/09/2019 | FRC213 - 26 | 26 | Py | MW | Waste | 7.9 | 1.5 | 1 | 4.9 | 0.2 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.9 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.1 | 0.081 | <0.0010 |
| 11/09/2019 | FRC213 - 37 | 37 | Pg | HW | Waste | 7.9 | 1.6 | 1 | 4.9 | 0.4 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.7 | <0.1 | 1 | <0.1 | <0.05 | <0.1 | 0.3 | 0.046 | <0.0010 |
| 11/09/2019 | FRC213 - 58 | 58 | Py | SW | Waste | 8.3 | 1.6 | 1 | 4.9 | 0.4 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 4.8 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.2 | 0.136 | <0.0010 |
| 11/09/2019 | FRC213 - 62 | 62 | Pg | SW | Waste | 8.2 | 1.6 | 1 | 4.9 | 0.5 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 3.2 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.4 | 0.022 | <0.0010 |
| 11/09/2019 | FRC213 - 67 | 67 | Pg | SW | Waste | 8.3 | 1.7 | 1 | 4.9 | 0.3 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 1.6 | <0.1 | 0.4 | <0.1 | <0.05 | <0.1 | 0.4 | 0.032 | <0.0010 |
| 11/09/2019 | FRC213 - 86 | 86 | Pg | Fr | Waste | 8.75 | 1.6 | 1 | 4.9 | 0.85 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 8 | <0.1 | 0.1 | <0.1 | <0.05 | <0.1 | 0.2 | 0.1905 | <0.0010 |
| 11/09/2019 | FRC213 - 107 | 107 | Sst | Fr | Waste | 8.7 | 1.6 | 1 | 4.9 | 1.4 | <0.1 | 0.2 | <0.05 | <0.1 | <0.1 | <0.1 | 16.2 | <0.1 | 0.3 | <0.1 | <0.05 | <0.1 | 0.3 | 0.274 | <0.0010 |
| 11/09/2019 | FRC213 - 131 | 131 | Py | Fr | Waste | 9 | 1.6 | 1 | 4.9 | 1 | <0.1 | 0.2 | <0.05 | 0.1 | <0.1 | <0.1 | 22.5 | <0.1 | 0.4 | <0.1 | <0.05 | <0.1 | 0.3 | 0.319 | <0.0010 |
| 14/09/2019 | FRC213 - 142 | 142 | Pg | Fr | Ore | 8 | 1.3 | 1 | 5 | 0.4 | <0.1 | 0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 18.2 | <0.1 | 0.7 | <0.1 | <0.05 | <0.1 | 0.3 | 0.467 | <0.0010 |
| 14/09/2019 | FRC213 - 148 | 148 | Pg | Fr | Ore | 8.6 | 1.2 | 1 | 5 | 0.7 | <0.1 | <0.1 | <0.05 | 0.1 | <0.1 | <0.1 | 22.4 | <0.1 | 0.5 | <0.1 | <0.05 | <0.1 | 0.6 | 1.27 | <0.0010 |
| 14/09/2019 | FRC213 - 156 | 156 | Pg | Fr | Ore | 7.7 | 1.3 | 1 | 5.1 | 0.8 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 7.2 | <0.1 | 0.3 | <0.1 | <0.05 | <0.1 | 1.4 | 0.255 | <0.0010 |
| 14/09/2019 | FRC213 - 170 | 170 | Pg | Fr | Ore | 8.9 | 1.3 | 1 | 5.2 | 1.1 | <0.1 | <0.1 | <0.05 | 0.2 | <0.1 | <0.1 | 37.8 | <0.1 | 0.6 | <0.1 | <0.05 | <0.1 | 0.8 | 2.2 | <0.0010 |
| 14/09/2019 | FRC213 - 178 | 178 | Pg | Fr | Ore | 8.8 | 1.3 | 1 | 5 | 0.9 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 12.85 | <0.1 | 1.05 | <0.1 | <0.05 | <0.1 | 0.5 | 1.88 | <0.0010 |
| 14/09/2019 | FRC213 - 187 | 187 | Py | Fr | Waste | 8.8 | 1.2 | 1 | 5.2 | 2 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 9.6 | 0.2 | 0.3 | <0.1 | <0.05 | <0.1 | 0.6 | 0.291 | <0.0010 |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| 14/09/2019 | FRC214 - 6 | 6 | Py | CW | Waste | 7.4 | 1.3 | 1 | 4.9 | 0.2 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.1 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.1 | 0.022 | <0.0010 |
| 14/09/2019 | FRC214 - 13 | 13 | Py/Qv | HW | Waste | 7.4 | 1.4 | 1 | 4.9 | 0.2 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.1 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.2 | 0.024 | <0.0010 |
| 14/09/2019 | FRC214 - 20 | 20 | Py | CW | Waste | 6.2 | 1.3 | 1 | 4.9 | 0.2 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.05 | <0.1 | 0.1 | 0.02 | <0.0010 |
| 14/09/2019 | FRC214 - 34 | 34 | Py | HW | Waste | 6.4 | 1.3 | 1 | 4.9 | 0.3 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 5 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.1 | 0.086 | <0.0010 |
| 14/09/2019 | FRC214 - 45 | 45 | Py | MW | Waste | 6.9 | 1.3 | 1 | 4.9 | 0.3 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 4 | <0.1 | 0.3 | <0.1 | <0.05 | <0.1 | 0.1 | 0.081 | <0.0010 |
| 14/09/2019 | FRC214 - 50 | 50 | Py | SW | Waste | 7.6 | 1.3 | 1 | 4.9 | 0.8 | <0.1 | 0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 11.8 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.2 | 0.106 | <0.0010 |
| 14/09/2019 | FRC214 - 74 | 74 | Py | Fr | Waste | 7.9 | 1.3 | 1 | 4.9 | 0.6 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 12.4 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.1 | 0.17 | <0.0010 |
| 14/09/2019 | FRC214 - 102 | 102 | Pg | Fr | Ore | 8.4 | 1.4 | 1 | 5 | 0.8 | <0.1 | <0.1 | <0.05 | 0.2 | <0.1 | <0.1 | 37.6 | <0.1 | 1.2 | 0.1 | <0.05 | <0.1 | 0.6 | 1.09 | <0.0010 |
| 14/09/2019 | FRC214 - 116 | 116 | Pg | Fr | Waste | 8.2 | 1.4 | 1 | 4.9 | 1.3 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 12 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.5 | 0.213 | <0.0010 |

# APPENDIX D – Naturally Occurring Radioactive Materials (NORM)

| Sample details | | | | | | NORM | |
|---|---|---|---|---|---|---|---|
| Sample Date | Sample ID | Depth | Lithology | Weathering | Sample Type | Radeye B20 Contamination Meter Alpha/Beta/Gamma SN 32215 Calibrated 15/04/19 | |
| | | | | | | µSv/h | mSv/yr[1] |
| | | | | | | Bkd 0.10 | 0.22 |
| 10/09/2019 | NRC129 - 4 | 4 | Py | EW | Waste | 0.14 | 0.30 |
| 10/09/2019 | NRC129 - 20 | 20 | Py | MW | Waste | 0.13 | 0.27 |
| 10/09/2019 | NRC129 - 55 | 55 | Py | SW | Waste | 0.14 | 0.30 |
| 10/09/2019 | NRC129 - 68 | 68 | Sst | Fr | Waste | 0.13 | 0.28 |
| 10/09/2019 | NRC129 - 89 | 89 | Py | Fr | Waste | 0.12 | 0.26 |
| 10/09/2019 | NRC129 - 98 | 98 | Pg | Fr | Waste | 0.14 | 0.30 |
| 10/09/2019 | NRC129 - 134 | 134 | Py | Fr | Waste | 0.15 | 0.32 |
| | | | | | | | |
| 10/09/2019 | FRC212 - 8 | 8 | Pg | HW | Waste | 0.16 | 0.35 |
| 10/09/2019 | FRC212 - 15 | 15 | Py | MW | Waste | 0.14 | 0.30 |
| 10/09/2019 | FRC212 - 44 | 44 | Py | MW | Waste | 0.15 | 0.32 |
| 10/09/2019 | FRC212 - 53 | 53 | Pg | MW | Waste | 0.12 | 0.26 |
| 11/09/2019 | FRC212 - 66 | 66 | Py | SW | Waste | 0.18 | 0.38 |
| 11/09/2019 | FRC212 - 81 | 81 | Pg | Fr | Waste | 0.22 | 0.48 |
| 11/09/2019 | FRC212 - 88 | 88 | Py | Fr | Waste | 0.20 | 0.43 |
| 11/09/2019 | FRC212 - 92 | 92 | Pg | Fr | Waste | 0.15 | 0.32 |
| 11/09/2019 | FRC212 - 97 | 97 | Pg | Fr | Ore | 0.11 | 0.24 |
| 11/09/2019 | FRC212 - 109 | 109 | Pg | Fr | Ore | 0.17 | 0.37 |
| 11/09/2019 | FRC212 - 122 | 122 | Pg | Fr | Ore | 0.17 | 0.37 |
| 11/09/2019 | FRC212 - 131 | 131 | Pg | Fr | Waste | 0.15 | 0.32 |
| 11/09/2019 | FRC212 - 143 | 143 | Py | Fr | Waste | 0.17 | 0.37 |
| | | | | | | | |
| 11/09/2019 | FRC213 - 5 | 5 | Py | HW | Waste | 0.13 | 0.28 |
| 11/09/2019 | FRC213 - 26 | 26 | Py | MW | Waste | 0.17 | 0.37 |
| 11/09/2019 | FRC213 - 37 | 37 | Pg | HW | Waste | 0.14 | 0.30 |
| 11/09/2019 | FRC213 - 58 | 58 | Py | SW | Waste | 0.13 | 0.28 |
| 11/09/2019 | FRC213 - 62 | 62 | Pg | SW | Waste | 0.16 | 0.35 |
| 11/09/2019 | FRC213 - 67 | 67 | Pg | SW | Waste | 0.17 | 0.37 |
| 11/09/2019 | FRC213 - 86 | 86 | Pg | Fr | Waste | 0.14 | 0.30 |
| 11/09/2019 | FRC213 - 107 | 107 | Sst | Fr | Waste | 0.16 | 0.35 |
| 11/09/2019 | FRC213 - 131 | 131 | Py | Fr | Waste | 0.17 | 0.37 |
| 14/09/2019 | FRC213 - 142 | 142 | Pg | Fr | Ore | 0.11 | 0.24 |
| 14/09/2019 | FRC213 - 148 | 148 | Pg | Fr | Ore | 0.14 | 0.30 |
| 14/09/2019 | FRC213 - 156 | 156 | Pg | Fr | Ore | 0.15 | 0.32 |
| 14/09/2019 | FRC213 - 170 | 170 | Pg | Fr | Ore | 0.13 | 0.28 |
| 14/09/2019 | FRC213 - 178 | 178 | Pg | Fr | Ore | 0.17 | 0.36 |
| 14/09/2019 | FRC213 - 187 | 187 | Py | Fr | Waste | 0.19 | 0.41 |

| Sample details | | | | | | NORM | |
|---|---|---|---|---|---|---|---|
| Sample Date | Sample ID | Depth | Lithology | Weathering | Sample Type | Radeye B20 Contamination Meter Alpha/Beta/Gamma SN 32215 Calibrated 15/04/19 | |
| | | | | | | µSv/h | mSv/yr[1] |
| | | | | | | **Bkd 0.10** | **0.22** |
| 14/09/2019 | FRC214 - 6 | 6 | Py | CW | Waste | 0.22 | 0.48 |
| 14/09/2019 | FRC214 - 13 | 13 | Py/Qv | HW | Waste | 0.21 | 0.45 |
| 14/09/2019 | FRC214 - 20 | 20 | Py | CW | Waste | 0.15 | 0.32 |
| 14/09/2019 | FRC214 - 34 | 34 | Py | HW | Waste | 0.15 | 0.32 |
| 14/09/2019 | FRC214 - 45 | 45 | Py | MW | Waste | 0.19 | 0.41 |
| 14/09/2019 | FRC214 - 50 | 50 | Py | SW | Waste | 0.16 | 0.35 |
| 14/09/2019 | FRC214 - 74 | 74 | Py | Fr | Waste | 0.14 | 0.30 |
| 14/09/2019 | FRC214 - 102 | 102 | Pg | Fr | Ore | 0.18 | 0.39 |
| 14/09/2019 | FRC214 - 116 | 116 | Pg | Fr | Waste | 0.12 | 0.26 |

1. Calculated assuming exposure across a 1 year period using a 45 h working week on average

# APPENDIX E – Soil Characterisation

**APPENDIX E: Soil characterisation**

| Parameter | Units | LOR | NRC129 - 0 | FRC212 - 0 | FRC213 - 0 | FRC214 - 0 |
|---|---|---|---|---|---|---|
| **Sample Location** | | | | | | |
| Easting | | | 694439 | 694384 | 694362 | 694455 |
| Northing | | | 8593567 | 8593490 | 8593491 | 8593410 |
| **Sample Description** | | | | | | |
| Depth | | | 0 | 0 | 0 | 0 |
| Lithology | | | Soil (SO) | Soil (SO) | Soil (SO) | Soil (SO) |
| Color | | | Dark Gray | Light Olive Brown | Grayish Brown | Dark Gray |
| Texture | | | Sandy Loam | Sandy Clay Loam | Clay Loam | Loamy Sand |
| Weathering | | | Completely Weathered | Completely Weathered | Completely Weathered | Completely Weathered |
| **General** | | | | | | |
| Bulk Density | kg/m3 | 1 | 3180 | 3170 | 3160 | 2030 |
| Moisture Content | % | 0.1 | 3 | 0.4 | 1.1 | <0.1 |
| Emerson Class Number | | | 7 | 7 | 7 | 7 |
| pH Value | pH Unit | 0.1 | 5.7 | 5.7 | 5.8 | 5.3 |
| Electrical Conductivity @ 25Â°C | ÂµS/cm | 1 | 17 | 33 | 17 | 14 |
| **Particle sizing** | | | | | | |
| +75Âµm | % | 1 | 67 | 61 | ---- | 65 |
| +150Âµm | % | 1 | 37 | 36 | ---- | 26 |
| +300Âµm | % | 1 | 19 | 26 | ---- | 8 |
| +425Âµm | % | 1 | 16 | 25 | ---- | 5 |
| +600Âµm | % | 1 | 14 | 24 | ---- | 3 |
| +1180Âµm | % | 1 | 13 | 22 | ---- | <1 |
| +2.36mm | % | 1 | 12 | 19 | ---- | <1 |
| +4.75mm | % | 1 | 10 | 14 | ---- | <1 |
| +9.5mm | % | 1 | 2 | 2 | ---- | <1 |
| +19.0mm | % | 1 | <1 | <1 | ---- | <1 |
| +37.5mm | % | 1 | <1 | <1 | ---- | <1 |
| +75.0mm | % | 1 | <1 | <1 | ---- | <1 |
| **Classification based on particle size** | | | | | | |
| Clay (<2 Âµm) | % | 1 | 11 | 9 | ---- | 7 |
| Silt (2-60 Âµm) | % | 1 | 18 | 23 | ---- | 22 |
| Sand (0.06-2.00 mm) | % | 1 | 59 | 48 | ---- | 71 |
| Gravel (>2mm) | % | 1 | 12 | 20 | ---- | <1 |
| Cobbles (>6cm) | % | 1 | <1 | <1 | ---- | <1 |
| **Exchangeable Cations** | | | | | | |
| Cation Exchange Capacity | meq/100g | 0.1 | 0.6 | 0.9 | 0.6 | 0.3 |
| Exchangeable Calcium | meq/100g | 0.1 | 0.2 | 0.4 | 0.2 | <0.1 |
| Exchangeable Magnesium | meq/100g | 0.1 | 0.4 | 0.4 | 0.4 | 0.2 |
| Exchangeable Potassium | meq/100g | 0.1 | <0.1 | 0.1 | <0.1 | <0.1 |
| Exchangeable Sodium | meq/100g | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Exchangeable Aluminium | meq/100g | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Exchangeable Sodium Percentage | % | 0.1 | n/a | n/a | n/a | n/a |
| Calcium/Magnesium Ratio | | 0.1 | 0.5 | 1 | 0.5 | n/a |
| **Total Metals by ICP-MS** | | | | | | |
| Arsenic | mg/kg | 0.1 | 6 | 14.9 | 5.7 | 0.8 |
| Cadmium | mg/kg | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Chromium | mg/kg | 0.1 | 5.1 | 12.3 | 6 | 1.9 |
| Copper | mg/kg | 0.1 | 2.5 | 5.2 | 2.9 | 0.9 |
| Nickel | mg/kg | 0.1 | 2.4 | 4.7 | 3 | 0.9 |
| Lead | mg/kg | 0.1 | 4.3 | 5.6 | 4.1 | 1.8 |
| Zinc | mg/kg | 0.5 | 3.9 | 11.7 | 6.5 | 1.7 |
| Lithium | mg/kg | 0.1 | 7.6 | 33.1 | 13.9 | 7 |
| Tin | mg/kg | 0.1 | 0.8 | 0.8 | 0.6 | 0.4 |
| Mercury | mg/kg | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **Nutrients** | | | | | | |
| Nitrite + Nitrate as N (Sol.) | mg/kg | 0.1 | 0.7 | <0.1 | <0.1 | 0.3 |
| Total Kjeldahl Nitrogen as N | mg/kg | 20 | 790 | 780 | 470 | 410 |
| Total Nitrogen as N | mg/kg | 20 | 790 | 780 | 470 | 410 |
| Bicarbonate Ext. P (Colwell) | mg/kg | 5 | <5 | <5 | <5 | <5 |
| Bicarbonate Extractable K (Colwell) | mg/kg | 100 | 129 | 135 | 341 | <100 |
| KCl Extractable Sulfur (23Ce) | % S | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| **Organic Matter** | | | | | | |
| Organic Matter | % | 0.5 | 2 | 1.3 | 1.3 | 1 |
| Total Organic Carbon | % | 0.5 | 1.1 | 0.8 | 0.7 | 0.6 |

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# Static Geochemical Testing of Mine Wastes & Ore

Finniss Lithium Project BP33 UG Mine

S1312 / J000662 / R1428

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DOCUMENT NUMBER: S1312 / J000662 / R1428

# Static Geochemical Testing of Mine Wastes & Ore

## FINNISS LITHIUM PROJECT BP33 UG MINE

| DOCUMENT STATUS AND REVIEW | | | | |
|---|---|---|---|---|
| **REV:** | **DESCRIPTION:** | **AUTHOR:** | **AUTHORISED BY:** | **DATE:** |
| 0 | First Issue | RS | WAS | 05/07/2021 |
| 1 | Final Report | RS | WAS | 14/07/2021 |
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# LIST OF ABBREVIATIONS

## ABBREVIATIONS USED IN GEOCHEMICAL ASSESSMENT

| | |
|---|---|
| **ARD** | Acid Rock Drainage |
| **AMD** | Acid, Metalliferous and Saline Drainage |
| **NMD** | Neutral and Metalliferous Drainage |
| **ABA** | Acid Base Account |
| **$pH_{1:2}$** | pH of a sample slurry with a solid to water ratio of 1:2 (by weight) |
| **$EC_{1:2}$** | Electrical Conductivity of a sample slurry with a solid to water ratio of 1:2 (by weight) |
| **ESP** | Exchangeable Sodium Percentage |
| **ECEC** | Effective Cation Exchange Capacity |
| **S** | Sulphur |
| **CRS** | Chromium Reducible Sulphur |
| **KCl** | Potassium Chloride |
| **$H_2SO_4$** | Sulphuric Acid |
| **$SO_4$** | Sulphate |
| **$CaCO_3$** | Calcium Carbonate |
| **ANC** | Acid Neutralising Capacity in kg $H_2SO_4$/t |
| **$ANC_{ABCC}$** | Acid Neutralising Capacity in kg $H_2SO_4$/t estimated from ABCC testing |
| **CNV** | Carbonate Neutralising Value in kg $H_2SO_4$/t |
| **MPA** | Maximum Potential Acidity, calculated from total S in kg $H_2SO_4$/t |
| **NAPP** | Net Acid Producing Potential, calculated from ANC and total S (or MPA) in kg $H_2SO_4$/t. |
| **NAG** | Net Acid Generation (test) |
| **NAGpH** | pH of NAG solution before titration |
| **$NAG_{(pH4.5)}$** | NAG acidity titrated to pH 4.5 in kg $H_2SO_4$/t |
| **$NAG_{(pH7.0)}$** | NAG acidity titrated to pH 7.0 in kg $H_2SO_4$/t |
| **ABCC** | Acid Buffering Characteristic Curve |
| **GAI** | Geochemical Abundance Index based on multi-elements of solids |
| **PAF** | Potentially Acid Forming |
| **PAF-LC** | Potentially Acid Forming - Low Capacity |
| **NAF** | Non Acid Forming |
| **UC** | Uncertain |
| **AC** | Acid Consuming |

## UNITS OF MEASUREMENTS

| | |
|---|---|
| **%** | Percentage |
| **°C** | Degrees Celsius |
| **dS** | Deci Siemen |
| **µm** | Micrometre |
| **mm** | Millimetre |
| **m** | Metre |
| **mg** | Milligram |
| **g** | Gram |
| **kg** | Kilogram |
| **t** | Tonne |
| **L** | Litre |
| **ml** | Millilitre |

## OTHER ABBREVIATIONS

| | |
|---|---|
| **ALS** | Australian Laboratory Services |
| **EGi** | Environmental Geochemistry International Pty Ltd |
| **IRL** | International Resource Laboratories Pty Ltd |
| **Project** | Hunter Valley Operations Life-of-Mine Project |
| **ROM** | Run-of-Mine |

# EXECUTIVE SUMMARY

Previously, Environmental Geochemistry International Pty Ltd (EGi) were commissioned by EcOz Environmental Consultants to undertake data analysis, interpretation and reporting on physical and geochemical analysis results for drill core samples collected from the Core Lithium BP33 project. The results of this study were included in Core Lithium's submissions for mining approvals. The results from the initial test programme suggested that most waste rock, including oxide rock excavated during installation of a box cut portal, transitional and fresh rock excavated during construction of the mine decline and ore that will be mined during the project, will present little risk of acid or saline drainage. However, these investigations identified the potential for some potentially acid forming (PAF) waste, particularly in fresh phyllite rock. Results also suggested that both oxide and fresh rock may contain labile aluminium, arsenic and zinc which could be leached during surface storage.

In the NT EPA's response to the referral document, a Supplementary Environmental Report (SER) was requested. In relation to waste rock characterisation, their response requested that the additional studies should be undertaken and reported as a part of the SER. Consequently, EcOZ who are coordinating the SER on behalf of Core Lithium, requested EGi to undertake the following studies.

1. Complete ANC and NAG testing on selected samples from drill holes FRC166 – FRC171, focusing on, but not exclusively, samples with sulphur content >0.2 %S. Ideally all fresh and transitional waste rock from the 2018 drill holes should be included in the test program.
2. Kinetic testing (leach columns) of oxidised and fresh rock samples to confirm initial results of aluminium, arsenic and zinc leachability and to define the kinetics of this process. Kinetic leach column (KLC) testing conducted under oxidising conditions to simulate conditions during storage in the waste rock dumps (WRD) and in the unsaturated zones within the backfilled UG mine and box cut. Following a period of leaching under oxidising conditions, KLC tests will be conducted under saturated conditions to simulate the leaching properties of backfilled waste which will be placed below the water table upon rebound.

At the time of the current study, samples from the previous investigations were no longer available for further testing. Consequently, an alternate set of 69 samples were obtained from drilling programmes conducted during 2018 and 2019, from which 47 samples were selected for detailed static geochemical testing to meet the requirements of Task 1.

During December 2020 and January 2021, Core Lithium undertook further drilling at the BP33 project. This programme included three diamond drill holes, two of which intersected waste rock to a depth of around 70 m, which will be excavated during construction of the box cut. A third hole to a depth around 350 m, and intersecting waste rock and ore which will be mined during development of the decline and ore extraction, was also drilled as a part of this programme. Twenty-nine samples were obtained from these three drill holes to investigate the suitability of these materials for kinetic testing to meet the requirements of Task 2.

This report provides results for test work conducted for Task 1 above. From these results, criteria were developed to distinguish between non-acid forming (NAF), potentially acid forming – low capacity (PAF-LC) and PAF waste rock and ore. Using these criteria, and a database containing assay data and geological descriptions for over 2500 samples from the BP33 deposit, volumes of NAF, PAF-LC and PAF waste and ore were estimated.

The report also describes results from batch leaching tests under both oxidising and non-oxidising conditions to better define the likely quality of seepage from waste rock stockpiles. These tests can provide insight into elements of concern that may be potentially mobilised during surface storage, but they do not provide understanding of rates of reactivity and likely mobility of various metals and metalloids under field conditions. To obtain this information longer-term leach column testing is being conducted which provides insight into the rate of reactions under conditions

which are closer to field conditions than are provided in the short-term batch leach tests. Column leach tests have now commenced and are expected to be completed in around 12 months.

Preliminary testing was also undertaken on oxide, transition and fresh waste rock samples to define their geochemical properties and to ascertain the representativeness of these materials of waste rock which will be stockpiled in WRD and then backfilled in mine voids, and thereby their suitability for KLC testing (Task 2). Results for this preliminary testing are also reported.

Based on the results of geochemical testing of 144 samples from both the current and earlier test programmes, criteria were developed to identify NAF, PAF-LC and PAF waste rock and ore. These criteria are summarised in the table below. The criteria rely on oxidation and Total S content to classify mined materials according to their acid forming potential. While it is anticipated that there will be some overlap between the classifications, it is expected that the listed criteria can be used to provide a reasonable segregation of waste rock and ore according to their likelihood to produce acid as a consequence of exposure to air during surface storage.

The assay database was analysed to define the distribution of Total S among the various categories of materials including type (ore, waste), lithology and oxidation for waste rock samples. The results show that 99.8% of the sample interval represented by ore samples contain less than 0.2% Total S, supporting the acid rock drainage (ARD) classification criteria suggesting all ore can be classified as NAF. Similarly, 100% of the sample intervals representing oxide rock had a Total S content of below 0.2%, also supporting the classification of all oxide rock as NAF.

| **ARD Classification** | **Criteria** |
|---|---|
| NAF | Ore *OR*<br>Oxide waste rock *OR*<br>Transition and fresh waste rock with Total S <0.2% |
| PAF-LC | Transition and fresh waste rock with Total S ≥0.2% and <0.4% |
| PAF | Transition and fresh waste rock with Total S ≥0.4% |

Calculations used to estimate volumes of waste rock and ore indicated that the ARD properties of mined materials at the BP33 projects can be summarised as follows:

- Oxide rock excavated from the box cut and which will be placed in WRD1 is expected to be NAF;
- Ore that will be stored in the ROM pad while awaiting transport to the processing plant is expected to be NAF; and
- Estimates indicate that only around 15,000 tonnes of PAF-LC and PAF waste will be moved to WRD2 through the life of the mine out of a total of 229,000 tonnes of transition and fresh waste rock which will be mined, with most of the 15,000 tonnes likely to be classified as PAF-LC with limited acid producing potential.

These results suggest that all of the stockpiled mine materials (oxide waste in WRD1, transition and fresh waste in WRD2, ore in the ROM pad) will present little risk of producing acidic metalliferous drainage as a result of short-term surface storage during the mining operation.

The results of water extraction tests conducted on ore samples showed:

- Water extracts for the ore samples were slightly alkaline with low salinity;

- Except for Al and Fe, metal and metalloid concentrations were non-detectable in almost all of the water extracts of the ore samples;
- On average, concentrations of Al in ore water extracts were about an order of magnitude higher than the default ANZECC guideline values (DGV) for freshwater systems. Similarly, the concentrations of Al in ore water extracts were in the order of ten times those measured in both nearby surface water and shallow groundwater at the adjacent Grants project. These results suggest that Al in run-off from ore stockpiled in the ROM pad may present an environmental risk; and
- As the ore samples are all likely to be NAF and therefore unlikely to produce acidic drainage, stockpiled ore may not require any specific management to reduce potential impacts from run-off. However, since the results from water extractions indicate a potential risk from elevated Al concentrations in run-off, the likelihood of this risk should be evaluated at site, and it is recommended that any run-off from the ROM stockpile should be monitored and containment of run-off undertaken as required.

The results of water extraction tests conducted on waste rock samples showed:

- Oxide waste rock stored in WRD1, or transition and fresh waste rock stored in WRD2 would be unlikely to produce low pH saline seepage during short-term surface storage.
- The mobility of Al in all waste rock and As in fresh waste rock on contact with water, could potentially result in elevated concentrations of these elements in seepage from WRD1 (Al only) and WRD2 (Al and As) during short-term surface storage.
- Concentrations of As in water extracts of transition and fresh waste rock were of a similar magnitude to those measured in the groundwater collected from bores sampling the deeper aquifer within the Burrell Creek Formation (BCF) at the nearby Grants project. These results suggest that, on backfilling the mine with fresh waste rock that has not undergone extensive weathering, groundwater should not be significantly impacted in terms of mobilisation of As.

The results from kinetic leach column testing will help to confirm if leaching of Al and As from waste rock has the potential to provide any risk to the environment during surface storage in the WRD.

The results of peroxide extraction tests conducted on waste rock samples showed:

- Should substantial oxidation of fresh waste rock occur during surface storage, the concentrations of a number of metals/metalloids including Al, As, Co, Cr, Cu, U and Zn may by elevated in comparison to desirable environmental conditions, and seepage from the WRD could potentially represent a risk of contaminating the receiving environment.

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.

Comparison of the combined geochemical test results for the oxide, transition and fresh composite waste rock samples proposed for use in KLC testing with results for the corresponding waste types from all drill holes, suggests that these composite samples are representative of waste to be stored in the WRD at the BP33 project. Kinetic leach column tests using these samples should therefore deliver results which will provide a good indication of the quality of seepage that may result during surface storage of waste and the mobility of solutes in the waste following backfill and inundation by recovering groundwater.

The following recommendations follow from the results of this study:

- Kinetic leach column tests should be completed as proposed including operation under oxidising conditions to simulate conditions during storage in the WRD and in the unsaturated zones within the backfilled UG mine and box cut. Following a period of leaching under oxidising conditions, KLC tests should be continued under saturated conditions to simulate the leaching properties of backfilled waste which will be placed below the water table upon rebound.
- Groundwater monitoring t BP33 (both shallow alluvial and deeper BCF aquifers) should be on-going to provide baseline water quality data for comparison with column leachate data collected during leach column testing.
- Similarly, collection of surface water quality should continue to provide baseline water quality data for comparison with KLC test results.
- The results from static and kinetic geochemical testing should be used to conduct an ARD/Neutral Mine Drainage (NMD) risk assessment which can be applied in developing an ARD/NMD management plan for the operation.

# 1. INTRODUCTION

The BP33 deposit is a part of Core's Finniss Lithium Project, located in the Northern Territory on the Cox Peninsula, approximately 23 km southwest of Darwin or 90 km by road. The BP33 proposal involves excavation of a box cut portal to a depth of 60 m and construction of a 400 m long decline from the base of the box cut to access the spodumene deposit located beneath the historically worked open pit.

Two separate waste rock dumps (WRD) will be established for temporary storage of waste rock prior to it being used to backfill the underground mine and box-cut. WRD 1 with a design capacity of 2 million $m^3$ will accept oxide waste rock excavated from the box-cut. WRD 2 with a design capacity of 170,000 $m^3$ will accept transitional and fresh waste rock from the underground. Waste rock from WRD2 will be used to progressively backfill the underground mine as each production level is complete to maintain stability as the mine progresses. Ore mined at BP33 will be transported to the Grants processing facility approximately 7 km to the north-west. A ROM pad will be constructed for temporary storage of mined ore ready for transport to the Grants processing facility. Tailings will be deposited in the Tailings Storage Facility constructed as part of the Grants Project.

Previously, Environmental Geochemistry International Pty Ltd (EGi) were commissioned by EcOz Environmental Consultants to undertake data analysis, interpretation and reporting on physical and geochemical analysis results for drill core samples collected from the Core Lithium BP33 project. This work formed a part of an Environment Protection Act Referral submitted to the NT Environmental Protection Authority (NT EPA) in April 2020 for development of the BP33 Underground mine.

The results from the initial test programme suggested that most waste rock, including oxide and transitional rock excavated during installation of a box cut portal, transitional and fresh rock excavated during construction of the mine decline and ore that will be mined during the project, will present little risk of acid or saline drainage. However, these investigations identified the potential for some potentially acid forming (PAF) waste, particularly in fresh phyllite rock. Results also suggested that both oxide and fresh rock may contain labile aluminium, arsenic and zinc which could be leached during surface storage. As a result of these investigations, EGi recommended the following test work should be conducted to clarify potential environmental issues raised from the study:

- Complete ANC and NAG testing on selected samples from drill holes FRC166 – FRC171, focusing on, but not exclusively, samples with sulphur content >0.2 %S. Ideally all fresh and transitional waste rock from the 2018 drill holes should be included in the test program.
- Kinetic testing (leach columns) of oxidised and fresh rock samples to confirm initial results of aluminium, arsenic and zinc leachability and to define the kinetics of this process. Kinetic leach column (KLC) testing should be conducted under oxidising conditions to simulate conditions during storage in the WRD and in the unsaturated zones within the backfilled UG mine and box cut. Following a period of leaching under oxidising conditions, KLC tests should be conducted under saturated conditions to simulate the leaching properties of backfilled waste which will be placed below the water table upon rebound.

In the NT EPA's response to the referral document, a Supplementary Environmental Report (SER) was requested. In relation to waste rock characterisation, their response requested that the additional studies outlined above should be undertaken and reported as a part of the SER. Consequently, EcOZ who are coordinating the SER on behalf of Core Lithium, requested EGi to undertake the required studies as described in Attachment A, Section 8 Terrestrial environmental quality in the NT EPA referral response.

At the time of the current study, samples from the previous investigations were no longer available for further testing. Consequently, an alternate set of 69 samples were obtained from drilling programmes conducted during 2018 and 2019, from which 47 samples were selected for detailed static geochemical testing. Samples were selected from both waste and ore and covered a range of lithologies, including phyllite, pegmatite and sandstone, focusing on fresh rock with a sulphur content above 0.1%, which were under-represented in the initial geochemical tests and in accordance with the testing requirements of the NT EPA response.

During December 2020 and January 2021, Core Lithium undertook further drilling at the BP33 project. This programme was designed to provide samples for geotechnical testing, and included three diamond drill holes, two of which intersected waste rock to a depth of around 70 m, which will be excavated during construction of the box cut. A third hole to a depth around 350 m, and intersecting waste rock and ore which will be mined during development of the decline and ore extraction, was also drilled as a part of this programme. Twenty nine samples were obtained from these three drill holes to investigate the suitability of these materials for kinetic testing which requires crushed rock available from diamond drill core. Based on assay data, four oxide samples, four transition samples and five fresh samples were composited to produce oxide, transition and fresh rock samples, which subsequently underwent geochemical testing together with the 47 samples selected from earlier drill holes. The results from testing of the three composite samples were used to confirm these samples are likely to be representative of oxide, transition and fresh waste rock which will be temporarily surface stored in WRD prior to return to the underground mine and box cut. Kinetic testing is planned using oxide, transition and fresh rock in accordance with the testing requirements of the NT EPA referral response.

This report describes results of static geochemical testing conducted using fresh waste rock and ore samples, focusing on samples with a sulphur content above 0.1%. The results of this study were then combined with the results from geochemical tests conducted previously, in which most samples contained limited sulphur (<0.1%). Using the combined data set containing 144 samples, criteria were developed to allow identification of non-acid forming (NAF), potentially acid forming – low capacity (PAF-LC) and PAF materials, based around oxidation, type (waste, ore) and Total S content. Using these criteria and a database containing assay data and geological descriptions for around 2500 samples, volumes of NAF, PAF-LC and PAF waste rock and ore were estimated.

Ten samples of fresh higher S waste rock, including the three composite samples selected as potential candidates for kinetic testing, were subjected to batch leaching tests, using water to assess leachability of newly deposited waste, and peroxide to assess leaching from oxidised waste following surface exposure. The results from these leaching tests, which included NAF, PAF-LC and PAF wastes, where then combined with batch water leaching tests from the earlier test programme and which comprised almost exclusively NAF wastes and ore, to assess the leaching characteristics of waste rock and ore as a function of oxidation, lithology and ARD classification.

Finally, results from geochemical testing of the oxide, transition and fresh waste rock composite samples, including acid base accounting (ABA), net acid generation (NAG) testing, assay data and water and peroxide leaching experiments are described and compared with the results from the wider sample set, to evaluate how likely these composite materials are to represent materials which will be mined during the BP33 project and assess their suitability for kinetic testing.

# 2. STATIC GEOCHEMICAL TESTING

A number of pulp samples from previous drilling campaigns were available for the current test work. From this set of samples, a set of 47 samples were selected for detailed static geochemical testing. Samples were selected from both waste and ore and covered a range of lithologies, including phyllite, pegmatite and sandstone, focusing on fresh rock with a sulphur content above 0.1% (Table 1), which were under-represented in the initial geochemical tests. Figures 1 and 2 show plan and section views of the drill traces for the drill holes in relation to the ore body from which samples were selected.

*Table 1: Details of the samples used for current static geochemical test programme*

| EGi Code | Hole ID | Sample ID | Depth (m) | | Interval (m) | Lithology | Oxidation | Type |
|---|---|---|---|---|---|---|---|---|
| | | | From | To | | | | |
| 21086 | FDD008 | B1174 | 326 | 327 | 1.0 | Phyllite | Fresh | Waste |
| 21087 | FRC164 | A3428 | 139 | 140 | 1.0 | Pegmatite | Fresh | Waste |
| 21088 | FRC164 | A3429 | 140 | 141 | 1.0 | Pegmatite | Fresh | Waste |
| 21089 | FRC164 | A3430 | 141 | 142 | 1.0 | Pegmatite | Fresh | Ore |
| 21090 | FRC164 | A3435 | 145 | 148 | 3.0 | Phyllite | Fresh | Waste |
| 21091 | FRC166 | A3512 | 212 | 213 | 1.0 | Phyllite | Fresh | Waste |
| 21093 | FRC167 | A3515 | 124 | 125 | 1.0 | Pegmatite | Fresh | Waste |
| 21094 | FRC167 | A3516 | 125 | 126 | 1.0 | Pegmatite | Fresh | Waste |
| 21095 | FRC167 | A3517 | 126 | 129 | 3.0 | Phyllite | Fresh | Waste |
| 21097 | FRC168 | A3627 | 108 | 109 | 1.0 | Phyllite | Fresh | Waste |
| 21098 | FRC168 | A4408 | 109 | 110 | 1.0 | Phyllite | Fresh | Waste |
| 21099 | FRC168 | A4409 | 110 | 111 | 1.0 | Phyllite | Fresh | Waste |
| 21101 | FRC169 | A3629 | 66 | 69 | 3.0 | Phyllite | Fresh | Waste |
| 21102 | FRC169 | A3630 | 69 | 70 | 1.0 | Phyllite | Fresh | Waste |
| 21103 | FRC169 | A3632 | 70 | 71 | 1.0 | Phyllite | Fresh | Waste |
| 21106 | FRC172 | A3764 | 186 | 187 | 1.0 | Pegmatite | Fresh | Waste |
| 21107 | FRC172 | A3795 | 219 | 222 | 3.0 | Phyllite | Fresh | Waste |
| 21108 | FRC172 | A3796 | 222 | 223 | 1.0 | Phyllite | Fresh | Waste |
| 21109 | FRC172 | A3797 | 223 | 224 | 1.0 | Phyllite | Fresh | Waste |
| 21110 | FRC172 | A3798 | 224 | 225 | 1.0 | Pegmatite | Fresh | Waste |
| 21112 | FRC174 | A3972 | 190 | 191 | 1.0 | Phyllite | Fresh | Waste |
| 21114 | FRC203 | C3610 | 81 | 82 | 1.0 | Sandstone | Fresh | Waste |
| 21115 | FRC205 | C3617 | 138 | 141 | 3.0 | Sandstone | Fresh | Waste |
| 21116 | FRC205 | C3669 | 184 | 185 | 1.0 | Pegmatite | Fresh | Ore |
| 21118 | FRC205 | C3696 | 207 | 208 | 1.0 | Pegmatite | Fresh | Ore |
| 21119 | FRC205 | C3697 | 208 | 209 | 1.0 | Pegmatite | Fresh | Waste |
| 21122 | FRC205 | C3709 | 218 | 219 | 1.0 | Pegmatite | Fresh | Waste |
| 21123 | FRC206 | C3782 | 137 | 138 | 1.0 | Phyllite | Fresh | Waste |
| 21125 | FRC212 | A6714 | 88 | 89 | 1.0 | Phyllite | Fresh | Waste |
| 21126 | FRC213 | A6787 | 68 | 69 | 1.0 | Phyllite | Transition | Waste |
| 21129 | FRCD016 | B1053 | 276.2 | 277 | 0.8 | Phyllite | Fresh | Waste |
| 21130 | NRC057 | A4851 | 105 | 106 | 1.0 | Phyllite | Fresh | Waste |
| 21132 | NRC057 | A4854 | 108 | 109 | 1.0 | Phyllite | Fresh | Waste |
| 21134 | NRC057 | A4857 | 111 | 112 | 1.0 | Phyllite | Fresh | Waste |
| 21135 | NRC057 | A4858 | 112 | 113 | 1.0 | Pegmatite | Fresh | Waste |
| 21138 | NRC057 | A4869 | 122 | 123 | 1.0 | Sandstone | Fresh | Waste |
| 21140 | NRC057 | A4873 | 125 | 126 | 1.0 | Pegmatite | Fresh | Waste |
| 21141 | NRC057 | A4875 | 127 | 128 | 1.0 | Pegmatite | Fresh | Waste |
| 21143 | NRC129 | A6640 | 93 | 96 | 3.0 | Pegmatite | Fresh | Waste |
| 21144 | NRC148 | A6967 | 246 | 247 | 1.0 | Pegmatite | Fresh | Waste |
| 21145 | NRC148 | A6968 | 247 | 250 | 3.0 | Phyllite | Fresh | Waste |
| 21146 | NRC148 | A6969 | 250 | 253 | 3.0 | Phyllite | Fresh | Waste |
| 21148 | NRC148 | A6977 | 258 | 261 | 3.0 | Phyllite | Fresh | Waste |
| 21149 | NRC148 | A6983 | 274 | 275 | 1.0 | Pegmatite | Fresh | Waste |
| 21151 | NRC148 | A6985 | 276 | 277 | 1.0 | Pegmatite | Fresh | Waste |
| 21152 | NRC148 | A6992 | 281 | 282 | 1.0 | Pegmatite | Fresh | Waste |
| 21153 | NRC148 | A6993 | 282 | 283 | 1.0 | Pegmatite | Fresh | Waste |

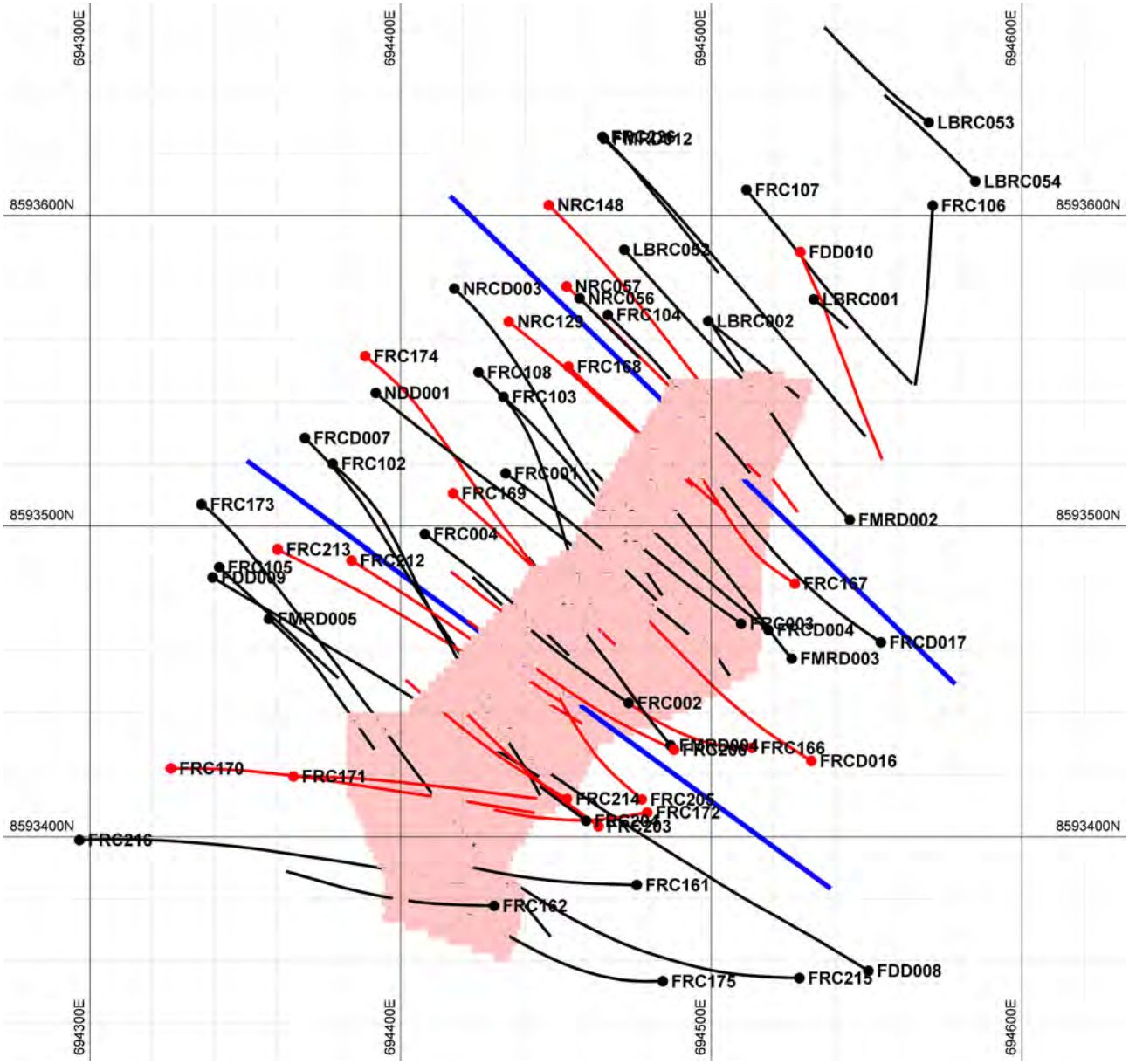


*Figure 1: Plan view showing drill hole traces for the BP33 project. Drill hole traces shown in red are for holes from which samples were collected for testing during the current study. The current resource block model is highlighted in pink. The two blue lines show the locations for sections shown in Figure 2 below.*

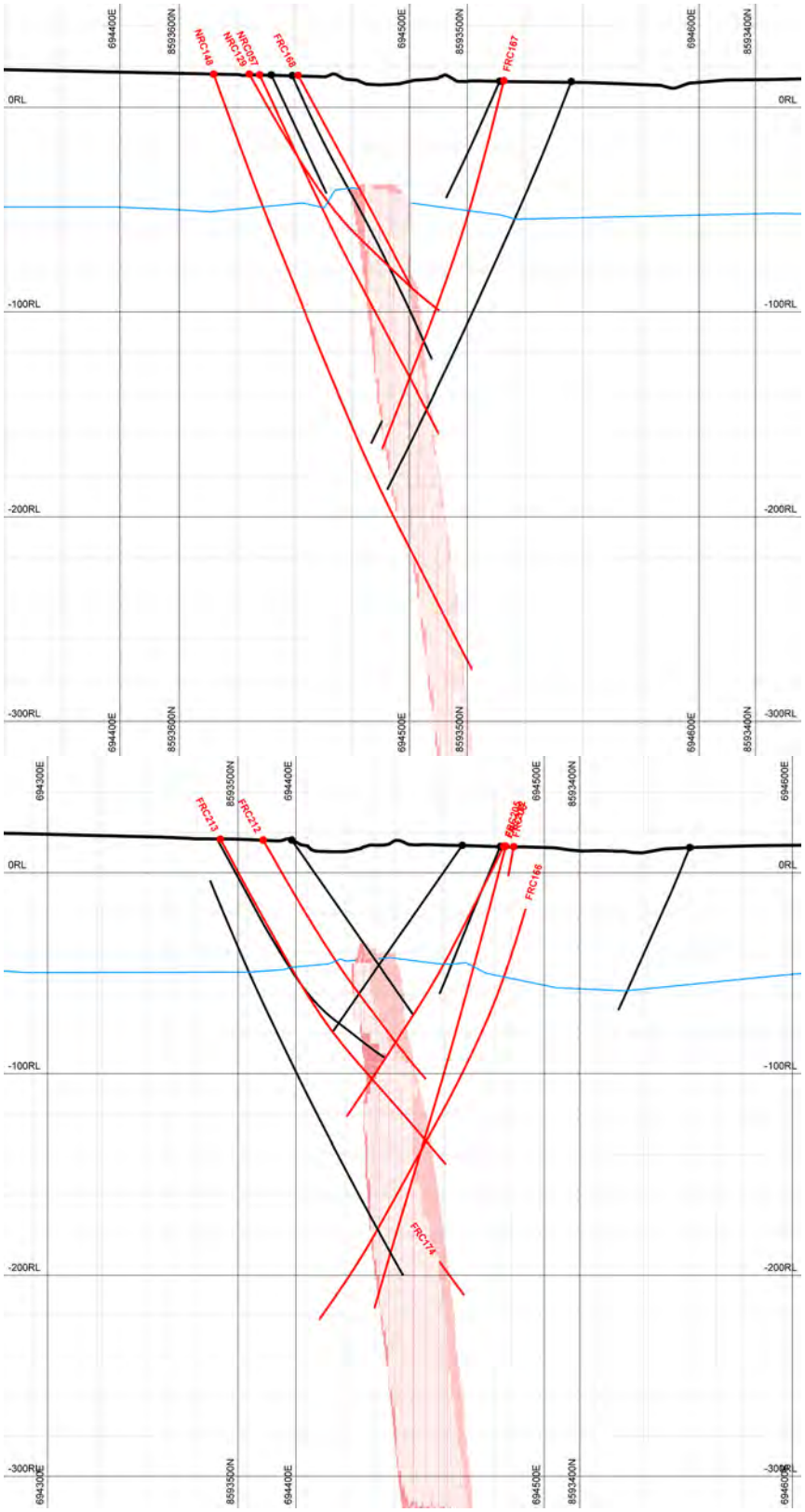


*Figure 2: Section views showing drill hole traces for the BP33 project. Traces shown in red are for holes from which samples were collected for testing during the current study. The current resource block model is highlighted in pink. The light blue line shows the top of the fresh rock profile.*

## 2.1. ABA and NAG testing: Current test samples

Geochemical testing conducted on 47 samples included Total S, carbon speciation (Total C, Organic C, Inorganic C), ANC and NAG tests. Additional testing including CRS which gives a measure of pyritic sulphur content and ABCC testing which provides a measure of readily available neutralising capacity was also conducted on 10 of the samples. The full set of results for these tests are provided in Appendix A (Table A1).

Total S values for the samples examined ranged from 0.1 to 1.1 % showing little variation between lithologies, with average Total S of 0.26, 0.31 and 0.18% for pegmatite, phyllite and sandstone respectively. However, samples with the highest sulphur content were all phyllites. The neutralising potential of these materials appears to be low to moderate with average ANC around 10 kg $H_2SO_4$/t, ranging from 4 to 27 kg $H_2SO_4$/t and with little variation between lithologies.

NAGpH ranged from 2.7 to 9.0, with most samples giving a pH between 3 and 4.5 after digestion with peroxide. Many of these samples gave a negative net acid producing potential (NAPP) value based on Total S and standard ANC measurements, which meant these materials plotted in the uncertain region of the ARD classification plot (Figure 3).

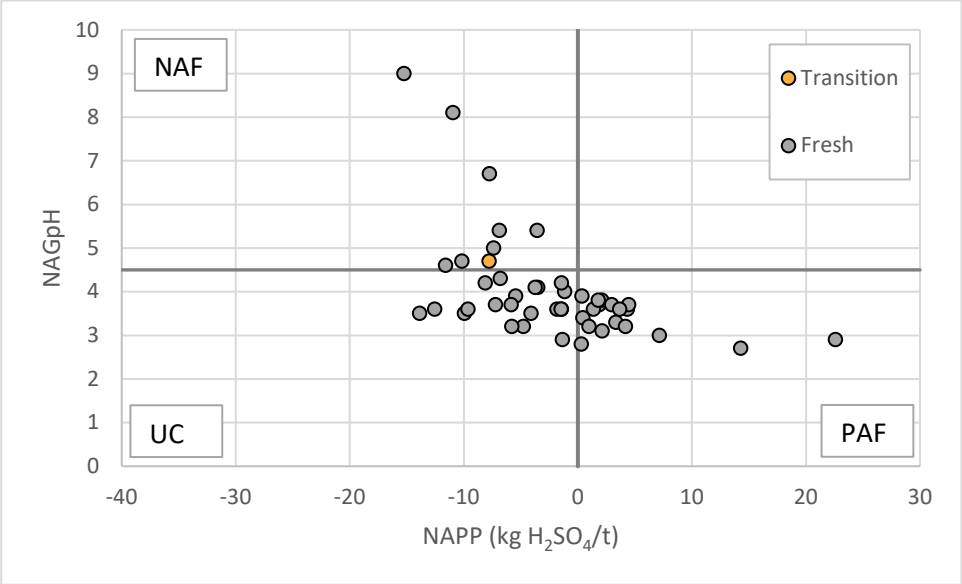


*Figure 3: ARD classification plot split by oxidation type.*

To further understand the reasons for the uncertain ARD classification of these samples, more detailed measurements were made to determine the nature of the neutralising phases present. Selected samples were subjected to acid buffering characteristic curve measurements (ABCC), which determines the amount of readily available neutralising capacity within the sample. The neutralising capacity of the samples was also calculated from their inorganic carbon (IC) content. Figure 4 shows a comparison between the neutralising capacity measured using the standard ANC method and neutralising capacity calculated from IC ($ANC_{IC}$) or by the ABCC method. The plot shows that with one exception the neutralising capacity of these materials measured using $ANC_{IC}$ or ABCC methods is significantly less than the standard ANC method, with the former methods measuring only around 20 -25% of the standard ANC on average. The results from ABCC testing (

Table 2 and Appendix B), indicate these samples contain very few reactive neutralising minerals, with effective ANC typically at or below 5 kg $H_2SO_4$/t. ABCC plots (Appendix B) suggest most of the carbonate is in the form of iron carbonates which provide limited neutralising capacity.

The presence of iron carbonates may have impacted inorganic carbon measurements, resulting in low $ANC_{IC}$ values for these samples. Figure 5 shows a comparison between neutralising capacity measured by $ANC_{IC}$ and ABCC, demonstrating that for all but one sample, ABCC was higher than $ANC_{IC}$. For samples containing iron carbonates, the opposite is often true. The measured values are very low for all of the samples where ABCC > $ANC_{IC}$, and the difference may just reflect uncertainties in the measurements at such low values. However, it is also possible that the presence of iron carbonates has resulted in an underestimation of the IC content of these materials, as precise measurement of IC can be difficult for iron carbonates.

Notwithstanding the issues described above, the results show that the fresh waste rock samples from the BP33 project represented by the materials tested here, have very limited acid neutralising capacities and consequently the presence of even minor sulphide sulphur will likely result in the potential for acid formation following oxidation. Use of $ANC_{IC}$ to generate the ARD classification plot suggests that many of these samples may be PAF (Figure 6), albeit with limited acid potential, with NAG values typically below 5 kg $H_2SO_4$/t (Table A1).

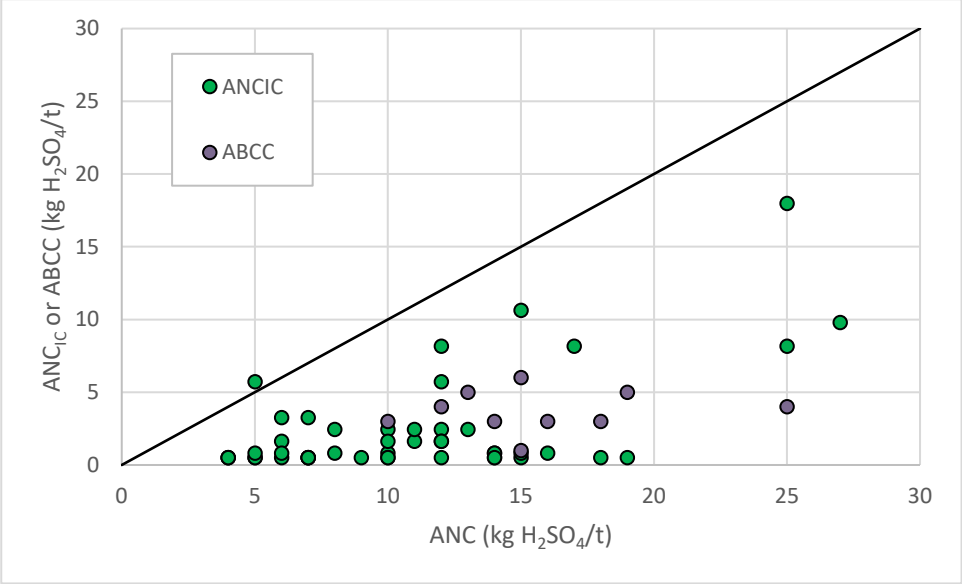


*Figure 4: Comparison between the neutralising capacity measured using the standard ANC method and carbonate ANC calculated from inorganic carbon assay ($ANC_{IC}$) and readily available ANC measured using the ABCC method. The black line represents agreement between the methods.*

*Table 2: ABCC test results*

| EGi Code | Sample ID | Figure Number (Appendix B) | Type of Carbonate Buffering | Effective ANC to pH 4 (kg $H_2SO_4$/t) | ANC (kg $H_2SO_4$/t) | Effective ANC as % of Measured ANC |
|---|---|---|---|---|---|---|
| 21091 | A3512 | B1 | Siderite | 3 | 10 | 32 |
| 21094 | A3516 | B2 | Ferroan Dolomite | 5 | 13 | 38 |
| 21103 | A3632 | B3 | Siderite | 4 | 25 | 16 |
| 21109 | A3797 | B4 | Siderite | 3 | 18 | 16 |
| 21110 | A3798 | B2 | Siderite/Ferroan Dolomite | 3 | 14 | 23 |
| 21130 | A4851 | B2 | Siderite | 1 | 15 | 10 |
| 21134 | A4857 | B2 | Siderite | 3 | 16 | 18 |
| 21135 | A4858 | B4 | Siderite | 5 | 19 | 26 |
| 21141 | A4875 | B2 | Ferroan Dolomite | 6 | 15 | 41 |
| 21144 | A6967 | B1 | Siderite | 4 | 12 | 31 |

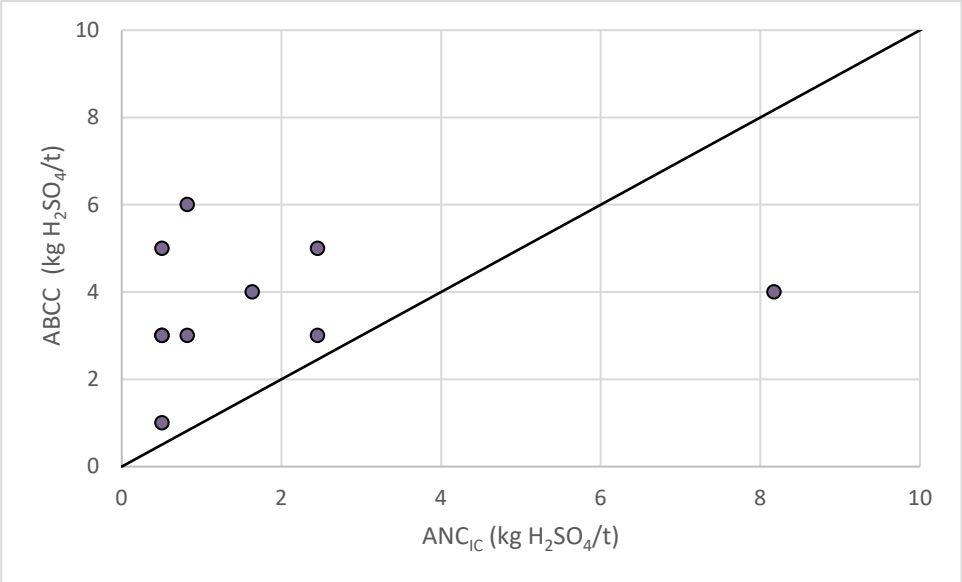


*Figure 5: Comparison between the neutralising capacity measured using carbonate ANC calculated from inorganic carbon assay ($ANC_{IC}$) and readily available ANC measured using the ABCC method. The black line represents agreement between the methods.*

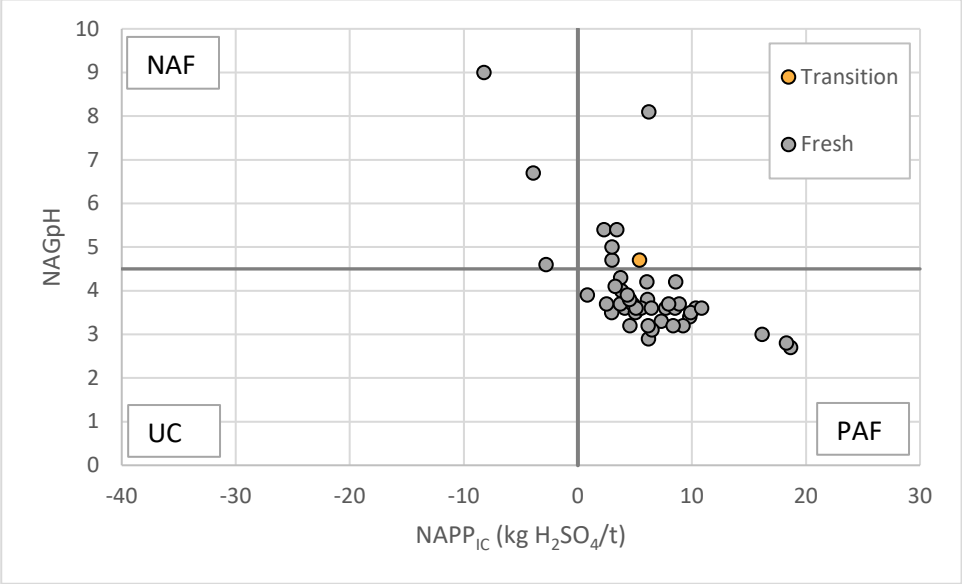


*Figure 6: ARD classification plot with NAPP calculated from $ANC_{IC}$.*

## 2.2. ABA and NAG testing: All samples

To provide a set of samples which would be more representative of waste and ore from the BP33 project, the results of ABA and NAG testing from the earlier study which investigated geochemical properties of waste rock[1] were combined with results from the current sample set. This provided a set of samples covering the major lithotypes (approximately two thirds phyllite, one third pegmatite, minor sandstone, laterite, soil), oxidation types (approximately 20% oxide and transition, 60% fresh), sample types (approximately 90% waste and 10% ore) and ARD classes (approximately 55% NAF, 40% PAF-LC and minor PAF) (Table 3). The total number of samples tested across the two test programmes was 144, but only 91 of these samples had sufficient results to provide ARD classification. Test results for the full sample set are presented in Appendix A (Table A2).

Figure 7 shows NAGpH and NAG (pH4.5) as a function of Total S for the full samples set (91 samples). The figure shows that where Total S is less than 0.2%, most samples gave a NAGpH above 4.5, although there were some samples were the NAGpH was between 3.5 to 4.5. However, the measured NAG(pH4.5) for these samples was less than 2 kg $H_2SO_4$/t, with uncertainty about the ARD classification assigned to these samples due to the very close balance between the acid generating and acid neutralising capacity.

Figure 7 also shows that for samples with Total S between 0.2 and 0.4% the NAG pH was below 4.5 for all but two samples, but the NAG(pH4.5) was below 5 kg $H_2SO_4$/t, suggesting these materials may have the potential to produce acid after oxidation, but that the amount of acidity generated is likely to be minor.

For samples where Total S was above 0.4%, the NAGpH was below 3.5 with one exception, and NAG(pH4.5) was above 5 kg $H_2SO_4$/t. Although there are a limited number of samples in this category, results suggest that materials with Total S above 0.4% may have the potential to be acid forming.

[1] Core Lithium BP33Project - Geochemical characterisation of waste rock and ore, March 2020, Document No. S1312/J000390/R1346.

*Table 3: Details of sample set used to define criteria for ARD classification of waste rock and ore*

| **Category** | **No. of Samples** | **Percentage of Samples** |
|---|---|---|
| *Lithology* | | |
| Py | 95 | 66% |
| Pg | 40 | 28% |
| Sst | 5 | 3% |
| Soil | 1 | 1% |
| Laterite | 3 | 2% |
| Total | 144 | |
| | | |
| *Oxidation* | | |
| Oxide | 27 | 19% |
| Transition | 29 | 20% |
| Fresh | 88 | 61% |
| Total | 144 | |
| | | |
| *Type* | | |
| Ore | 12 | 8% |
| Waste | 132 | 92% |
| Total | 144 | |
| | | |
| *ARD Classification* | | |
| NAF | 50 | 55% |
| PAF-LC | 35 | 38% |
| PAF | 6 | 7% |
| Total | 91 | |

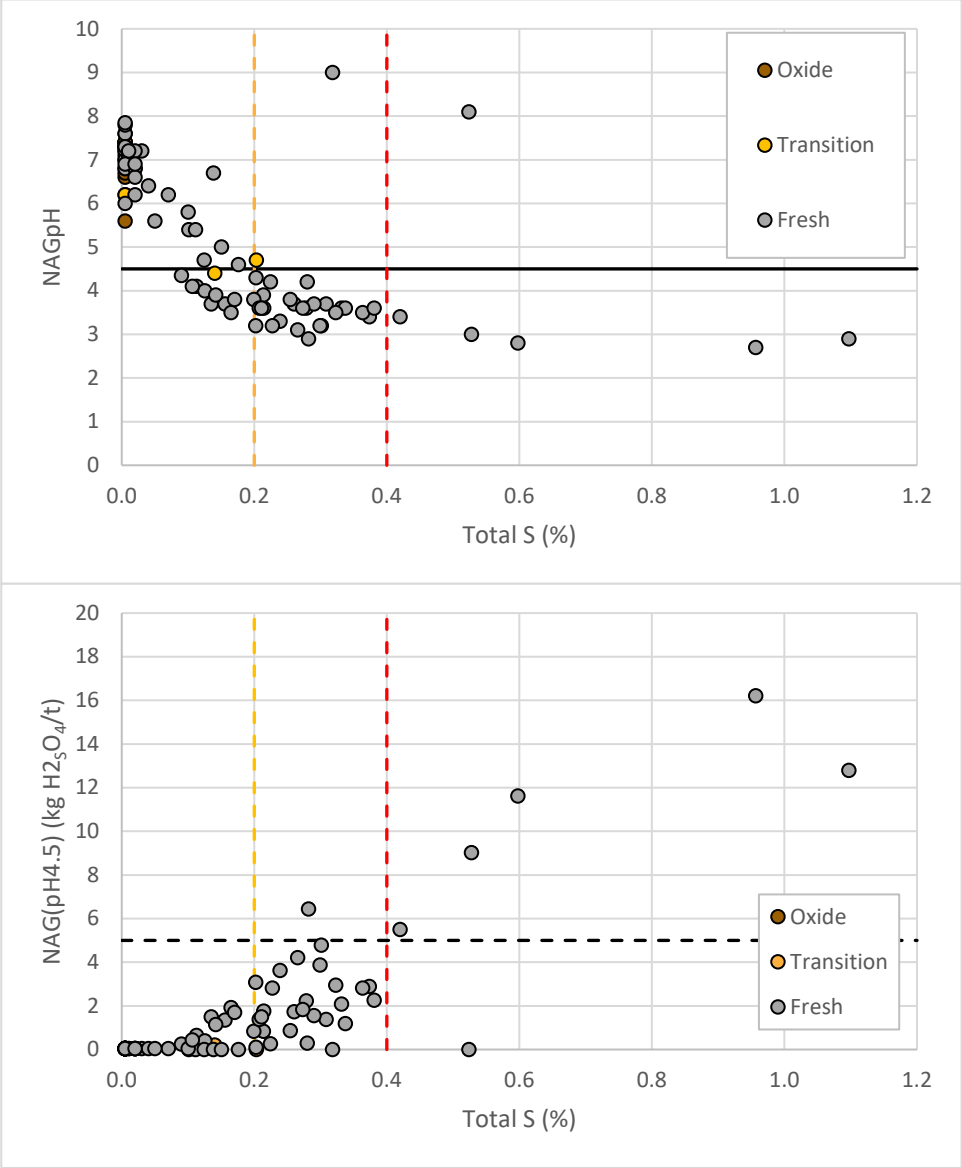


*Figure 7: NAGpH (top) and NAG(pH 4.5) (bottom) as a function of Total S for the full sample set.*

Figure 8 shows box plots displaying the distribution of Total S within set of samples examined in this and the earlier geochemical characterisation programmes. Total S distributions were split according to lithology/waste/ore, oxidation and ARD classification. Also shown in these figures are lines showing 0.2 and 0.4% Total S, which NAG test results suggest may form a basis for delineating NAF, PAF-LC and PAF materials.

This Figure shows that of the ore samples examined, a clear majority have a Total S content below 0.2%. These samples classified as NAF materials with a couple of exceptions, which while having a NAGpH below 4.5, produced very little acidity when treated with peroxide (NAG(pH4.5) <2 kg $H_2SO_4$/t). While around 75% of the phyllite samples examined had Total S of below 0.2%, it is likely that the sulphur content of some materials from this rock type may be higher, and consequently may potentially produce acid on oxidation. More than half of the waste pegmatite samples contained more than 0.2% Total S, suggesting that these materials may also have the potential to produce acid on oxidation.

All but one of the oxide samples contained Total S below the reporting limit of 0.01%, a clear indication that oxidised waste rock will likely classify as NAF. While many of the transition waste rock samples also gave a Total S assay below the reporting limit, the Total S content of these materials appears to be higher than highly oxidised rock, with sulphur content ranging up to 0.51%, but with around 95% of samples below 0.2% Total S. While the majority of fresh waste rock from within this sample set contained below 0.2% Total S, there is a significant proportion of the fresh rock samples with higher Total S content, indicating that fresh waste rock is likely to encompass a range of materials from NAF through to PAF rock.

Based on the results of geochemical testing of 144 samples from both the current and earlier test programmes as discussed above, criteria were developed to identify NAF, PAF-LC and PAF waste rock and ore. These criteria are summarised in Table 4 below. The criteria rely on oxidation and Total S content to classify mined materials according to their acid forming potential. Ore and oxidised waste rock are classified as NAF, with transitional and fresh waste rock with a Total S of below 0.2% also classified as NAF. For fresh and transitional waste rock with a Total S content above 0.2%, a Total S value of 0.4% is suggested for differentiating between PAF-LC and PAF materials. While there is likely to be some overlap between the classifications, it is expected that the listed criteria may be used to provide a reasonable segregation of waste rock and ore according to their likelihood to produce acid as a consequence of exposure to air during surface storage.

*Table 4: Criteria for ARD classification of waste rock and ore*

| **ARD Classification** | **Criteria** |
|---|---|
| NAF | Ore *OR*<br>Oxide waste rock *OR*<br>Transition and fresh waste rock with Total S <0.2% |
| PAF-LC | Transition and fresh waste rock with Total S ≥0.2% and <0.4% |
| PAF | Transition and fresh waste rock with Total S ≥0.4% |

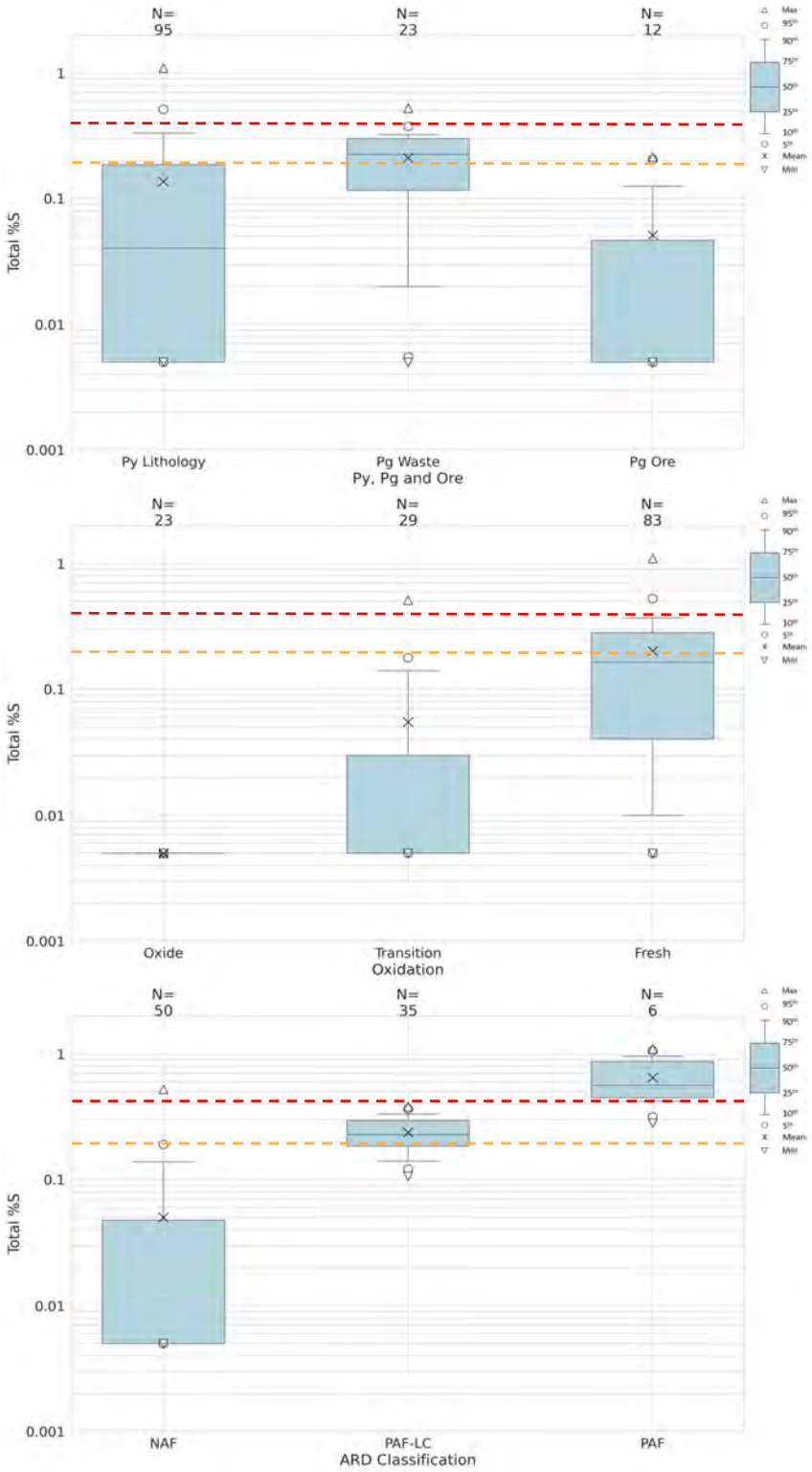


*Figure 8: Distributions of Total S as a function of lithology/waste/ore (top), oxidation (middle) and ARD classification (bottom) for the full sample set. The orange broken lines show 0.2% Total S and the red broken lines 0.4% Total S.*

## 2.3. Estimates of NAF, PAF-LC and PAF waste volumes

Core Lithium supplied a database containing assay data for around 2500 samples from 48 drill holes for the BP33 deposit (Figure 1). The database also contained a drill log which included details of sample colour, weathering, lithology and mineralogy. Samples were collected using RC, (36 holes), DD (3 holes), RC/DD (5 holes) and MR/DD (4 holes) drilling methods. Assays covered a standard set of 14 elements, including Li (value), As, Fe and Total S. Total S assay results provided in the database were employed to define ARD classification using criteria shown in Table 4 above.

Drilling programmes at BP33 have in the main been designed to provide resource definition data and consequently have been focused on fresh pegmatite which hosts the spodumene containing the value element (Li). Consequently, the sample set consists of nearly 90% fresh rock, with around 5% transition and oxide by sample interval length (Table 5). Pegmatite is the dominant lithology (63%) represented in the database, but a significant proportion of phyllite (36%) sample interval is present in the set. The split between ore and waste rock interval length is approximately even, with a slightly higher amount of waste sample interval (57%).

The assay database was analysed to define the distribution of Total S among the various categories of materials including type (ore, waste) and lithology and oxidation for waste rock samples. The results (Table 6) show that 99.8% of the sample interval represented by ore samples contain less than 0.2% Total S, supporting the ARD classification criteria suggesting all ore can be classified as NAF. Similarly, 100% of the sample intervals representing oxide rock had a Total S content of below 0.2%, also supporting the classification of all oxide rock as NAF. Around 90 to 95% of phyllite, pegmatite (waste) and sandstone samples contain a Total S content below 0.2%. Similarly, when waste rock is categorised according to oxidation, transitional and fresh waste rock display a similar sulphur distribution, suggesting that the majority of transitional and fresh waste rock, irrespective of the lithotype, will classify as NAF.

*Table 5: Details of samples from the BP33 deposit database used to estimated volumes of rock from each ARD class*

| **Category** | **Sample Interval Length (m)** | **Percentage of Total Interval Length** |
|---|---|---|
| *Lithology* | | |
| Pegmatite | 1989.55 | 63% |
| Phyllite | 1131.45 | 36% |
| Quartz (massive) | 2.25 | 0.1% |
| Quartz Vein | 9.4 | 0.3% |
| Soil | | 0% |
| Sandstone | 46.6 | 1.5% |
| Shale | 1 | 0.03% |
| Total | 3180.25 | |
| | | |
| *Oxidation* | | |
| Oxide | 179 | 5.6% |
| Transition | 178 | 5.6% |
| Fresh | 2823.25 | 88.8% |
| Total | 3180.25 | |
| | | |
| *Type* | | |
| Ore | 1371.6 | 43% |
| Waste | 1808.65 | 57% |
| Total | 3180.25 | |

*Table 6: Percentage interval length for drill hole samples as a function of Total S content*

| **Total S →** | **<0.2%** | **≥0.2 & <0.4%** | **≥0.4%** |
|---|---|---|---|
| **Category ↓** | **(NAF)** | **(PAF-LC)** | **(PAF)** |
| Ore | 99.8% | 0.2% | 0.0% |
| Waste | 94.3% | 5.1% | 0.6% |
| | | | |
| Pegmatite | 95.9% | 3.8% | 0.3% |
| Phyllite | 94.0% | 5.4% | 0.6% |
| Sandstone | 87.3% | 11.6% | 1.1% |
| | | | |
| Oxide | 100.0% | 0.0% | 0.0% |
| Transition | 90.1% | 9.9% | 0.0% |
| Fresh | 93.8% | 5.5% | 0.7% |
| | | | |
| All | 96.6% | 3.1% | 0.3% |

The amounts of waste rock and ore which will be mined during the BP33 operation are shown in Table 7. Amounts of waste rock are further divided according to oxidation, with the majority waste rock produced during construction of the box cut. This material is expected to be comprised of only oxide rock which will be placed in WRD1. All of this material is expected to be NAF, as is any ore that will be stored in the ROM pad while awaiting transport to the processing plant.

A much smaller volume of transition and fresh waste rock which will be mined to develop the underground operation, will be placed in WRD2. Assuming the sample set provided in the drill hole assay database is representative of mined waste rock, then around 90% of waste rock removed from the UG mine will be fresh rock with the remainder as transitional rock. Based on the same assumption, using the proportions of transitional and fresh waste as a function of ARD class shown in Table 6, the estimated volumes/tonnages of NAF, PAF-LC and PAF waste rock to be placed in WRD2 were calculated. The results of these estimates are shown in Figure 9 and Table 8.

These estimates indicate that only around 15,000 tonnes of PAF-LC and PAF waste will be moved to WRD2 through the life of the mine out of a total of 229,000 tonnes of transition and fresh waste rock which will be mined, with most of the 15,000 tonnes likely to be classified as PAF-LC with limited acid producing potential.

These results suggest that all of the stockpiled mine materials (oxide waste in WRD1, transition and fresh waste in WRD2, ore in the ROM pad) will present little risk of producing acidic metalliferous drainage as a result of surface storage during the mining operation.

*Table 7: Volumes and tonnages of waste rock and ore which will be moved to LOM*

| Material | Volume (BCM) | Volume (LCM)[1] | Tonnage (kt) |
|---|---|---|---|
| Oxide waste (box cut) | 1,000,000 | 1,500,000 | 2,000 |
| Transition/fresh waste (from underground) | 85,000 | 127,500 | 229 |
| Ore (production tonnes) | 776,000 | 1,164,000 | 2,095 |

1. Assumes a swell factor of 50%

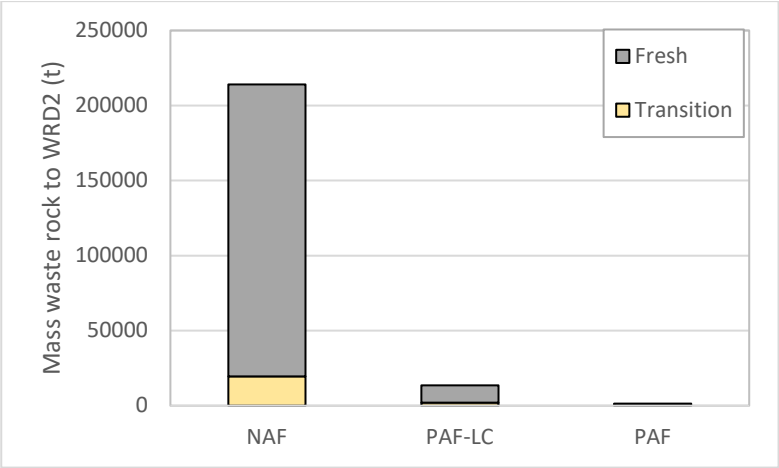


*Figure 9: Estimated mass of transition and fresh waste rock by ARD class to be placed in WRD2.*

*Table 8: Estimated volumes and tonnages of transition and fresh waste rock to be placed in WRD2*

| Rock Type | ARD Class | BCM | LCM | Tonnage (t) |
|---|---|---|---|---|
| Transition/fresh waste (from underground) | | 85000 | 127500 | 229000 |
| Transition rock in WRD2 | | 8036 | 12053 | 21649 |
| Fresh Rock in WRD2 | | 76964 | 115447 | 207351 |
| Transition Rock in WRD2 | NAF | 7239 | 10859 | 19503 |
| | PAF-LC | 796 | 1194 | 2145 |
| | PAF | 0 | 0 | 0 |
| Fresh Rock in WRD2 | NAF | 72223 | 108334 | 194576 |
| | PAF-LC | 4199 | 6298 | 11312 |
| | PAF | 543 | 814 | 1463 |
| Waste Rock in WRD2 | NAF | 79462 | 119193 | 214080 |
| | PAF-LC | 4995 | 7493 | 13457 |
| | PAF | 543 | 814 | 1463 |

# 3. LEACHING CHARACTERISTICS

Results from the previous study indicated that drainage from oxidised rock stored in the Box cut WRD may contain low concentrations of aluminium and zinc and some of the fresh rock stored on the UG WRD may contain water leachable arsenic and zinc. Consequently, as a part of the current study, the fresh rock samples examined here were subject to water extraction tests. Because these materials also contained higher than average sulphur content, NAG test liquors were also assayed to examine potential metal content of drainage from oxidised materials containing elevated sulphur.

The results of water extraction provide an indication of chemical mobility for a material that is freshly mined and exposed to atmospheric conditions, whereas the results of the peroxide extractions (NAG test) provide information on metal mobility for sulphidic materials that undergo oxidation. These two tests represent the two extremes of the leaching process. As waste rock at the BP33 project will only be stored on the surface for a short period of time, and residual ore remaining in stopes will only be exposed for a relatively short time prior to inundation, it is expected any sulphidic material will only undergo partial oxidation. Therefore, the potential for metals leaching will lie somewhere between the findings of the tests representing the two extremes.

Batch-leaching tests are short-term tests that can be used to provide an indication of the potential for environmental risk associated with leaching of metals from the ore and waste rock. However, these tests are also conducted at solid to liquid ratios far from what can be typically expected in waste rock or ore stockpiles, where precipitation reactions can be expected in addition to dissolution. Consequently, these tests can provide insight into elements of concern that may be potentially mobilised during surface storage, but they do not provide understanding of rates of reactivity and likely mobility of various metals and metalloids under field conditions. To obtain this information longer-term leach column testing is conducted which provides insight into the rate of reactions under conditions which are closer to field conditions than are provided by in the short-term batch leach tests. Column leach tests are currently being conducted and are expected to be completed in 12 months.

## 3.1. Multi-Element Assays

Multi-element assays were conducted on selected samples from the current sample set. The results are shown in Appendix C (Table C1). Using the results from the multi-element assays, geochemical abundance indices (GAI) were calculated to determine where there is significant enrichment of various elements in these samples. The calculated GAI are provided in Table 9. Where the GAI value is 3 or above this represents significant enrichment above the typical background level of each element. Note, where the GAI value is shown as "-", this indicates a calculated GAI of <0.5. The data provided in Table 9, show most samples have significant enrichment in As, Be, Cs, Li, Sn and Tl, with Bi, Ta and W displaying evidence of some enrichment.

While elevated concentrations in a rock sample may indicate the potential for higher concentrations in leachates, the mobility of any given element will depend on the mineral associations and environmental conditions including extent of oxidation, leachate pH etc. Nevertheless, the results suggest that elevated concentrations of typically mobile elements such as As (especially as arsenate), Li and Cs could result in elevated concentrations in leachates.

*Table 9: Geochemical Abundance Indices (GAI) for selected samples from the BP33 project*

| Element | Median Soil Abundance[2] | Sample ID | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **21095** | **21093** | **21291** | **21290** | **21138** | **21134** | **21109** | **21102** | **21086** | **21289** |
| Ag | 0.05 | - | - | - | - | - | 1 | 2 | 2 | 2 | **3** |
| Al | 7.1% | - | - | - | - | - | - | - | - | - | - |
| As | 6 | **8** | **9** | **3** | **3** | **7** | **9** | **10** | **5** | **5** | **3** |
| Ba | 500 | - | - | - | - | - | - | - | - | - | - |
| Be | 0.3 | **5** | **6** | 2 | **3** | **7** | **7** | **6** | **5** | **4** | **6** |
| Bi | 0.2 | 2 | **3** | - | 1 | 2 | **3** | **3** | **3** | 1 | 1 |
| Ca | 1.5% | - | - | - | - | - | - | - | - | - | - |
| Cd | 0.35 | - | - | - | - | - | 2 | 1 | - | 2 | - |
| Ce | 50 | - | - | - | - | - | - | - | - | - | - |
| Co | 8 | - | - | - | - | - | - | - | - | - | - |
| Cr | 70 | - | 1 | - | - | 2 | - | - | - | - | - |
| Cs | 4 | **>6** | **6** | **3** | **5** | **6** | **>6** | **5** | **>6** | **>6** | **4** |
| Cu | 30 | - | - | - | - | - | - | - | 1 | - | - |
| Fe | 4.0% | - | - | - | - | - | - | - | - | - | - |
| Ga | 20 | - | - | - | - | - | - | - | - | - | - |
| Ge | 1 | - | - | - | - | - | - | - | - | - | - |
| Hf | 6 | - | - | - | - | - | - | - | - | - | - |
| Hg | 0.06 | - | - | - | - | - | - | - | - | - | - |
| In | 1 | - | - | - | - | - | - | - | - | - | - |
| K | 1.4% | 1 | - | - | - | 1 | 1 | 1 | - | 1 | - |
| La | 40 | - | - | - | - | - | - | - | - | - | - |
| Li | 25 | **5** | **4** | 2 | 2 | **6** | **6** | **5** | **5** | **4** | 2 |
| Mg | 0.5% | - | - | - | - | - | - | - | - | - | - |
| Mn | 1000 | - | - | - | - | - | - | - | - | - | - |
| Mo | 1.2 | - | - | - | - | - | - | - | - | - | - |
| Na | 0.5% | - | - | - | - | - | - | - | - | - | 1 |
| Nb | 10 | - | 1 | - | - | 1 | 1 | 1 | - | - | 2 |
| Ni | 50 | - | - | - | - | - | - | - | - | - | - |
| P | 800 | - | 1 | - | - | 1 | 2 | 2 | 2 | - | - |
| Pb | 35 | - | - | - | - | - | - | - | - | **3** | - |
| Rb | 150 | 2 | 2 | - | - | 2 | **3** | 2 | 1 | 1 | - |
| S | 0.07% | - | 1 | - | - | - | 1 | **3** | **3** | 1 | - |
| Sb | 1 | - | - | - | - | - | - | - | - | - | - |
| Sc | 7 | - | - | - | - | - | - | - | - | - | - |
| Se | 0.4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Sn | 4 | **5** | **5** | - | - | **5** | **6** | **5** | **4** | **3** | 2 |
| Sr | 250 | - | - | - | - | - | - | - | - | - | - |
| Ta | 2 | 1 | **5** | - | - | **3** | **3** | 2 | 1 | - | **5** |
| Th | 9 | 2 | **3** | - | - | 1 | 1 | - | - | 1 | - |
| Ti | 0.50% | - | - | - | - | - | - | - | - | - | - |
| Tl | 0.2 | **5** | **4** | 2 | 2 | **5** | **6** | **5** | **4** | **4** | **3** |
| U | 2 | 1 | 1 | - | - | 1 | - | 1 | - | 1 | - |
| V | 90 | - | - | - | - | - | - | - | - | - | - |
| W | 1.5 | **3** | **3** | 2 | 1 | **3** | **3** | **3** | 2 | 2 | 2 |
| Zn | 90 | - | - | - | - | - | - | - | - | **3** | - |
| Zr | 400 | - | - | - | - | - | - | - | - | - | - |

[2] Bowen H.J.M.(1979) Environmental Chemistry of the Elements.

## 3.2. Water Extraction

Batch water extraction tests were conducted by extracting samples with deionised water at a solid to liquid ratio of 1:5 for 24 hours, which is generally sufficient for chemical equilibrium to be established. Extract pHs were recorded after the equilibration period, then the liquors were filtered and analysed for a suite of elements, the results of which are given in Appendix D (Table D1).

The results from the water extraction tests conducted as a part of the earlier study[3] were added to the water extraction results for the current sample set. The combined sample set provided samples that covered both ore (9 samples) and waste rock (45 samples). The properties of the waste rock samples used for water extraction tests are shown in Table 10. Samples covered oxide, transition and fresh rock types, with the majority of samples classified as NAF, showing the selected samples are reasonably representative of the waste rock which will be mined during the BP33 project. However, the number of PAF samples is likely to over-represent this ARD class in the waste rock stockpiles at the mine.

*Table 10: Details of samples used for water extraction tests*

| Category | No. Samples | Percentage of Total Samples |
|---|---|---|
| Oxide | 9 | 20% |
| Transition | 13 | 29% |
| Fresh | 23 | 51% |
| Total | 45 | |
| | | |
| NAF | 38 | 84% |
| PAF-LC | 4 | 9% |
| PAF | 3 | 7% |
| Total | 45 | |

Water extracts from the ore samples were slightly alkaline (average pH 9.2) with low salinity (average EC 105 µS/cm). Figure 10 shows the average concentration of metals in water extracts for the nine ore samples tested. For comparison, the average concentrations of metals in water extracts for the 45 waste rock samples tested are also shown in the figure. With the exception of Al and Fe, metal and metalloid concentrations were non-detectable in almost all of the water extracts of the ore samples. On average, concentrations of Al in ore water extracts were about an order of magnitude higher than the default ANZECC guideline values for freshwater systems. Analysis of surface water collected from ephemeral water courses at BP33 site, gave a median Al concentration also about an order of magnitude below that measured in water extracts of the ore samples. Similarly, water samples from bores within the oxidised rock profile at the nearby Grants project, indicated Al concentrations in the water contained in the shallow alluvial aquifer are also typically about an order of magnitude below those in water extracts of the BP33 ore. These results suggest that Al in run-off from ore stockpiled in the ROM pad may present an environmental risk. As all ore is likely to be NAF and therefore not produce acidic drainage, it would appear that stockpiled ore should not require any specific management to reduce potential impacts from run-off. However, since the results from water extractions indicate a potential risk from elevated Al concentrations in run-off, the likelihood of this risk should be evaluated at

[3] Core Lithium BP33Project - Geochemical characterisation of waste rock and ore, March 2020, Document No. S1312/J000390/R1346. Appendix B

site and it is recommended that any run-off from the ROM stockpile should be monitored and containment of run-off undertaken as required.

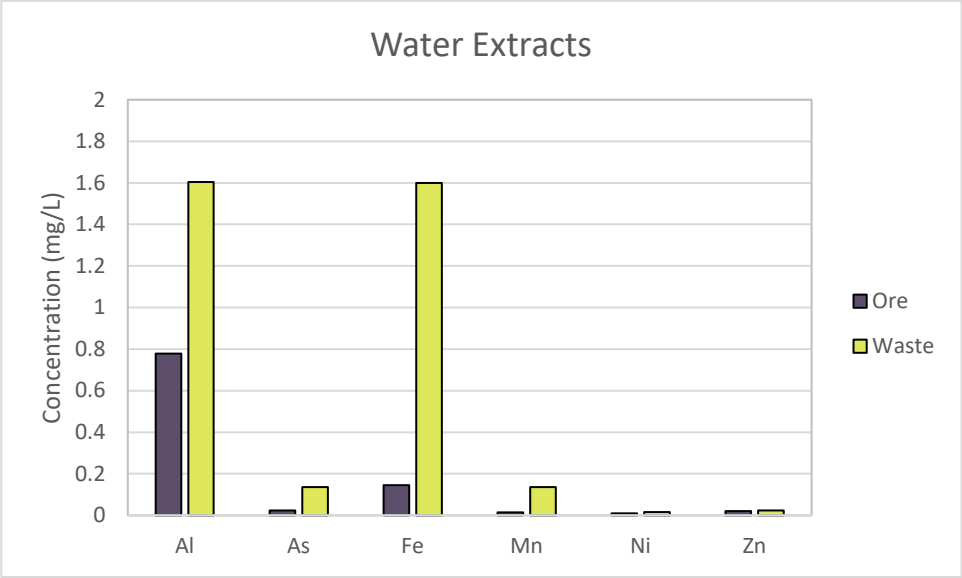


*Figure 10: Metal concentrations in water extracts for ore and waste rock.*

The results for water extraction tests conducted on waste rock samples are summarised in Figures 11 and 12. Results are grouped according to the oxidation state of the waste rock. Water extract pH for waste rock samples were slightly alkaline (average pH 8.2) with little difference between oxide, transition and fresh samples (Figure 11). Salinity in water extracts from oxide and transition waste rock samples were low (typically below 80 µS/cm), with fresh waste rock producing slightly higher salinity in water extracts (average 108 µS/cm). These results imply that oxide waste rock stored in WRD1, or transition and fresh waste rock stored in WRD2 are unlikely to produce low pH saline seepage during short-term surface storage.

Selected metal and metalloid concentrations in the water extracts for waste rock samples are summarised in Figure 12. For many metals, concentrations in water extracts were below the detection limit in all waste rock extracts, including Be, Sn and Tl which all showed significant enrichment in these materials. Mn, Ni and Zn concentrations in water extracts for waste rocks were all low and of a similar order of magnitude to the corresponding ANZECC DGV, with the exception of Mn where water extract concentrations were significantly below the DGV.

Similar to the ore samples, concentrations of Al in water extracts of waste rock were typically up to and order of magnitude or more higher than the ANZECC DGV and background surface and groundwater concentrations. Al concentrations were similar in water extracts for oxide, transition and fresh waste rock.

Arsenic concentrations in water extracts of fresh waste rock were significantly higher than in the water extracts of oxide and transition waste rock, and on average about an order of magnitude higher than the ANZECC DGV and background surface water concentrations. However, background concentrations of As in the aquifer hosted within the Burrell Creek Formation appear to be of a similar magnitude to those in water extracts, indicating elevated As concentrations in the deeper aquifer are in agreement with the apparent aqueous mobility of As within fresh rock.

There appears to be an inverse relationship between the amount of iron found in water extracts and As concentrations, with oxide and transition rock extracts having elevated concentrations of iron and lower As concentrations, while the reverse is true of the water extracts from the fresh waste rock. This may imply that iron is controlling As leachability to some extent, with higher iron concentrations in the leachate possibly associated with higher amounts of ferric oxyhydroxide precipitate which can attenuate As concentrations through adsorption.

These water extraction tests suggest that the mobility of Al in all waste rock and As in fresh waste rock on contact with water, could potentially result in elevated concentrations of these elements in seepage from WRD1 (Al only) and WRD2 (Al and As) during short-term surface storage. The results from kinetic leach column testing will help to confirm if leaching of Al and As from waste rock has the potential to provide any risk to the environment during surface storage in the WRD.

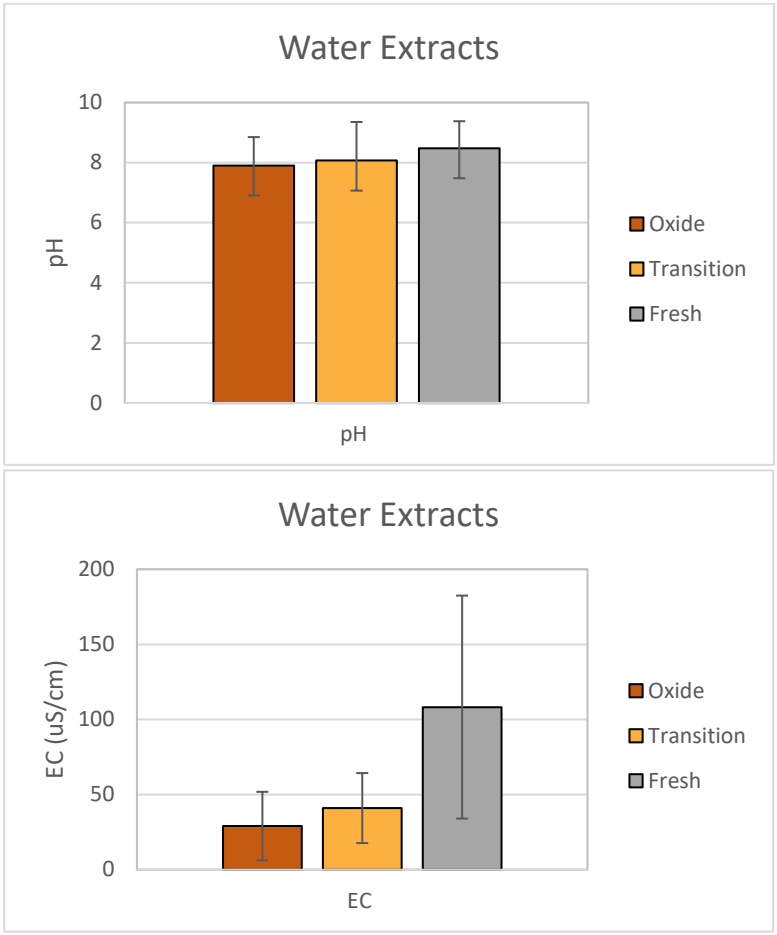


*Figure 11: Mean pH (top) and EC (bottom) in water extracts for waste rock samples. Error bars show plus/minus one standard deviation from the mean.*

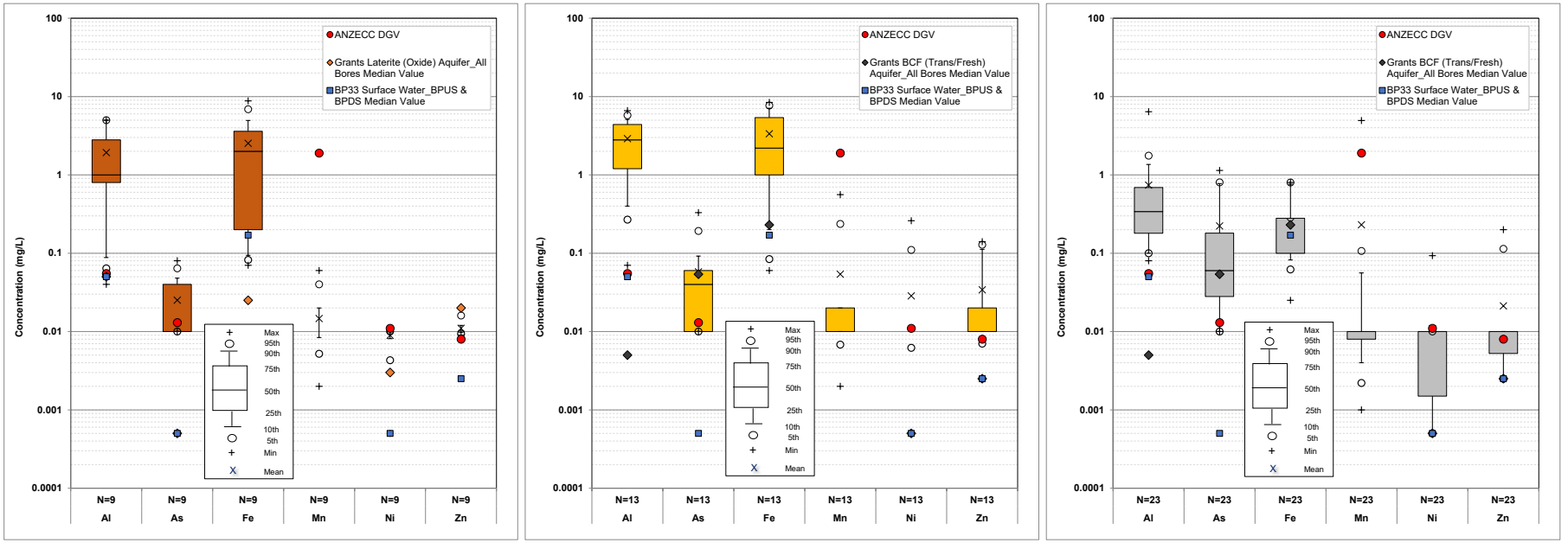


*Figure 12: Box plots for metal concentrations in water extracts for oxide(left), transition (middle) and fresh (right) waste rock samples. The water extracts were produced at a solid to liquid ratio of 1:5. Also shown for comparison are ANZECC DGV for fresh water at 95% protection level (red circles), median concentrations for groundwater from the Grants project shallow (oxide) aquifer (brown diamonds), median concentrations for groundwater from the Grants project deep BCF (trans/fresh)) aquifer (grey diamonds), and median concentrations for surface water from the BP33 project site (blue squares). Note, where median values were below the limit of reporting (LOR), 0.5 x LOR are shown. LOR are: Al – 0.01, As – 0.001, Ni – 0.001, Zn – 0.005 mg/L.*

## 3.3. Peroxide Extraction

A series of accelerated oxidation tests based on the NAG test procedure were also carried out to provide indicative data on metals and metalloids that are likely to occur in runoff from waste rock that is subject to oxidation processes following surface storage. The NAG test involves reaction of a sample with hydrogen peroxide to rapidly oxidise any sulphides that are present. Normally only the pH and acidity of the NAG solution are measured following the oxidation stage, but elemental analysis of the NAG liquor can also be carried out to provide data on the release of elements that may be of interest. Past experience has suggested NAG test concentrations typically need to be multiplied by between 3 to 10 times to provide a reasonable guide to what might be expected from column leach tests, so multiplication by a factor of five of metal concentrations in peroxide leachate was undertaken to give indicative metal/metalloid concentrations from column tests.

The full results for multi-element analysis of NAG liquors are provided in Appendix D (Table D2) and Figure 13 summarises the results. Analysis of NAG liquors was only carried out for fresh rock samples where peroxide treatment would result in sulphide oxidation. Comparison of the concentrations between water extracts (Figure 12) and peroxide extracts (Figure 13), considering the different solid to liquid ratios used in the two extraction tests, show that metal and metalloid concentrations were significantly higher in the peroxide extracts. Typically, Al and As concentrations were 1 to 2 orders of magnitude higher following oxidation with peroxide in comparison with water extracts, while Mn, Ni and Zn concentrations were 2 to 3 orders of magnitude higher in peroxide extracts in comparison with water extraction. A number of other metals, including Co, Cr, Cu, Mo, Pb and U were measurable following peroxide treatment, but non-detectable in the water extracts.

The pH of the peroxide extracts were substantially lower than the water extracts, with NAG liquor pH ranging from 2.7 to 6.2. This lower pH has undoubtedly led to increased solubility for a number of the metals after peroxide treatment. However, estimates of the volume of transition and fresh waste rock which will be temporarily stored in WRD2, and which will potentially be acid forming, are very low (Section 2.3) and widespread low pH conditions in pore water within the dump are unlikely. Consequently, even if significant oxidation were to occur during short-term storage of fresh waste rock in WRD2, mobilisation of many metals may be limited due to the likely near-neutral conditions within the WRD. This effect can be seen by comparing the concentration range of the various elements in peroxide extracts when all samples are included (pH range 2.7 – 6.2, average 4.6) shown in the top part of Figure 13, with the concentrations of the same elements in the peroxide extracts for NAF samples only (pH range 4.5 – 6.2, average 5.4) shown in the bottom part of Figure 13. For hydrolysable metals such as Al, Co, Cu, Ni and Zn, there is a significant increase in concentrations in peroxide extracts when PAF-LC samples are included in the sample set, but little change in the concentrations of metals which will be present as metal oxy anions (As, Cr, and Mo), where changes in pH will not influence hydrolysis and subsequent solubility. For the later metal types, oxidation during surface storage may result in mobility and elevated concentrations in seepage even if pH conditions remain circum-neutral.

ANZECC default guideline values for various metals in fresh water systems are also shown in Figure 13 for comparison with the concentrations in the NAG liquors. Also shown in the figure are the background concentrations of various metals in both surface water and the aquifer hosted within the Burrell Creek Formation (fresh rock) at the nearby Grants project. Comparisons with DGV and background surface and groundwater quality suggest that should substantial oxidation of fresh waste rock occur during surface storage, the concentrations of a number of metals/metalloids including Al, As, Co, Cr, Cu, U and Zn may by elevated in comparison to background water quality, and seepage from the WRD could potentially represent a risk of contaminating the receiving environment. The likelihood that significant oxidation and metal/metalloid release will occur during short-term surface storage will be further investigated using the kinetic leach column testing now in progress.

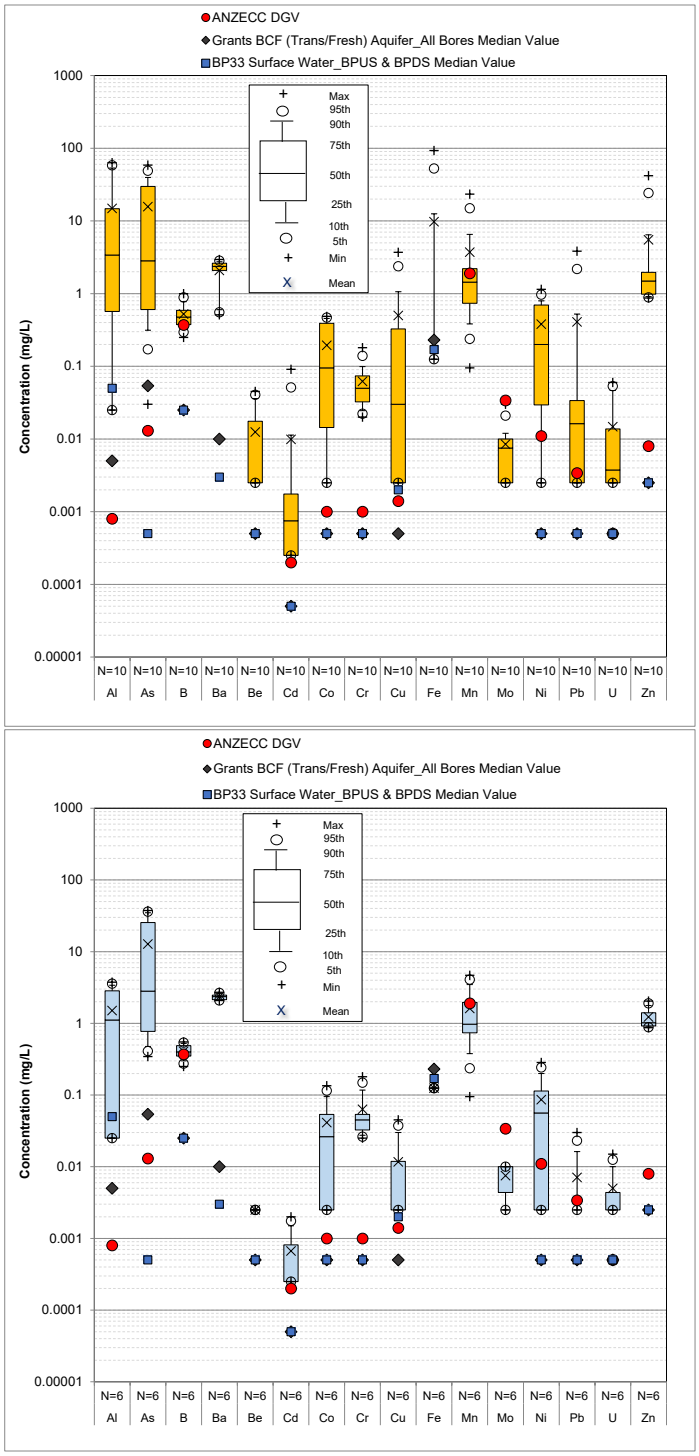


*Figure 13: Box plots for metal concentrations in peroxide extracts for all (top) and NAF only (bottom) waste rock samples. Note the concentrations shown here have been multiplied by a factor of five which provides and equivalent solid to liquid ratio of 1:20. Also shown for comparison are ANZECC DGV for fresh water at 95% protection level (red circles), median concentrations for groundwater from the Grants project deep BCF (trans/fresh)) aquifer (grey diamonds), and median concentrations for surface water from the BP33 project site (blue squares). Note, where median values were below the limit of reporting (LOR), 0.5 x LOR are shown. LOR are: Al – 0.01, As – 0.001, B – 0.05,Be – 0.001,Cd – 0.0001, Co – 0.001, Cr – 0.001, Cu – 0.001, Ni – 0.001, Pb – 0.001, U – 0.001, Zn – 0.005 mg/L.*

# 4. STATIC GEOCHEMICAL TESTING OF SAMPLES FOR KINETIC COLUMN TESTS

Twenty-nine samples obtained from the three DD holes drilled during December 2020 and January 2021 were tested to investigate the suitability of these materials for kinetic testing which requires crushed rock available from diamond drill core. Based on assay data (Appendix E), four oxide samples, four transition samples and five fresh samples were composited to produce oxide, transition and fresh rock samples, which subsequently underwent geochemical testing. The results from testing of the three composite samples have been compared with results for typical oxide, transition and fresh waste rock samples to ascertain if these samples can be used as representative of waste rock which will be temporarily surface stored in WRD prior to return to the underground mine and box cut. Kinetic testing is planned using oxide, transition and fresh rock in accordance with the testing requirements of the NT EPA referral response.

Results from ABA and NAG testing of the composite samples are given in Appendix A (Table A1). As is the case for most waste rock samples at the BP33 project, there is little neutralising capacity in the composite samples with ANC less than 10 kg $H_2SO_4$/t for the three samples. Despite the limited ANC, the very low concentrations of sulphur in these samples mean that all samples are NAPP negative. NAGpH for the three composite samples were between 5.7 and 6.3, confirming that the oxide, transition and fresh composite samples are classified as NAF. Since all oxide samples and the large majority of transition and fresh waste rock from the BP33 project are likely to be classified as NAF, the NAF classification of the three composite samples to be used for kinetic testing is in agreement with the acid forming characteristics expected for waste rock to be stored in the WRD during mining operations.

Figure 14 displays box plots which show the distributions of sulphur and arsenic in oxide, transition and fresh waste rock from the BP33 drill hole assay database. Overlaying the box plots are the sulphur and arsenic concentrations in the oxide, transition and fresh waste rock composite samples. The figure shows that sulphur and arsenic concentrations in the composite samples lie just either side of the corresponding median values for waste rock, except for the sulphur content of the oxide composite sample, which is significantly lower than the median sulphur value for oxide waste.

Figure 15 shows a similar comparison between the water leachability of various metals/metalloids in the three composite samples with the results from water leach tests conducted on 45 waste rock samples. In general, the concentrations of metals in water leachates of the composite samples were significantly lower than concentrations in leachates from the larger sample set. The exceptions are As and Al (fresh waste rock composite sample only), where concentrations in water extracts in the composite samples were close to median values for the larger sample set. These results suggest that these composite samples may not be entirely representative of the waste rock to be stored in the WRD at the BP33 project, with the possible exception of Al and As which are potentially the most significant elements in seepage from the WRD. However, the set of 45 samples used to compare with the three composite samples may not be entirely representative of waste rock in general, because for the fresh waste rock samples in particular, the sulphur content was significantly higher than the average value and this may have biased the results of water leachate tests towards higher concentrations.

Comparison of the combined geochemical test results for the oxide, transition and fresh composite waste rock samples with results for the corresponding waste types from all drill holes, suggests that these composite samples provide a representative set of waste rock types to be stored in the WRD at the BP33 project. Kinetic leach column tests using these samples should therefore provide results which will give a good indication of the nature of seepage that may result during surface storage of waste and leachability of solutes from the waste following backfill and inundation by recovering groundwater.

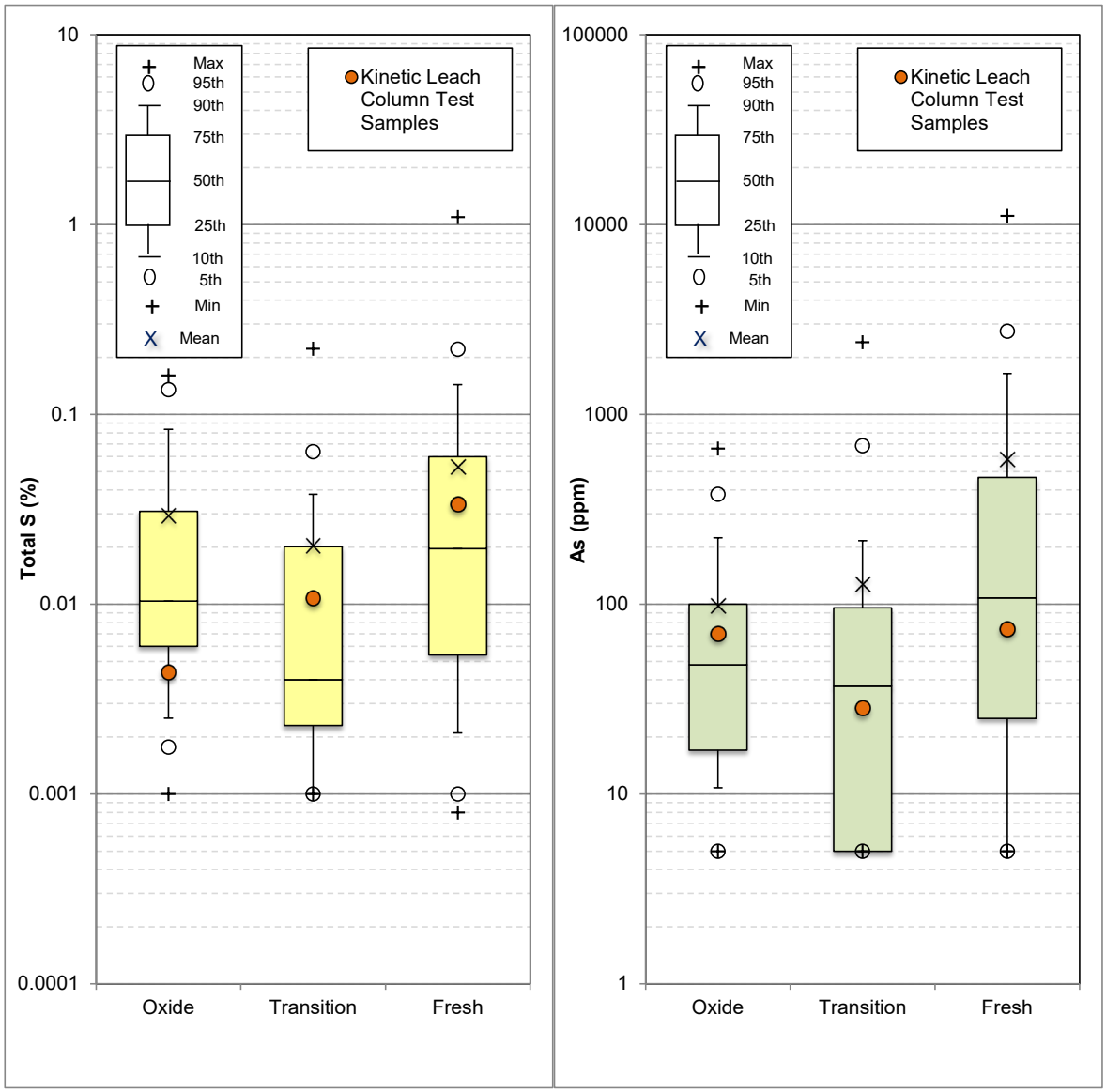


*Figure 14: Box plots for sulphur content (left) and arsenic content (right) for waste rock from the BP33 project. The brown circles show the concentrations of sulphur and arsenic for the composite oxide, transition and fresh rock samples.*

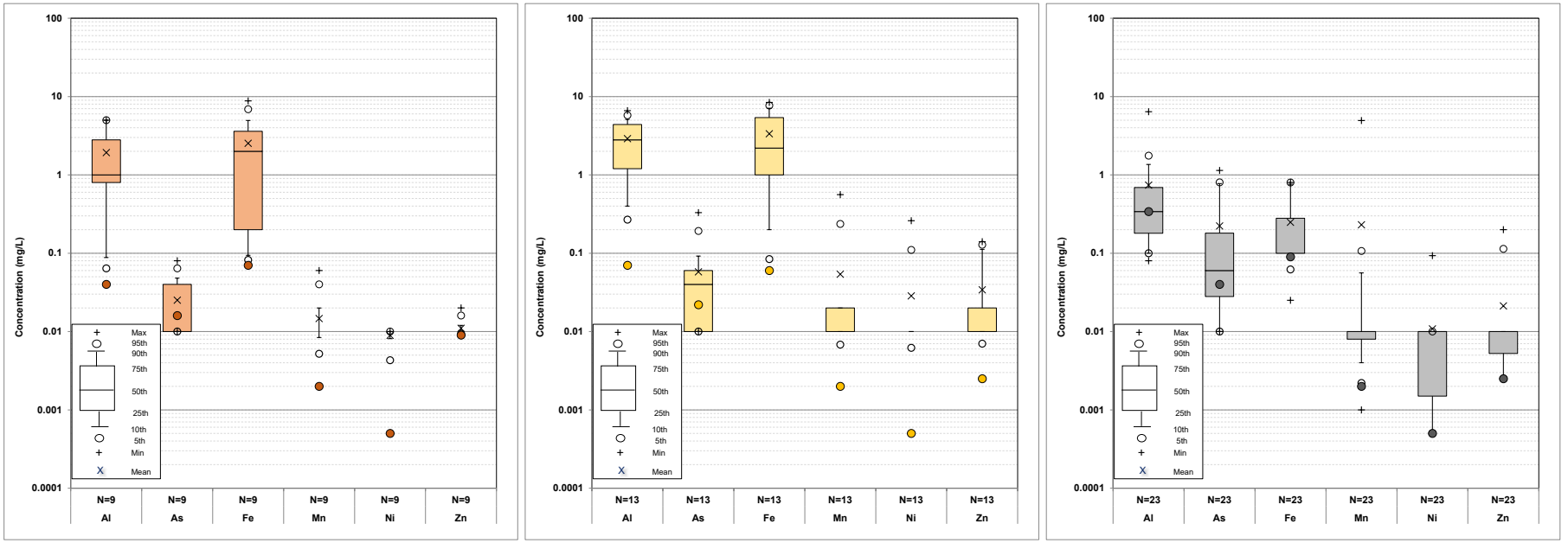


*Figure 15: Box plots for metal concentrations in water extracts for oxide(left), transition (middle) and fresh (right) waste rock samples. The brown, yellow and grey circles show the concentrations of metals in water extracts for the composite oxide, transition and fresh rock samples respectively.*

# 5. CONCLUSIONS AND RECOMMENDATIONS

## 5.1. Study Conclusions

Static geochemical testing conducted on samples covering the range of oxidation, lithologies and type (waste and ore) from the BP33 project showed that oxidation and sulphur content could be used to determine the ARD classification of materials which will be disturbed during mining of the BP33 deposit. Using the derived criteria, waste rock and ore were classified to categorise their acid forming potential. The results show:

- Oxide rock excavated from the box cut and which will be placed in WRD1 is expected to be NAF;
- Ore that will be stored in the ROM pad while awaiting transport to the processing plant is expected to be NAF; and
- Estimates indicate that only around 15,000 tonnes of PAF-LC and PAF waste will be moved to WRD2 through the life of the mine out of a total of 229,000 tonnes of transition and fresh waste rock which will be mined, with most of the 15,000 tonnes likely to be classified as PAF-LC with limited acid producing potential.

These results suggest that waste rock and ore stockpiled on the surface prior to backfill of the mine excavations or processing are unlikely to produce low pH metalliferous drainage during short-term storage.

Despite the unlikely occurrence of low pH drainage, water extraction tests suggest that Al in both waste rock and ore could be readily mobilised from freshly mined materials at neutral to slightly alkaline pH. Results also indicated that As may be mobilised from fresh waste rock on contact with water, even in the absence of significant oxidation. Consequently, the preponderance of NAF waste and likely limited oxidation of minor PAF-LC and PAF waste during short-term surface storage, does not ensure that seepage from stockpiled waste and ore will contain concentrations of Al and As near to or below local surface and shallow groundwater background concentrations.

Peroxide extraction of fresh wastes, especially PAF-LC and PAF wastes, showed that, should extensive oxidation of waste rock in WRD2 occur, the concentrations of a number of metals/metalloids including Al, As, Co, Cr, Cu, U and Zn may by elevated in comparison to background water quality, and seepage from the WRD could potentially represent a risk of contaminating the receiving environment. While PAF-LC and PAF waste volumes in this WRD are likely to represent only a very small volume of the total waste rock, testing has shown that these wastes contain very limited readily available neutralising capacity. Therefore, the possibility of poor-quality drainage from WRD2 cannot be discounted should waste be stored for an extended period, beyond what is currently anticipated under the current mine plan.

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. Geochemical test results for the oxide, transition and fresh composite waste rock samples suggest that these composite samples provide a representative set of waste rock types to be stored in the WRD at the BP33 project. Kinetic leach column tests using these samples should therefore provide results which will give a good indication of the nature of seepage that may result during surface storage of waste and leachability of solutes from the waste following backfill and inundation by recovering groundwater.

## 5.2. Recommendations

The results of this study have confirmed the requirement for kinetic testing to fully understand the geochemistry of waste rock from the BP33 project and the potential implications for environmental impacts as a result of mining. The following recommendations follow from the results of this study:

- Kinetic leach column tests should be completed as proposed including operation under oxidising conditions to simulate conditions during storage in the WRD and in the unsaturated zones within the backfilled UG mine and box cut. Following a period of leaching under oxidising conditions, KLC tests should be continued under saturated conditions to simulate the leaching properties of backfilled waste which will be placed below the water table upon rebound.
- Groundwater monitoring at BP33 (both shallow alluvial and deeper BCF aquifers) should be on-going to provide baseline water quality data for comparison with column leachate data collected during leach column testing.
- Similarly, collection of surface water quality should continue to provide baseline water quality data for comparison with KLC test results.
- The results from static and kinetic geochemical testing should be used to conduct an ARD/NMD risk assessment which can be applied in developing an ARD/NMD management plan for the operation.

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# APPENDIX A
# ABA and NAG Test Results

*Table A1: Acid forming characteristics of samples from Core Lithium BP33 Project – Current study samples set*

| EGi Code | Hole ID | Sample ID | Depth (m) | | Interval (m) | Lithology | Oxidation | Type | $pH_{1:5}$ | $EC_{1:5}$ | ACID-BASE ANALYSIS | | | | | | | | | | | | | NAG TEST | | | Reaction Comments | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | From | To | | | | | | | Total %S | CRS (%) | Total %C | Organic %C | Inorganic %C | MPA | ANC | $ANC_{TC}$ | ABCC | NAPP | $NAPP_{IC}$ | ANC/MPA | NAGpH | $NAG_{(pH4.5)}$ | $NAG_{(pH7.0)}$ | | |
| 21086 | FDD008 | B1174 | 326 | 327 | 1.0 | Py | Fr | Waste | 9.0 | 0.111 | 0.11 | | 0.02 | 0.03 | <0.01 | 3 | 7 | <1 | | -4 | 3 | 2.0 | 4.1 | 1 | 3 | | UC (PAF-LC) |
| 21087 | FRC164 | A3428 | 139 | 140 | 1.0 | Pg | Fr | Waste | 9.1 | 0.195 | 0.32 | | 0.27 | 0.05 | 0.22 | 10 | 25 | 18 | | -15 | -8 | 2.6 | 9.0 | 0 | 0 | | NAF |
| 21088 | FRC164 | A3429 | 140 | 141 | 1.0 | Pg | Fr | Waste | 8.9 | 0.272 | 0.52 | | 0.16 | 0.04 | 0.12 | 16 | 27 | 10 | | -11 | 6 | 1.7 | 8.1 | 0 | 0 | | NAF |
| 21089 | FRC164 | A3430 | 141 | 142 | 1.0 | Pg | Fr | Ore | 9.0 | 0.192 | 0.21 | | 0.08 | 0.05 | 0.03 | 7 | 8 | 2 | | -1 | 4 | 1.2 | 3.6 | 2 | 4 | | PAF-LC |
| 21090 | FRC164 | A3435 | 145 | 148 | 3.0 | Py | Fr | Waste | 9.1 | 0.159 | 0.21 | | 0.11 | 0.04 | 0.07 | 7 | 12 | 6 | | -5 | 1 | 1.8 | 3.9 | 1 | 3 | | UC (PAF-LC) |
| 21091 | FRC166 | A3512 | 212 | 213 | 1.0 | Py | Fr | Waste | 8.2 | 0.092 | 0.28 | 0.20 | 0.18 | 0.15 | 0.03 | 9 | 10 | 2 | 3 | -1 | 6 | 1.2 | 2.9 | 6 | 12 | | PAF |
| 21093 | FRC167 | A3515 | 124 | 125 | 1.0 | Pg | Fr | Waste | 9.3 | 0.121 | 0.18 | | 0.14 | 0.04 | 0.10 | 5 | 17 | 8 | | -12 | -3 | 3.2 | 4.6 | 0 | 3 | | NAF |
| 21094 | FRC167 | A3516 | 125 | 126 | 1.0 | Pg | Fr | Waste | 9.3 | 0.113 | 0.20 | <0.02 | 0.07 | 0.04 | 0.03 | 6 | 13 | 2 | 5 | -7 | 4 | 2.1 | 4.3 | 0 | 2 | | UC (PAF-LC) |
| 21095 | FRC167 | A3517 | 126 | 129 | 3.0 | Py | Fr | Waste | 9.4 | 0.126 | 0.10 | | 0.04 | 0.03 | 0.01 | 3 | 10 | 1 | | -7 | 2 | 3.2 | 5.4 | 0 | 3 | | NAF |
| 21097 | FRC168 | A3627 | 108 | 109 | 1.0 | Py | Fr | Waste | 8.8 | 0.099 | 0.16 | | 0.05 | 0.05 | <0.01 | 5 | 12 | <1 | | -7 | 5 | 2.5 | 3.7 | 1 | 6 | | PAF-LC |
| 21098 | FRC168 | A4408 | 109 | 110 | 1.0 | Py | Fr | Waste | 8.7 | 0.125 | 0.33 | | 0.07 | 0.04 | 0.03 | 10 | 12 | 2 | | -2 | 8 | 1.2 | 3.6 | 2 | 6 | | PAF-LC |
| 21099 | FRC168 | A4409 | 110 | 111 | 1.0 | Py | Fr | Waste | 8.4 | 0.162 | 0.37 | | 0.05 | 0.03 | 0.02 | 11 | 11 | 2 | | 0 | 10 | 1.0 | 3.4 | 3 | 8 | | PAF-LC |
| 21101 | FRC169 | A3629 | 66 | 69 | 3.0 | Py | Fr | Waste | 5.8 | 0.752 | 1.10 | | 0.08 | 0.05 | 0.03 | 34 | 11 | 2 | | 23 | 31 | 0.3 | 2.9 | 13 | 26 | *Reacted* | PAF |
| 21102 | FRC169 | A3630 | 69 | 70 | 1.0 | Py | Fr | Waste | 6.0 | 0.346 | 0.96 | | 0.16 | 0.03 | 0.13 | 29 | 15 | 11 | | 14 | 19 | 0.5 | 2.7 | 16 | 27 | *Reacted* | PAF |
| 21103 | FRC169 | A3632 | 70 | 71 | 1.0 | Py | Fr | Waste | 7.1 | 0.337 | 0.36 | 0.12 | 0.15 | 0.05 | 0.10 | 11 | 25 | 8 | 4 | -14 | 3 | 2.2 | 3.5 | 3 | 7 | | PAF-LC |
| 21106 | FRC172 | A3764 | 186 | 187 | 1.0 | Pg | Fr | Waste | 8.4 | 0.054 | 0.34 | | 0.02 | 0.03 | <0.01 | 10 | 6 | <1 | | 4 | 10 | 0.6 | 3.6 | 1 | 3 | | PAF-LC |
| 21107 | FRC172 | A3795 | 219 | 222 | 3.0 | Py | Fr | Waste | 8.2 | 0.143 | 0.28 | | 0.04 | 0.04 | <0.01 | 9 | 10 | <1 | | -1 | 9 | 1.2 | 3.6 | 2 | 6 | | PAF-LC |
| 21108 | FRC172 | A3796 | 222 | 223 | 1.0 | Py | Fr | Waste | 7.5 | 0.231 | 0.53 | | 0.02 | 0.03 | <0.01 | 16 | 9 | <1 | | 7 | 16 | 0.6 | 3.0 | 9 | 15 | | PAF |
| 21109 | FRC172 | A3797 | 223 | 224 | 1.0 | Py | Fr | Waste | 7.5 | 0.122 | 0.60 | 0.39 | 0.02 | 0.03 | <0.01 | 18 | 18 | <1 | 3 | 0 | 18 | 1.0 | 2.8 | 12 | 16 | | PAF |
| 21110 | FRC172 | A3798 | 224 | 225 | 1.0 | Pg | Fr | Waste | 8.5 | 0.096 | 0.30 | 0.13 | 0.03 | 0.04 | <0.01 | 9 | 14 | <1 | 3 | -5 | 9 | 1.5 | 3.2 | 5 | 8 | | PAF-LC |
| 21112 | FRC174 | A3972 | 190 | 191 | 1.0 | Py | Fr | Waste | 8.4 | 0.123 | 0.31 | | 0.14 | 0.07 | 0.07 | 9 | 5 | 6 | | 4 | 4 | 0.5 | 3.7 | 1 | 5 | | PAF-LC |
| 21114 | FRC203 | C3610 | 81 | 82 | 1.0 | Sst | Fr | Waste | 8.8 | 0.087 | 0.11 | | 0.03 | 0.05 | <0.01 | 3 | 7 | <1 | | -4 | 3 | 2.1 | 5.4 | 0 | 2 | | UC (NAF) |
| 21115 | FRC205 | C3617 | 138 | 141 | 3.0 | Sst | Fr | Waste | 8.5 | 0.137 | 0.29 | | 0.04 | 0.06 | <0.01 | 9 | 7 | <1 | | 2 | 9 | 0.8 | 3.7 | 2 | 5 | | PAF-LC |
| 21116 | FRC205 | C3669 | 184 | 185 | 1.0 | Pg | Fr | Ore | 9.7 | 0.275 | 0.20 | | 0.02 | 0.03 | <0.01 | 6 | 4 | <1 | | 2 | 6 | 0.7 | 3.8 | 1 | 3 | | PAF-LC |
| 21118 | FRC205 | C3696 | 207 | 208 | 1.0 | Pg | Fr | Ore | 9.5 | 0.302 | 0.13 | | 0.01 | 0.02 | <0.01 | 4 | 5 | <1 | | -1 | 4 | 1.3 | 4.0 | 0 | 3 | | UC (PAF-LC) |
| 21119 | FRC205 | C3697 | 208 | 209 | 1.0 | Pg | Fr | Waste | 8.8 | 0.365 | 0.24 | | 0.01 | 0.02 | <0.01 | 7 | 4 | <1 | | 3 | 7 | 0.5 | 3.3 | 4 | 7 | | PAF-LC |
| 21122 | FRC205 | C3709 | 218 | 219 | 1.0 | Pg | Fr | Waste | 7.9 | 0.279 | 0.26 | | 0.03 | 0.03 | <0.01 | 8 | 5 | <1 | | 3 | 8 | 0.6 | 3.7 | 2 | 6 | | PAF-LC |
| 21123 | FRC206 | C3782 | 137 | 138 | 1.0 | Py | Fr | Waste | 8.6 | 0.096 | 0.13 | | 0.06 | 0.04 | 0.02 | 4 | 10 | 2 | | -6 | 2 | 2.4 | 3.7 | 2 | 5 | | UC (PAF-LC) |
| 21125 | FRC212 | A6714 | 88 | 89 | 1.0 | Py | Fr | Waste | 9.0 | 0.111 | 0.12 | | 0.04 | 0.03 | 0.01 | 4 | 14 | 1 | | -10 | 3 | 3.7 | 4.7 | 0 | 3 | | UC (NAF) |
| 21126 | FRC213 | A6787 | 68 | 69 | 1.0 | Py | SW | Waste | 7.9 | 0.107 | 0.20 | | 0.07 | 0.06 | 0.01 | 6 | 14 | 1 | | -8 | 5 | 2.3 | 4.7 | 0 | 2 | | UC (NAF) |
| 21129 | FRCD016 | B1053 | 276.2 | 277 | 0.8 | Py | Fr | Waste | 9.3 | 0.133 | 0.14 | | 0.12 | 0.02 | 0.10 | 4 | 12 | 8 | | -8 | -4 | 2.8 | 6.7 | 0 | 0 | | NAF |
| 21130 | NRC057 | A4851 | 105 | 106 | 1.0 | Py | Fr | Waste | 8.5 | 0.059 | 0.16 | 0.03 | 0.04 | 0.04 | <0.01 | 5 | 15 | <1 | 1 | -10 | 5 | 3.0 | 3.5 | 2 | 5 | | PAF-LC |
| 21132 | NRC057 | A4854 | 108 | 109 | 1.0 | Py | Fr | Waste | 8.6 | 0.133 | 0.28 | | 0.05 | 0.05 | <0.01 | 9 | 10 | <1 | | -1 | 9 | 1.2 | 4.2 | 0 | 4 | | UC (PAF-LC) |
| 21134 | NRC057 | A4857 | 111 | 112 | 1.0 | Py | Fr | Waste | 8.3 | 0.096 | 0.21 | 0.02 | 0.04 | 0.03 | 0.01 | 6 | 16 | 1 | 3 | -10 | 6 | 2.5 | 3.6 | 1 | 5 | | PAF-LC |
| 21135 | NRC057 | A4858 | 112 | 113 | 1.0 | Pg | Fr | Waste | 8.1 | 0.140 | 0.21 | 0.08 | 0.13 | 0.13 | <0.01 | 6 | 19 | <1 | 5 | -13 | 6 | 3.0 | 3.6 | 1 | 5 | | PAF-LC |
| 21138 | NRC057 | A4869 | 122 | 123 | 1.0 | Sst | Fr | Waste | 8.4 | 0.091 | 0.15 | | 0.17 | 0.15 | 0.02 | 5 | 12 | 2 | | -7 | 3 | 2.6 | 5.0 | 0 | 2 | | UC (NAF) |
| 21140 | NRC057 | A4873 | 125 | 126 | 1.0 | Pg | Fr | Waste | 8.4 | 0.150 | 0.32 | | 0.02 | 0.03 | <0.01 | 10 | 14 | <1 | | -4 | 10 | 1.4 | 3.5 | 3 | 7 | | PAF-LC |
| 21141 | NRC057 | A4875 | 127 | 128 | 1.0 | Pg | Fr | Waste | 9.1 | 0.201 | 0.22 | 0.07 | 0.07 | 0.06 | 0.01 | 7 | 15 | 1 | 6 | -8 | 6 | 2.2 | 4.2 | 0 | 4 | | PAF-LC |
| 21143 | NRC129 | A6640 | 93 | 96 | 3.0 | Pg | Fr | Waste | 8.5 | 0.135 | 0.38 | | 0.09 | 0.08 | 0.01 | 12 | 8 | 1 | | 4 | 11 | 0.7 | 3.6 | 2 | 8 | | PAF-LC |
| 21144 | NRC148 | A6967 | 246 | 247 | 1.0 | Pg | Fr | Waste | 8.1 | 0.166 | 0.20 | 0.04 | 0.21 | 0.19 | 0.02 | 6 | 12 | 2 | 4 | -6 | 5 | 1.9 | 3.2 | 3 | 9 | | PAF-LC |
| 21145 | NRC148 | A6968 | 247 | 250 | 3.0 | Py | Fr | Waste | 8.2 | 0.116 | 0.27 | | 0.10 | 0.08 | 0.02 | 8 | 6 | 2 | | 2 | 6 | 0.7 | 3.1 | 4 | 10 | | PAF-LC |
| 21146 | NRC148 | A6969 | 250 | 253 | 3.0 | Py | Fr | Waste | 8.0 | 0.140 | 0.11 | | 0.55 | 0.58 | <0.01 | 3 | 7 | <1 | | -4 | 3 | 2.2 | 4.1 | 0 | 5 | | UC (PAF-LC) |
| 21148 | NRC148 | A6977 | 258 | 261 | 3.0 | Py | Fr | Waste | 7.4 | 0.245 | 0.23 | | 0.11 | 0.10 | 0.01 | 7 | 6 | 1 | | 1 | 6 | 0.9 | 3.2 | 3 | 11 | | PAF-LC |
| 21149 | NRC148 | A6983 | 274 | 275 | 1.0 | Pg | Fr | Waste | 8.5 | 0.164 | 0.30 | | 0.09 | 0.08 | 0.01 | 9 | 5 | 1 | | 4 | 8 | 0.5 | 3.2 | 4 | 8 | | PAF-LC |
| 21151 | NRC148 | A6985 | 276 | 277 | 1.0 | Pg | Fr | Waste | 8.2 | 0.170 | 0.27 | | 0.33 | 0.29 | 0.04 | 8 | 7 | 3 | | 1 | 5 | 0.8 | 3.6 | 2 | 6 | | PAF-LC |

| EGi Code | Hole ID | Sample ID | Depth (m) | | Interval (m) | Lithology | Oxidation | Type | $pH_{1:5}$ | $EC_{1:5}$ | ACID-BASE ANALYSIS | | | | | | | | | | | | NAG TEST | | | Reaction Comments | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | From | To | | | | | | | Total %S | CRS (%) | Total %C | Organic %C | Inorganic %C | MPA | ANC | $ANC_{TC}$ | ABCC | NAPP | $NAPP_{IC}$ | ANC/MPA | NAGpH | $NAG_{(pH4.5)}$ | $NAG_{(pH7.0)}$ | | |
| 21152 | NRC148 | A6992 | 281 | 282 | 1.0 | Pg | Fr | Waste | 8.9 | 0.134 | 0.25 | | 0.13 | 0.09 | 0.04 | 8 | 6 | 3 | | 2 | 5 | 0.8 | 3.8 | 1 | 6 | | PAF-LC |
| 21153 | NRC148 | A6993 | 282 | 283 | 1.0 | Pg | Fr | Waste | 5.9 | 0.613 | 0.14 | | 2.29 | 2.33 | <0.01 | 4 | 4 | <1 | | 0 | 4 | 0.9 | 3.9 | 1 | 6 | | UC (PAF-LC) |
| 21289 | - | - | - | - | - | Oxide Composite | | | 7.8 | 0.085 | 0.002 | | 0.03 | 0.04 | <0.01 | 0 | 1 | <1 | | -1 | 0 | 18.7 | 5.8 | 0 | 4 | | NAF |
| 21290 | - | - | - | - | - | Transition Composite | | | 7.9 | 0.083 | 0.011 | | 0.01 | 0.02 | <0.01 | 0 | 4 | <1 | | -4 | 0 | 12.2 | 5.7 | 0 | 3 | | NAF |
| 21291 | - | - | - | - | - | Fresh Composite | | | 9.5 | 0.076 | 0.034 | | 0.07 | 0.02 | 0.05 | 1 | 6 | 4 | | -5 | -3 | 5.8 | 6.3 | 0 | 1 | | NAF |

**KEY**

$pH_{1:2}$ = pH of 1:2 extract
$EC_{1:2}$ = Electrical Conductivity of 1:2 extract (dS/m)
MPA = Maximum Potential Acidity ($kgH_2SO_4/t$)
ANC = Acid Neutralising Capacity ($kgH_2SO_4/t$)
NAPP = Net Acid Producing Potential ($kgH_2SO_4/t$)

NAGpH = pH of NAG liquor
$NAG_{(pH4.5)}$ = Net Acid Generation capacity to pH 4.5 ($kgH_2SO_4/t$)
$NAG_{(pH7.0)}$ = Net Acid Generation capacity to pH 7.0 ($kgH_2SO_4/t$)

NAF = Non-Acid Forming
PAF = Potentially Acid Forming
PAF-LC = PAF - lower capacity
UC = Uncertain Classification
(expected classification in brackets)

*Table A2: Acid forming characteristics of samples from Core Lithium BP33 Project – Current and previous study sample sets*

| EGi Code | Hole ID | Sample ID | Depth (m) | | Depth (m) | Lithology | Weathering | Oxidation | Type | $pH_{1:2}$ | $EC_{1:2}$ | ACID-BASE ANALYSIS | | | | | | | | | | | | NAG TEST | | | Reaction Comments | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | From | To | | | | | | | | Total %S | CRS (%) | Total %C | Organic %C | Inorganic %C | MPA | ANC | $ANC_{TC}$ | ABCC | NAPP | $NAPP_{IC}$ | ANC/MPA | NAGpH | $NAG_{(pH4.5}$ | $NAG_{(pH7.0}$ | | |
| 21086 | FDD008 | B1174 | 326 | 327 | 327 | Py | FR | Fresh | Waste | 9.0 | 0.111 | 0.11 | | 0.02 | 0.03 | <0.01 | 3 | 7 | <1 | | -4 | 3 | 2.0 | 4.1 | 1 | 3 | | UC (PAF-LC) |
| 21087 | FRC164 | A3428 | 139 | 140 | 140 | Pg | FR | Fresh | Waste | 9.1 | 0.195 | 0.32 | | 0.27 | 0.05 | 0.22 | 10 | 25 | 18 | | -15 | -8 | 2.6 | 9.0 | 0 | 0 | | NAF |
| 21088 | FRC164 | A3429 | 140 | 141 | 141 | Pg | FR | Fresh | Waste | 8.9 | 0.272 | 0.52 | | 0.16 | 0.04 | 0.12 | 16 | 27 | 10 | | -11 | 6 | 1.7 | 8.1 | 0 | 0 | | NAF |
| 21089 | FRC164 | A3430 | 141 | 142 | 142 | Pg | FR | Fresh | Ore | 9.0 | 0.192 | 0.21 | | 0.08 | 0.05 | 0.03 | 7 | 8 | 2 | | -1 | 4 | 1.2 | 3.6 | 2 | 4 | | PAF-LC |
| 21090 | FRC164 | A3435 | 145 | 148 | 147 | Py | FR | Fresh | Waste | 9.1 | 0.159 | 0.21 | | 0.11 | 0.04 | 0.07 | 7 | 12 | 6 | | -5 | 1 | 1.8 | 3.9 | 1 | 3 | | UC (PAF-LC) |
| | FRC166 | FRC166_002 | | | 2 | Laterite | CW | Oxide | Waste | 5.5 | 0.003 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_008 | | | 8 | Py | CW | Oxide | Waste | 6.8 | 0.009 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_018 | | | 18 | Py | HW | Oxide | Waste | 7.0 | 0.008 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_032 | | | 32 | Py | HW | Oxide | Waste | 7.7 | 0.009 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_046 | | | 46 | Py | MW | Transition | Waste | 8.4 | 0.022 | 0.1 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_052 | | | 52 | Py | SW | Transition | Waste | 8.4 | 0.028 | 0.14 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_064 | | | 64 | Py | SW | Transition | Waste | 7.9 | 0.055 | 0.51 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_075 | | | 75 | Py | FR | Fresh | Waste | 8.5 | 0.032 | 0.29 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_088 | | | 88 | Py | FR | Fresh | Waste | 9.2 | 0.048 | 0.05 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_108 | | | 108 | Py | FR | Fresh | Waste | 9.2 | 0.037 | 0.09 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_144 | | | 144 | Py | FR | Fresh | Waste | 9.0 | 0.034 | 0.29 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_152 | | | 152 | Py | FR | Fresh | Waste | 9.1 | 0.039 | 0.21 | | | | | | | | | | | | | | | | |
| 21091 | FRC166 | A3512 | 212 | 213 | 213 | Py | FR | Fresh | Waste | 8.2 | 0.092 | 0.28 | 0.20 | 0.18 | 0.15 | 0.03 | 9 | 10 | 2 | 3 | -1 | 6 | 1.2 | 2.9 | 6 | 12 | | PAF |
| | FRC166 | FRC166_226 | | | 226 | Py | FR | Fresh | Waste | 9.1 | 0.055 | 0.04 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_004 | | | 4 | Py | CW | Oxide | Waste | 7.2 | 0.008 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_013 | | | 13 | Py | HW | Oxide | Waste | 7.2 | 0.007 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_020 | | | 20 | Py | HW | Oxide | Waste | 6.9 | 0.009 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_031 | | | 31 | Py | HW | Oxide | Waste | 7.0 | 0.009 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_044 | | | 44 | Py | MW | Transition | Waste | 7.8 | 0.010 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_049 | | | 49 | Py | MW | Transition | Waste | 7.0 | 0.066 | 0.14 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_060 | | | 60 | Py | SW | Transition | Waste | 8.7 | 0.033 | 0.13 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_072 | | | 72 | Py | FR | Fresh | Waste | 7.8 | 0.050 | 0.23 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_076 | | | 76 | Py | FR | Fresh | Waste | 8.6 | 0.025 | 0.05 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_098 | | | 98 | Py | FR | Fresh | Waste | 9.4 | 0.087 | 0.02 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_117 | | | 117 | Py | FR | Fresh | Waste | 9.4 | 0.088 | 0.16 | | | | | | | | | | | | | | | | |
| 21093 | FRC167 | A3515 | 124 | 125 | 125 | Pg | FR | Fresh | Waste | 9.3 | 0.121 | 0.18 | | 0.14 | 0.04 | 0.10 | 5 | 17 | 8 | | -12 | -3 | 3.2 | 4.6 | 0 | 3 | | NAF |
| 21094 | FRC167 | A3516 | 125 | 126 | 126 | Pg | FR | Fresh | Waste | 9.3 | 0.113 | 0.20 | <0.02 | 0.07 | 0.04 | 0.03 | 6 | 13 | 2 | 5 | -7 | 4 | 2.1 | 4.3 | 0 | 2 | | UC (PAF-LC) |
| 21095 | FRC167 | A3517 | 126 | 129 | 128 | Py | FR | Fresh | Waste | 9.4 | 0.126 | 0.10 | | 0.04 | 0.03 | 0.01 | 3 | 10 | 1 | | -7 | 2 | 3.2 | 5.4 | 0 | 3 | | NAF |
| | FRC167 | FRC167_140 | | | 140 | Py | FR | Fresh | Waste | 9.0 | 0.032 | 0.10 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_189 | | | 189 | Py | FR | Fresh | Waste | 9.2 | 0.052 | 0.04 | | | | | | | | | | | | | | | | |
| | FRC168 | FRC168_001 | | | 1 | Laterite | CW | Oxide | Waste | 6.0 | 0.005 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC168 | FRC168_005 | | | 5 | Py | CW | Oxide | Waste | 6.0 | 0.004 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC168 | FRC168_017 | | | 17 | Py | HW | Oxide | Waste | 6.1 | 0.004 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC168 | FRC168_042 | | | 42 | Py | MW | Transition | Waste | 7.8 | 0.012 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC168 | FRC168_045 | | | 45 | Py | MW | Transition | Waste | 7.9 | 0.012 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC168 | FRC168_052 | | | 52 | Py | SW | Transition | Waste | 8.2 | 0.012 | 0.02 | | | | | | | | | | | | | | | | |
| | FRC168 | FRC168_060 | | | 60 | Py | MW | Transition | Waste | 8.5 | 0.023 | 0.03 | | | | | | | | | | | | | | | | |
| 21097 | FRC168 | A3627 | 108 | 109 | 109 | Py | FR | Fresh | Waste | 8.8 | 0.099 | 0.16 | | 0.05 | 0.05 | 0.00 | 5 | 12 | 0 | | -7 | 5 | 2.5 | 3.7 | 1 | 6 | | PAF-LC |
| 21098 | FRC168 | A4408 | 109 | 110 | 110 | Py | FR | Fresh | Waste | 8.7 | 0.125 | 0.33 | | 0.07 | 0.04 | 0.03 | 10 | 12 | 2 | | -2 | 8 | 1.2 | 3.6 | 2 | 6 | | PAF-LC |
| 21099 | FRC168 | A4409 | 110 | 111 | 111 | Py | FR | Fresh | Waste | 8.4 | 0.162 | 0.37 | | 0.05 | 0.03 | 0.02 | 11 | 11 | 2 | | 0 | 10 | 1.0 | 3.4 | 3 | 8 | | PAF-LC |
| | FRC168 | FRC168_118 | | | 118 | Py | FR | Fresh | Waste | 8.7 | 0.076 | 0.37 | | | | | | | | | | | | | | | | |
| | FRC169 | FRC169_002 | | | 2 | Laterite | CW | Oxide | Waste | 7.3 | 0.010 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC169 | FRC169_004 | | | 4 | Py | CW | Oxide | Waste | 7.3 | 0.005 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC169 | FRC169_014 | | | 14 | Py | HW | Oxide | Waste | 7.1 | 0.007 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC169 | FRC169_026 | | | 26 | Py | HW | Oxide | Waste | 7.6 | 0.007 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC169 | FRC169_036 | | | 36 | Py | MW | Transition | Waste | 8.3 | 0.014 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC169 | FRC169_057 | | | 57 | Py | SW | Transition | Waste | 8.5 | 0.018 | 0.03 | | | | | | | | | | | | | | | | |
| | FRC169 | FRC169_065 | | | 65 | Py | FR | Fresh | Waste | 6.6 | 0.120 | 1.05 | | | | | | | | | | | | | | | | |
| 21101 | FRC169 | A3629 | 66 | 69 | 68 | Py | FR | Fresh | Waste | 5.8 | 0.752 | 1.10 | | 0.08 | 0.05 | 0.03 | 34 | 11 | 2 | | 23 | 31 | 0.3 | 2.9 | 13 | 26 | *Reacted* | PAF |

| EGi Code | Hole ID | Sample ID | Depth (m) | | Depth (m) | Lithology | Weathering | Oxidation | Type | $pH_{1:2}$ | $EC_{1:2}$ | ACID-BASE ANALYSIS | | | | | | | | | | | | NAG TEST | | | Reaction Comments | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | From | To | | | | | | | | Total %S | CRS (%) | Total %C | Organic %C | Inorganic %C | MPA | ANC | $ANC_{TC}$ | ABCC | NAPP | $NAPP_{tC}$ | ANC/MPA | NAGpH | $NAG_{(pH4.5}$ | $NAG_{(pH7.0}$ | | |
| 21102 | FRC169 | A3630 | 69 | 70 | 70 | Py | FR | Fresh | Waste | 6.0 | 0.346 | 0.96 | | 0.16 | 0.03 | 0.13 | 29 | 15 | 11 | | 14 | 19 | 0.5 | 2.7 | 16 | 27 | *Reacted* | PAF |
| 21103 | FRC169 | A3632 | 70 | 71 | 71 | Py | FR | Fresh | Waste | 7.1 | 0.337 | 0.36 | 0.12 | 0.15 | 0.05 | 0.10 | 11 | 25 | 8 | 4 | -14 | 3 | 2.2 | 3.5 | 3 | 7 | | PAF-LC |
| | FRC169 | FRC169_153 | | | 153 | Py | FR | Fresh | Waste | 9.0 | 0.033 | 0.07 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_004 | | | 4 | SOIL | CW | Oxide | Waste | 6.0 | 0.004 | 0.02 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_011 | | | 11 | Py | CW | Oxide | Waste | 6.7 | 0.004 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_023 | | | 23 | Py | HW | Oxide | Waste | 7.5 | 0.006 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_035 | | | 35 | Py | HW | Oxide | Waste | 7.6 | 0.009 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_044 | | | 44 | Py | MW | Transition | Waste | 8.0 | 0.007 | 0.02 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_056 | | | 56 | Py | SW | Transition | Waste | 8.5 | 0.016 | 0.02 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_064 | | | 64 | Py | FR | Fresh | Waste | 9.0 | 0.023 | 0.02 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_099 | | | 99 | Py | FR | Fresh | Waste | 9.2 | 0.076 | 0.02 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_142 | | | 142 | Py | FR | Fresh | Waste | 9.4 | 0.041 | 0.03 | | | | | | | | | | | | | | | | |
| | FRC171 | FRC171_040 | | | 40 | Py | MW | Transition | Waste | 8.1 | 0.007 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC171 | FRC171_065 | | | 65 | Py | SW | Transition | Waste | 6.2 | 0.002 | <0.01 | | | | | | | | | | | | | | | | |
| 21106 | FRC172 | A3764 | 186 | 187 | 187 | Pg | FR | Fresh | Waste | 8.4 | 0.054 | 0.34 | | 0.02 | 0.03 | <0.01 | 10 | 6 | <1 | | 4 | 10 | 0.6 | 3.6 | 1 | 3 | | PAF-LC |
| 21107 | FRC172 | A3795 | 219 | 222 | 221 | Py | FR | Fresh | Waste | 8.2 | 0.143 | 0.28 | | 0.04 | 0.04 | <0.01 | 9 | 10 | <1 | | -1 | 9 | 1.2 | 3.6 | 2 | 6 | | PAF-LC |
| 21108 | FRC172 | A3796 | 222 | 223 | 223 | Py | FR | Fresh | Waste | 7.5 | 0.231 | 0.53 | | 0.02 | 0.03 | <0.01 | 16 | 9 | <1 | | 7 | 16 | 0.6 | 3.0 | 9 | 15 | | PAF |
| 21109 | FRC172 | A3797 | 223 | 224 | 224 | Py | FR | Fresh | Waste | 7.5 | 0.122 | 0.60 | 0.39 | 0.02 | 0.03 | <0.01 | 18 | 18 | <1 | 3 | 0 | 18 | 1.0 | 2.8 | 12 | 16 | | PAF |
| 21110 | FRC172 | A3798 | 224 | 225 | 225 | Pg | FR | Fresh | Waste | 8.5 | 0.096 | 0.30 | 0.13 | 0.03 | 0.04 | <0.01 | 9 | 14 | <1 | 3 | -5 | 9 | 1.5 | 3.2 | 5 | 8 | | PAF-LC |
| 21112 | FRC174 | A3972 | 190 | 191 | 191 | Py | FR | Fresh | Waste | 8.4 | 0.123 | 0.31 | | 0.14 | 0.07 | 0.07 | 9 | 5 | 6 | | 4 | 4 | 0.5 | 3.7 | 1 | 5 | | PAF-LC |
| 21114 | FRC203 | C3610 | 81 | 82 | 82 | Sst | FR | Fresh | Waste | 8.8 | 0.087 | 0.11 | | 0.03 | 0.05 | <0.01 | 3 | 7 | <1 | | -4 | 3 | 2.1 | 5.4 | 0 | 2 | | UC (NAF) |
| 21115 | FRC205 | C3617 | 138 | 141 | 140 | Sst | FR | Fresh | Waste | 8.5 | 0.137 | 0.29 | | 0.04 | 0.06 | <0.01 | 9 | 7 | <1 | | 2 | 9 | 0.8 | 3.7 | 2 | 5 | | PAF-LC |
| 21116 | FRC205 | C3669 | 184 | 185 | 185 | Pg | FR | Fresh | Ore | 9.7 | 0.275 | 0.20 | | 0.02 | 0.03 | <0.01 | 6 | 4 | <1 | | 2 | 6 | 0.7 | 3.8 | 1 | 3 | | PAF-LC |
| 21118 | FRC205 | C3696 | 207 | 208 | 208 | Pg | FR | Fresh | Ore | 9.5 | 0.302 | 0.13 | | 0.01 | 0.02 | <0.01 | 4 | 5 | <1 | | -1 | 4 | 1.3 | 4.0 | 0 | 3 | | UC (PAF-LC) |
| 21119 | FRC205 | C3697 | 208 | 209 | 209 | Pg | FR | Fresh | Waste | 8.8 | 0.365 | 0.24 | | 0.01 | 0.02 | <0.01 | 7 | 4 | <1 | | 3 | 7 | 0.5 | 3.3 | 4 | 7 | | PAF-LC |
| 21122 | FRC205 | C3709 | 218 | 219 | 219 | Pg | FR | Fresh | Waste | 7.9 | 0.279 | 0.26 | | 0.03 | 0.03 | <0.01 | 8 | 5 | <1 | | 3 | 8 | 0.6 | 3.7 | 2 | 6 | | PAF-LC |
| 21123 | FRC206 | C3782 | 137 | 138 | 138 | Py | FR | Fresh | Waste | 8.6 | 0.096 | 0.13 | | 0.06 | 0.04 | 0.02 | 4 | 10 | 2 | | -6 | 2 | 2.4 | 3.7 | 2 | 5 | | UC (PAF-LC) |
| | FRC212 | FRC212 - 8 | | | 8 | Pg | HW | Oxide | Waste | 8.0 | 0.015 | <0.01 | | | | | <0.3 | 8 | | | -8 | | >25 | 6.6 | <0.1 | 1 | | NAF |
| | FRC212 | FRC212 - 15 | | | 15 | Py | MW | Transition | Waste | 7.9 | 0.017 | <0.01 | | | | | <0.3 | 12 | | | -12 | | >40 | 7.4 | <0.1 | <0.1 | | NAF |
| | FRC212 | FRC212 - 44 | | | 44 | Py | MW | Transition | Waste | 7.9 | 0.021 | <0.01 | | | | | <0.3 | 16 | | | -16 | | >54 | 7.3 | <0.1 | <0.1 | | NAF |
| | FRC212 | FRC212 - 53 | | | 53 | Pg | MW | Transition | Waste | 8.7 | 0.038 | <0.01 | | | | | <0.3 | 13 | | | -13 | | >42 | 7.0 | <0.1 | <0.1 | | NAF |
| | FRC212 | FRC212 - 66 | | | 66 | Py | SW | Transition | Waste | 8.9 | 0.042 | <0.01 | | | | | <0.3 | 14 | | | -14 | | >47 | 6.2 | <0.1 | 4 | | NAF |
| | FRC212 | FRC212 - 81 | | | 81 | Pg | FR | Fresh | Waste | 8.5 | 0.039 | <0.01 | | | | | <0.3 | 13 | | | -13 | | >44 | 6.8 | <0.1 | 1 | | NAF |
| | FRC212 | FRC212 - 88 | | | 88 | Py | FR | Fresh | Waste | 8.6 | 0.072 | 0.02 | | | | | 1 | 23 | | | -22 | | 37.6 | 6.2 | <0.1 | 2 | | NAF |
| 21125 | FRC212 | A6714 | 88 | 89 | 89 | Py | FR | Fresh | Waste | 9.0 | 0.111 | 0.12 | | 0.04 | 0.03 | 0.01 | 4 | 14 | 1 | | -10 | 3 | 3.7 | 4.7 | 0 | 3 | | UC (NAF) |
| | FRC212 | FRC212 - 92 | | | 92 | Pg | FR | Fresh | Waste | 9.3 | 0.050 | <0.01 | | | | | <0.3 | 12 | | | -12 | | >41 | 7.2 | <0.1 | <0.1 | | NAF |
| | FRC212 | FRC212 - 97 | | | 97 | Pg | FR | Fresh | Ore | 9.3 | 0.051 | <0.01 | | | | | <0.3 | 13 | | | -13 | | >42 | 6.0 | <0.1 | 4 | | NAF |
| | FRC212 | FRC212 - 109 | | | 109 | Pg | FR | Fresh | Ore | 9.4 | 0.129 | <0.01 | | | | | <0.3 | 16 | | | -16 | | >53 | 7.6 | <0.1 | <0.1 | | NAF |
| | FRC212 | FRC212 - 122 | | | 122 | Pg | FR | Fresh | Ore | 9.6 | 0.130 | <0.01 | | | | | <0.3 | 12 | | | -12 | | >41 | 7.0 | <0.1 | 1 | | NAF |
| | FRC212 | FRC212 - 131 | | | 131 | Pg | FR | Fresh | Waste | 9.3 | 0.077 | 0.01 | | | | | 0.3 | 36 | | | -35 | | 116.3 | 7.1 | <0.1 | <0.1 | | NAF |
| | FRC212 | FRC212 - 143 | | | 143 | Py | FR | Fresh | Waste | 9.4 | 0.076 | 0.07 | | | | | 2 | 21 | | | -19 | | 9.8 | 6.2 | <0.1 | 1 | | NAF |
| | FRC213 | FRC213 - 5 | | | 5 | Py | HW | Oxide | Waste | 8.1 | 0.012 | <0.01 | | | | | <0.3 | 11 | | | -11 | | >35 | 6.7 | <0.1 | 1 | | NAF |
| | FRC213 | FRC213 - 26 | | | 26 | Py | MW | Transition | Waste | 7.7 | 0.016 | <0.01 | | | | | <0.3 | 14 | | | -14 | | >45 | 7.4 | <0.1 | <0.1 | | NAF |
| | FRC213 | FRC213 - 37 | | | 37 | Pg | HW | Oxide | Waste | 8.1 | 0.032 | <0.01 | | | | | <0.3 | 16 | | | -16 | | >53 | 7.6 | <0.1 | <0.1 | | NAF |
| | FRC213 | FRC213 - 58 | | | 58 | Py | SW | Transition | Waste | 8.7 | 0.030 | <0.01 | | | | | <0.3 | 17 | | | -17 | | >56 | 6.2 | <0.1 | 3 | | NAF |
| | FRC213 | FRC213 - 62 | | | 62 | Pg | SW | Transition | Waste | 8.3 | 0.056 | <0.01 | | | | | <0.3 | 13 | | | -13 | | >43 | 6.8 | <0.1 | 1 | | NAF |
| | FRC213 | FRC213 - 67 | | | 67 | Pg | SW | Transition | Waste | 8.4 | 0.037 | 0.02 | | | | | 1 | 22 | | | -21 | | 35.1 | 6.8 | <0.1 | 1 | | NAF |
| 21126 | FRC213 | A6787 | 68 | 69 | 69 | Py | SW | Transition | Waste | 7.9 | 0.107 | 0.20 | | 0.07 | 0.06 | 0.01 | 6 | 14 | 1 | | -8 | 5 | 2.3 | 4.7 | 0 | 2 | | UC (NAF) |
| | FRC213 | FRC213 - 86 | | | 86 | Pg | FR | Fresh | Waste | 9.2 | 0.048 | 0.09 | | | | | 3 | 16 | | | -13 | | 5.7 | 4.4 | 0 | 2.4 | | UC (NAF) |
| | FRC213 | FRC213 - 107 | | | 107 | Sst | FR | Fresh | Waste | 9.4 | 0.082 | 0.02 | | | | | 1 | 22 | | | -21 | | 35.3 | 6.8 | <0.1 | 0.6 | | NAF |
| | FRC213 | FRC213 - 131 | | | 131 | Py | FR | Fresh | Waste | 9.5 | 0.089 | 0.03 | | | | | 1 | 15 | | | -14 | | 16.8 | 7.2 | <0.1 | <0.1 | | NAF |
| | FRC213 | FRC213 - 142 | | | 142 | Pg | FR | Fresh | Ore | 8.7 | 0.072 | 0.02 | | | | | 1 | 19 | | | -19 | | 31.5 | 7.2 | <0.1 | <0.1 | | NAF |
| | FRC213 | FRC213 - 148 | | | 148 | Pg | FR | Fresh | Ore | 9.4 | 0.128 | <0.01 | | | | | <0.3 | 10 | | | -10 | | >33 | 7.8 | <0.1 | <0.1 | | NAF |
| | FRC213 | FRC213 - 156 | | | 156 | Pg | FR | Fresh | Ore | 8.3 | 0.107 | 0.02 | | | | | 1 | 9 | | | -9 | | 15.4 | 6.6 | <0.1 | 0.8 | | NAF |
| | FRC213 | FRC213 - 170 | | | 170 | Pg | FR | Fresh | Ore | 9.5 | 0.143 | <0.01 | | | | | <0.3 | 10 | | | -10 | | >33 | 7.3 | <0.1 | <0.1 | | NAF |

| EGi Code | Hole ID | Sample ID | Depth (m) | | Depth (m) | Lithology | Weathering | Oxidation | Type | $pH_{1:2}$ | $EC_{1:2}$ | ACID-BASE ANALYSIS | | | | | | | | | | | | NAG TEST | | | Reaction Comments | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | From | To | | | | | | | | Total %S | CRS (%) | Total %C | Organic %C | Inorganic %C | MPA | ANC | $ANC_{TC}$ | ABCC | NAPP | $NAPP_{tC}$ | ANC/MPA | NAGpH | $NAG_{(pH4.5)}$ | $NAG_{(pH7.0)}$ | | |
| | FRC213 | FRC213 - 178 | | | 178 | Pg | FR | Fresh | Ore | 9.4 | 0.138 | <0.01 | | | | | <0.3 | 13 | | | -13 | | >44 | 7.9 | <0.1 | <0.1 | | NAF |
| | FRC213 | FRC213 - 187 | | | 187 | Py | FR | Fresh | Waste | 9.1 | 0.089 | 0.10 | | | | | 3 | 19 | | | -16 | | 6.1 | 5.8 | <0.1 | 0.9 | | NAF |
| | FRC214 | FRC214 - 6 | | | 6 | Py | CW | Oxide | Waste | 7.9 | 0.032 | <0.01 | | | | | <0.3 | 10 | | | -10 | | >32 | 7.4 | <0.1 | <0.1 | | NAF |
| | FRC214 | FRC214 - 13 | | | 13 | Py | HW | Oxide | Waste | 7.3 | 0.018 | <0.01 | | | | | <0.3 | 8 | | | -8 | | >27 | 7.1 | <0.1 | <0.1 | | NAF |
| | FRC214 | FRC214 - 20 | | | 20 | Py | CW | Oxide | Waste | 7.7 | 0.030 | <0.01 | | | | | <0.3 | 10 | | | -10 | | >32 | 7.2 | <0.1 | <0.1 | | NAF |
| | FRC214 | FRC214 - 34 | | | 34 | Py | HW | Oxide | Waste | 8.5 | 0.034 | <0.01 | | | | | <0.3 | 14 | | | -14 | | >46 | 7.4 | <0.1 | <0.1 | | NAF |
| | FRC214 | FRC214 - 45 | | | 45 | Py | MW | Transition | Waste | 8.6 | 0.034 | <0.01 | | | | | <0.3 | 14 | | | -14 | | >47 | 7.3 | <0.1 | <0.1 | | NAF |
| | FRC214 | FRC214 - 50 | | | 50 | Py | SW | Transition | Waste | 8.9 | 0.040 | <0.01 | | | | | <0.3 | 14 | | | -14 | | >46 | 7.3 | <0.1 | <0.1 | | NAF |
| | FRC214 | FRC214 - 74 | | | 74 | Py | FR | Fresh | Waste | 9.0 | 0.048 | 0.01 | | | | | 0 | 14 | | | -14 | | 45.8 | 7.2 | <0.1 | <0.1 | | NAF |
| | FRC214 | FRC214 - 102 | | | 102 | Pg | FR | Fresh | Ore | 9.2 | 0.115 | <0.01 | | | | | <0.3 | 11 | | | -11 | | >38 | 6.9 | <0.1 | 0.5 | | NAF |
| | FRC214 | FRC214 - 116 | | | 116 | Pg | FR | Fresh | Waste | 9.1 | 0.056 | 0.04 | | | | | 1 | 13 | | | -12 | | 10.5 | 6.4 | <0.1 | 0.4 | | NAF |
| 21129 | FRCD016 | B1053 | 276.2 | 277 | 277 | Py | FR | Fresh | Waste | 9.3 | 0.133 | 0.14 | | 0.12 | 0.02 | 0.10 | 4 | 12 | 8 | | -8 | -4 | 2.8 | 6.7 | 0 | 0 | | NAF |
| 21130 | NRC057 | A4851 | 105 | 106 | 106 | Py | FR | Fresh | Waste | 8.5 | 0.059 | 0.16 | 0.03 | 0.04 | 0.04 | <0.01 | 5 | 15 | <1 | 1 | -10 | 5 | 3.0 | 3.5 | 2 | 5 | | PAF-LC |
| 21132 | NRC057 | A4854 | 108 | 109 | 109 | Py | FR | Fresh | Waste | 8.6 | 0.133 | 0.28 | | 0.05 | 0.05 | <0.01 | 9 | 10 | <1 | | -1 | 9 | 1.2 | 4.2 | 0 | 4 | | UC (PAF-LC) |
| 21134 | NRC057 | A4857 | 111 | 112 | 112 | Py | FR | Fresh | Waste | 8.3 | 0.096 | 0.21 | 0.02 | 0.04 | 0.03 | 0.01 | 6 | 16 | 1 | 3 | -10 | 6 | 2.5 | 3.6 | 1 | 5 | | PAF-LC |
| 21135 | NRC057 | A4858 | 112 | 113 | 113 | Pg | FR | Fresh | Waste | 8.1 | 0.140 | 0.21 | 0.08 | 0.13 | 0.13 | <0.01 | 6 | 19 | <1 | 5 | -13 | 6 | 3.0 | 3.6 | 1 | 5 | | PAF-LC |
| 21138 | NRC057 | A4869 | 122 | 123 | 123 | Sst | FR | Fresh | Waste | 8.4 | 0.091 | 0.15 | | 0.17 | 0.15 | 0.02 | 5 | 12 | 2 | | -7 | 3 | 2.6 | 5.0 | 0 | 2 | | UC (NAF) |
| 21140 | NRC057 | A4873 | 125 | 126 | 126 | Pg | FR | Fresh | Waste | 8.4 | 0.150 | 0.32 | | 0.02 | 0.03 | <0.01 | 10 | 14 | <1 | | -4 | 10 | 1.4 | 3.5 | 3 | 7 | | PAF-LC |
| 21141 | NRC057 | A4875 | 127 | 128 | 128 | Pg | FR | Fresh | Waste | 9.1 | 0.201 | 0.22 | 0.07 | 0.07 | 0.06 | 0.01 | 7 | 15 | 1 | 6 | -8 | 6 | 2.2 | 4.2 | 0 | 4 | | PAF-LC |
| | NRC129 | NRC129 - 4 | | | 4 | Py | EW | Oxide | Waste | 5.6 | 0.007 | <0.01 | | | | | <0.3 | 8 | | | -8 | | >27 | 5.6 | <0.1 | 1 | | NAF |
| | NRC129 | NRC129 - 20 | | | 20 | Py | MW | Transition | Waste | 7.0 | 0.015 | <0.01 | | | | | <0.3 | 12 | | | -12 | | >41 | 7.3 | <0.1 | <0.1 | | NAF |
| | NRC129 | NRC129 - 55 | | | 55 | Py | SW | Transition | Waste | 8.3 | 0.082 | 0.14 | | | | | 4 | 19 | | | -15 | | 4.4 | 4.4 | 0.2 | 3 | | UC (PAF-LC) |
| | NRC129 | NRC129 - 68 | | | 68 | Sst | FR | Fresh | Waste | 9.0 | 0.052 | 0.05 | | | | | 2 | 15 | | | -14 | | 9.9 | 5.6 | <0.1 | 3 | | NAF |
| | NRC129 | NRC129 - 89 | | | 89 | Py | FR | Fresh | Waste | 8.8 | 0.062 | 0.17 | | | | | 5 | 18 | | | -12 | | 3.4 | 3.8 | 2 | 7 | | UC (PAF-LC) |
| 21143 | NRC129 | A6640 | 93 | 96 | 95 | Pg | FR | Fresh | Waste | 8.5 | 0.135 | 0.38 | | 0.09 | 0.08 | 0.01 | 12 | 8 | 1 | | 4 | 11 | 0.7 | 3.6 | 2 | 8 | | PAF-LC |
| | NRC129 | NRC129 - 98 | | | 98 | Pg | FR | Fresh | Waste | 9.0 | 0.069 | 0.02 | | | | | 1 | 13 | | | -13 | | 21.9 | 6.9 | <0.1 | 0.4 | | NAF |
| | NRC129 | NRC129 - 134 | | | 134 | Py | FR | Fresh | Waste | 9.3 | 0.095 | 0.42 | | | | | 13 | 17 | | | -4 | | 1.3 | 3.4 | 6 | 8 | | UC (PAF) |
| 21144 | NRC148 | A6967 | 246 | 247 | 247 | Pg | FR | Fresh | Waste | 8.1 | 0.166 | 0.20 | 0.04 | 0.21 | 0.19 | 0.02 | 6 | 12 | 2 | 4 | -6 | 5 | 1.9 | 3.2 | 3 | 9 | | PAF-LC |
| 21145 | NRC148 | A6968 | 247 | 250 | 249 | Py | FR | Fresh | Waste | 8.2 | 0.116 | 0.27 | | 0.10 | 0.08 | 0.02 | 8 | 6 | 2 | | 2 | 6 | 0.7 | 3.1 | 4 | 10 | | PAF-LC |
| 21146 | NRC148 | A6969 | 250 | 253 | 252 | Py | FR | Fresh | Waste | 8.0 | 0.140 | 0.11 | | 0.55 | 0.58 | <0.01 | 3 | 7 | <1 | | -4 | 3 | 2.2 | 4.1 | 0 | 5 | | UC (PAF-LC) |
| 21148 | NRC148 | A6977 | 258 | 261 | 260 | Py | FR | Fresh | Waste | 7.4 | 0.245 | 0.23 | | 0.11 | 0.10 | 0.01 | 7 | 6 | 1 | | 1 | 6 | 0.9 | 3.2 | 3 | 11 | | PAF-LC |
| 21149 | NRC148 | A6983 | 274 | 275 | 275 | Pg | FR | Fresh | Waste | 8.5 | 0.164 | 0.30 | | 0.09 | 0.08 | 0.01 | 9 | 5 | 1 | | 4 | 8 | 0.5 | 3.2 | 4 | 8 | | PAF-LC |
| 21151 | NRC148 | A6985 | 276 | 277 | 277 | Pg | FR | Fresh | Waste | 8.2 | 0.170 | 0.27 | | 0.33 | 0.29 | 0.04 | 8 | 7 | 3 | | 1 | 5 | 0.8 | 3.6 | 2 | 6 | | PAF-LC |
| 21152 | NRC148 | A6992 | 281 | 282 | 282 | Pg | FR | Fresh | Waste | 8.9 | 0.134 | 0.25 | | 0.13 | 0.09 | 0.04 | 8 | 6 | 3 | | 2 | 5 | 0.8 | 3.8 | 1 | 6 | | PAF-LC |
| 21153 | NRC148 | A6993 | 282 | 283 | 283 | Pg | FR | Fresh | Waste | 5.9 | 0.613 | 0.14 | | 2.29 | 2.33 | <0.01 | 4 | 4 | <1 | | 0 | 4 | 0.9 | 3.9 | 1 | 6 | | UC (PAF-LC) |

**KEY**

$pH_{1:2}$ = pH of 1:2 extract
$EC_{1:2}$ = Electrical Conductivity of 1:2 extract (dS/m)
MPA = Maximum Potential Acidity ($kgH_2SO_4/t$)
ANC = Acid Neutralising Capacity ($kgH_2SO_4/t$)
NAPP = Net Acid Producing Potential ($kgH_2SO_4/t$)

NAGpH = pH of NAG liquor
$NAG_{(pH4.5)}$ = Net Acid Generation capacity to pH 4.5 ($kgH_2SO_4/t$)
$NAG_{(pH7.0)}$ = Net Acid Generation capacity to pH 7.0 ($kgH_2SO_4/t$)

NAF = Non-Acid Forming
PAF = Potentially Acid Forming
PAF-LC = PAF - lower capacity
UC = Uncertain Classification
(expected classification in brackets

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# APPENDIX B
# ABCC Test Results

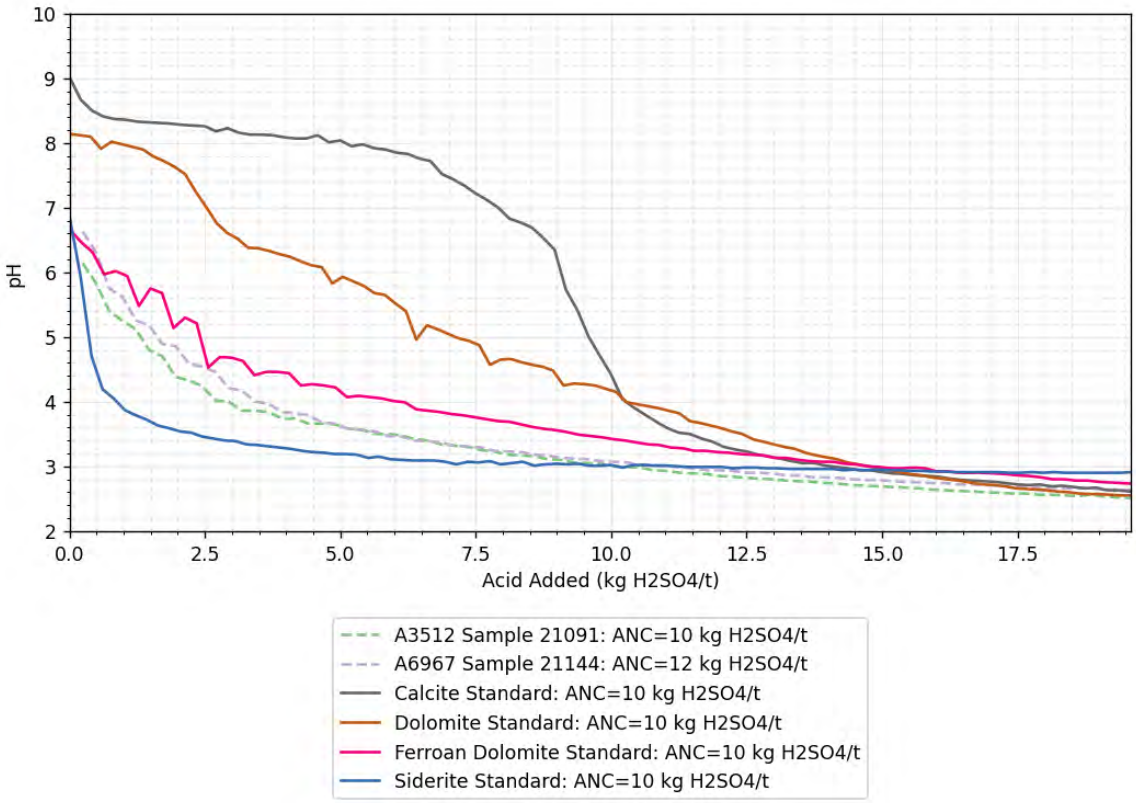


*Figure B16: ABCC profile for samples 21091, 21144 with an ANC value close to 10 kg H2SO4/t. Carbonate standard curves are included for reference. Note sample IDs used here are the EGi Codes. Sample details for each EGi Code can be found in Table A1 (Appendix A).*

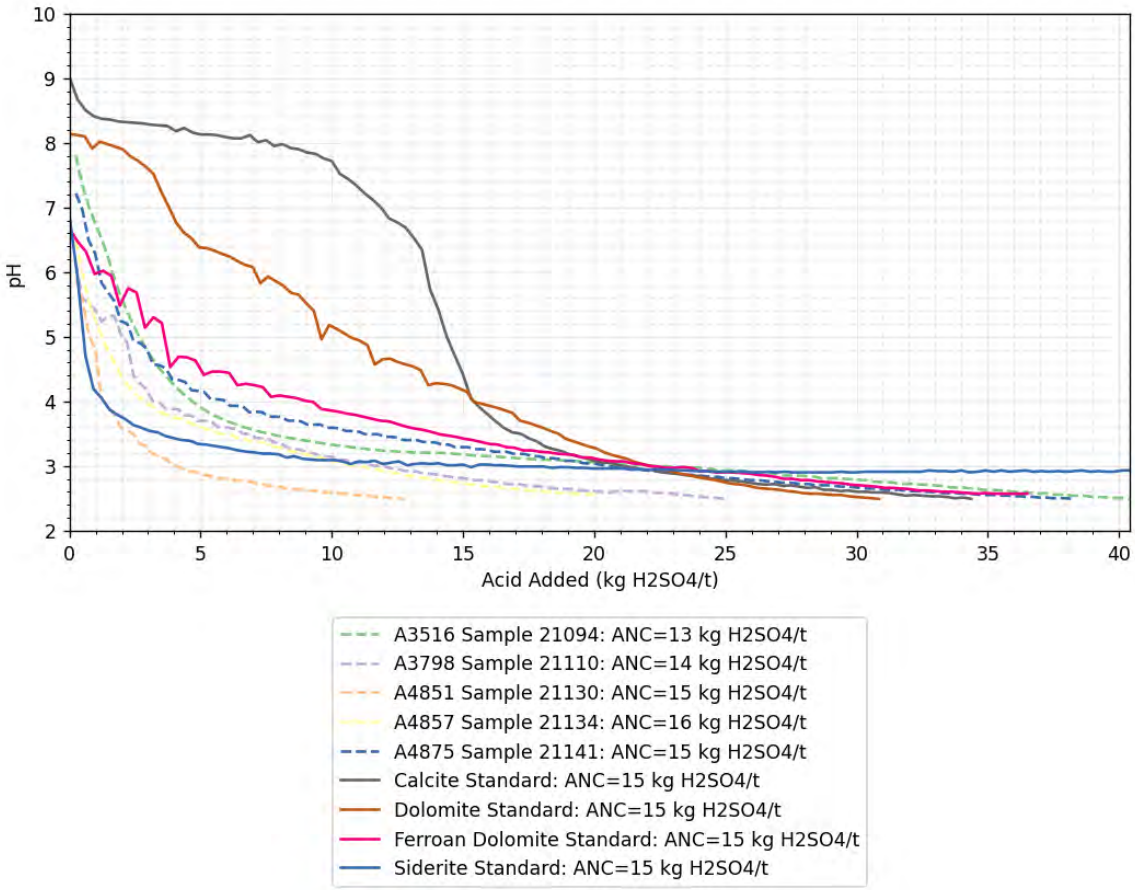


*Figure B17: ABCC profile for samples 21094, 21110, 21130, 21134, 21141 with an ANC value close to 15 kg H2SO4/t. Carbonate standard curves are included for reference. Note sample IDs used here are the EGi Codes. Sample details for each EGi Code can be found in Table A1 (Appendix A).*

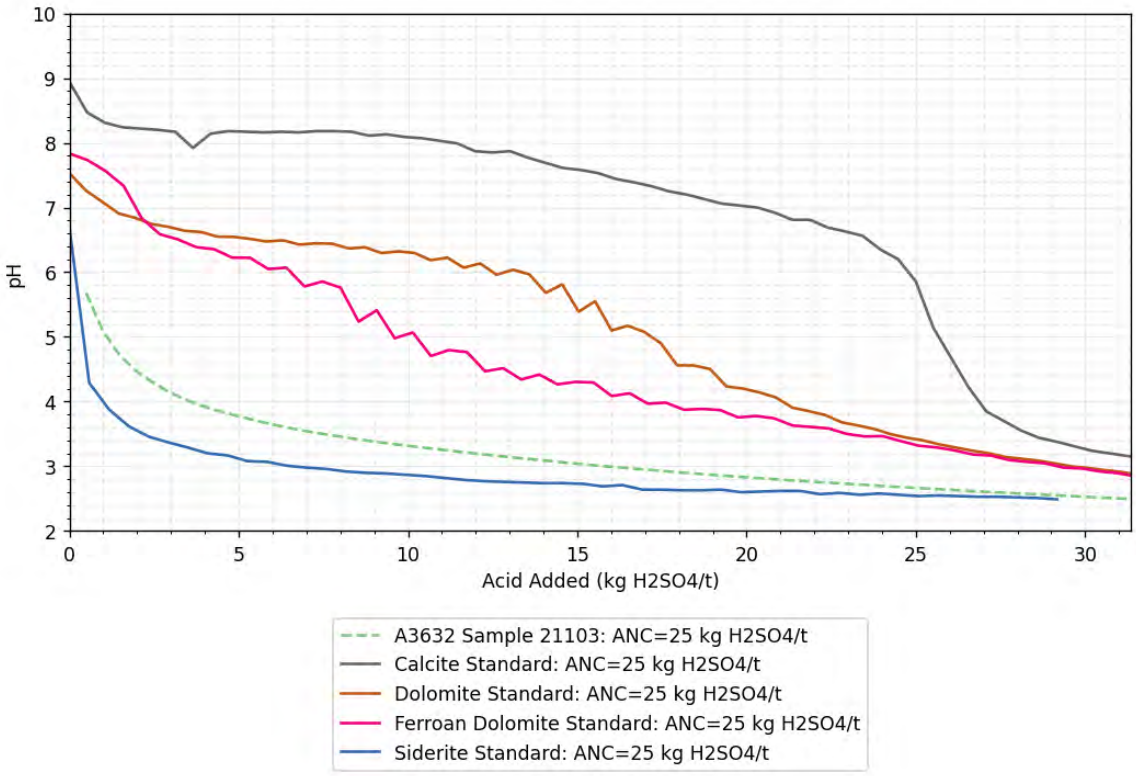


*Figure B18: ABCC profile for sample 21103 with an ANC value close to 25 kg H2SO4/t. Carbonate standard curves are included for reference. Note sample IDs used here are the EGi Codes. Sample details for each EGi Code can be found in Table A1 (Appendix A).*

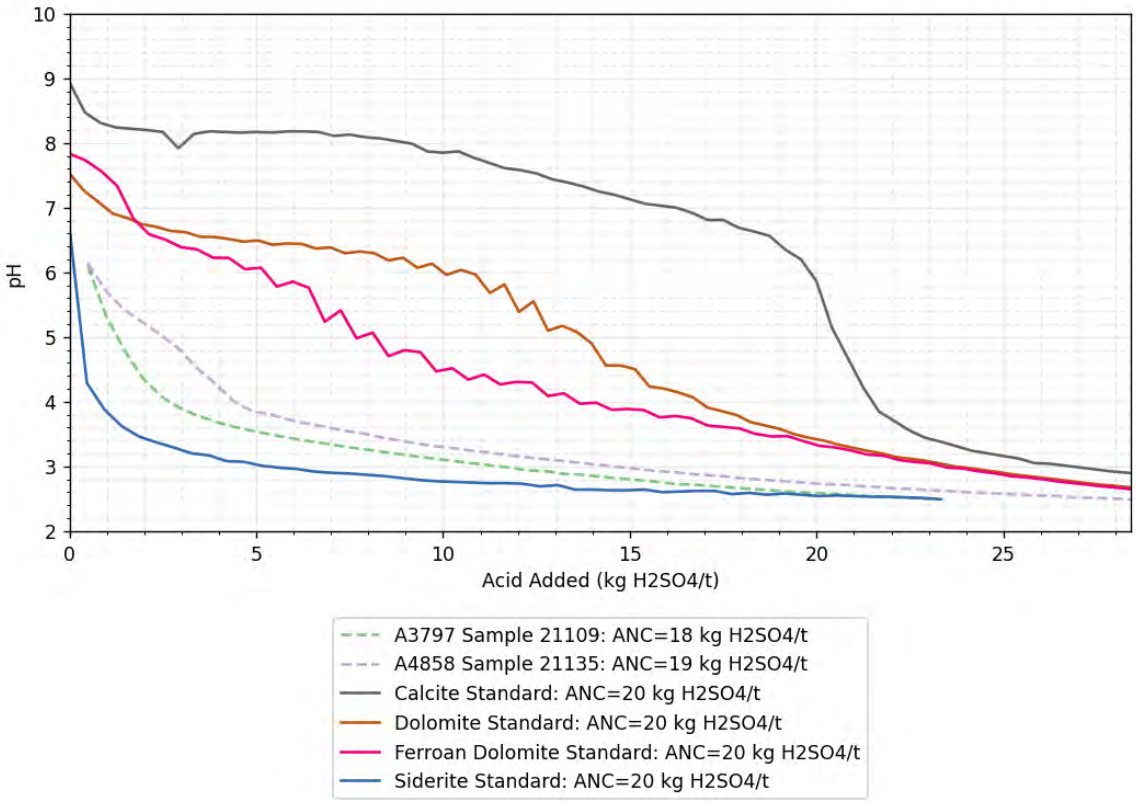


*Figure B19: ABCC profile for samples 21109, 21135 with an ANC value close to 20 kg H2SO4/t. Carbonate standard curves are included for reference. Note sample IDs used here are the EGi Codes. Sample details for each EGi Code can be found in Table A1 (Appendix A).*

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# APPENDIX C
# Bulk Assay Results

*Table C1: Multi-element assay results for selected samples from Core Lithium BP33 Project. All results are ppm except where indicated. Note sample IDs used here are the EGi Codes. Sample details for each EGi Code can be found in Table A1 (Appendix A).*

| | | Sample ID | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Element | Detection Limit | 21095 | 21093 | 21291 | 21290 | 21138 | 21134 | 21109 | 21102 | 21086 | 21289 |
| Ag | 0.01 | 0.01 | 0.03 | 0.04 | 0.05 | 0.08 | 0.11 | 0.22 | 0.26 | 0.28 | 0.59 |
| Al | 0.01% | 6.72% | 5.95% | 6.20% | 5.79% | 6.82% | 7.45% | 8.39% | 6.07% | 6.54% | 6.63% |
| As | 0.2 | 2710 | 5370 | 70.7 | 65.1 | 1100 | 6180 | 11350 | 380 | 397 | 87.1 |
| Ba | 10 | 570 | 360 | 550 | 570 | 400 | 490 | 450 | 580 | 590 | 370 |
| Be | 0.05 | 18.9 | 36 | 2.17 | 2.88 | 59.1 | 56.2 | 38.3 | 16 | 9.12 | 40 |
| Bi | 0.01 | 1.02 | 1.93 | 0.28 | 0.52 | 0.87 | 2.8 | 2.45 | 1.82 | 0.65 | 0.79 |
| Ca | 0.01% | 0.37% | 0.68% | 0.28% | 0.24% | 0.52% | 0.85% | 1.14% | 0.84% | 0.20% | 0.04% |
| Cd | 0.02 | 0.66 | 0.55 | 0.02 | 0.03 | 0.67 | 1.58 | 0.86 | 0.39 | 1.9 | 0.06 |
| Ce | 0.01 | 77.5 | 50.5 | 79.7 | 80.7 | 56.9 | 17.15 | 26.3 | 90.1 | 63.2 | 59 |
| Co | 0.1 | 8.2 | 6 | 7.4 | 9.1 | 7.1 | 12.4 | 9.9 | 9.3 | 11.5 | 6.1 |
| Cr | 1 | 129 | 149 | 71 | 76 | 357 | 112 | 69 | 105 | 76 | 99 |
| Cs | 0.05 | 500 | 321 | 47.6 | 159.5 | 452 | >500 | 225 | >500 | >500 | 99 |
| Cu | 0.2 | 3.8 | 4 | 16.7 | 14.9 | 16.2 | 3.9 | 8.5 | 69.8 | 29 | 16.2 |
| Fe | 0.01% | 2.65% | 2.19% | 2.96% | 2.58% | 2.35% | 3.22% | 2.23% | 5.86% | 4.11% | 2.46% |
| Ga | 0.05 | 19.55 | 24.4 | 17.6 | 15.65 | 18.95 | 22.1 | 27.7 | 18.55 | 20.2 | 19.75 |
| Ge | 0.05 | 0.16 | 0.14 | 0.19 | 0.15 | 0.15 | 0.12 | 0.13 | 0.17 | 0.15 | 0.16 |
| Hf | 0.01 | 5.2 | 4.4 | 5.3 | 5.8 | 4.3 | 6.5 | 4 | 3.8 | 4.5 | 5.1 |
| Hg | 0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.007 | <0.005 | 0.008 |
| In | 0.005 | 0.155 | 0.153 | 0.049 | 0.046 | 0.14 | 0.319 | 0.185 | 0.113 | 0.125 | 0.042 |
| K | 0.01% | 3.23% | 2.76% | 2.72% | 2.38% | 3.05% | 3.80% | 4.01% | 2.38% | 3.14% | 2.09% |
| La | 0.5 | 38.5 | 24.9 | 39.9 | 41.8 | 29.7 | 7.1 | 12.3 | 46.4 | 32 | 31.6 |
| Li | 0.2 | 1490 | 820 | 153 | 200 | 2340 | 2560 | 1380 | 900 | 840 | 113 |
| Mg | 0.01% | 0.55% | 0.36% | 0.66% | 0.53% | 0.45% | 0.63% | 0.42% | 0.64% | 0.79% | 0.25% |
| Mn | 5 | 328 | 486 | 329 | 196 | 299 | 211 | 335 | 2000 | 526 | 243 |
| Mo | 0.05 | 1.09 | 1.3 | 0.24 | 0.2 | 2 | 0.57 | 0.44 | 0.88 | 0.91 | 0.52 |
| Na | 0.01% | 0.23% | 0.62% | 0.68% | 0.60% | 0.68% | 0.12% | 0.88% | 0.27% | 0.36% | 1.16% |
| Nb | 0.1 | 14.5 | 31.3 | 11.4 | 11 | 31.2 | 23.6 | 23.3 | 16.3 | 11.7 | 54.6 |
| Ni | 0.2 | 18.6 | 14.5 | 15.5 | 16.5 | 21.4 | 21.3 | 14.3 | 25 | 20 | 12.5 |
| P | 10 | 1450 | 2530 | 300 | 290 | 2460 | 4010 | 5560 | 3710 | 560 | 280 |
| Pb | 0.5 | 10.8 | 12.6 | 12.9 | 14.6 | 10.6 | 7.3 | 11.2 | 10.8 | 309 | 22.4 |
| Rb | 0.1 | 1150 | 667 | 169.5 | 206 | 1160 | 2360 | 1060 | 508 | 602 | 307 |
| Re | 0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| S | 0.01% | 0.12% | 0.22% | 0.05% | 0.02% | 0.12% | 0.20% | 0.73% | 1.09% | 0.21% | 0.01% |
| Sb | 0.05 | 0.38 | 0.55 | 0.05 | 0.05 | 0.43 | 1.15 | 0.87 | 0.08 | 0.17 | 0.09 |
| Sc | 0.1 | 9.7 | 6.7 | 9.2 | 8.6 | 7.7 | 10 | 8.2 | 11 | 11.9 | 6.2 |
| Se | 1 | <1 | <1 | <1 | <1 | <1 | <1 | 1 | 1 | <1 | <1 |
| Sn | 0.2 | 147.5 | 183.5 | 5.8 | 6.1 | 141.5 | 363 | 210 | 91.5 | 35.8 | 22.9 |
| Sr | 0.2 | 44.8 | 66.8 | 47.4 | 53.4 | 126 | 369 | 400 | 64.3 | 43.9 | 24.2 |
| Ta | 0.05 | 7.02 | 77.2 | 1.01 | 1.04 | 18.75 | 19.05 | 12.65 | 4.59 | 1.06 | 87.8 |
| Te | 0.05 | 0.06 | 0.1 | <0.05 | <0.05 | 0.05 | 0.17 | 0.1 | 0.11 | <0.05 | <0.05 |
| Th | 0.2 | 50.5 | 111 | 16.25 | 15.75 | 22 | 36.4 | 8.84 | 17.4 | 19.85 | 13.3 |
| Ti | 0.005% | 0.23% | 0.17% | 0.26% | 0.26% | 0.18% | 0.22% | 0.15% | 0.20% | 0.25% | 0.17% |
| Tl | 0.02 | 11.6 | 5.89 | 0.88 | 1.16 | 11.6 | 24.8 | 8.85 | 5.12 | 5.97 | 2.54 |
| U | 0.1 | 6.3 | 6 | 3.7 | 4 | 5.8 | 3.3 | 5.6 | 3.9 | 6.9 | 4.1 |
| V | 1 | 43 | 29 | 40 | 38 | 36 | 46 | 31 | 40 | 51 | 28 |
| W | 0.1 | 18 | 16.1 | 7.6 | 4.6 | 12.8 | 17.9 | 21.8 | 7.2 | 11.5 | 10.6 |
| Y | 0.1 | 17.5 | 16.2 | 10.9 | 11.5 | 12 | 17.6 | 10.6 | 24.2 | 10.5 | 10.8 |
| Zn | 2 | 55 | 62 | 44 | 45 | 110 | 87 | 55 | 81 | 928 | 56 |
| Zr | 0.5 | 145 | 105.5 | 152 | 168.5 | 109 | 119 | 103.5 | 103 | 122 | 126 |

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# APPENDIX D
# Water and Peroxide Extraction Results

*Table D1: Multi-element assay results for water extracts of selected samples from Core Lithium BP33 Project. Note sample IDs used here are the EGi Codes. Sample details for each EGi Code can be found in Table A1 (Appendix A).*

| Element | Units | Detection Limit | Sample ID | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 21086 | 21093 | 21095 | 21102 | 21109 | 21134 | 21138 | 21289 | 21290 | 21291 |
| pH | | 0.1 | 9.0 | 9.3 | 9.4 | 6.0 | 7.5 | 8.3 | 8.4 | 7.8 | 7.9 | 9.5 |
| EC | dS/m | 0.001 | 0.111 | 0.121 | 0.126 | 0.346 | 0.122 | 0.096 | 0.091 | 0.085 | 0.083 | 0.076 |
| Acidity | mg/l | 1 | | | | 21 | | | | | | |
| Alkalinity | mg/l | 1 | 34 | 86 | 49 | | 16 | 23 | 25 | 14 | 49 | 41 |
| Ag | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Al | mg/l | 0.01 | 0.08 | 0.26 | 0.58 | 0.18 | 0.19 | 0.23 | 0.18 | 0.04 | 0.07 | 0.34 |
| As | mg/l | 0.001 | 0.016 | 0.578 | 0.739 | 0.014 | 0.805 | 0.785 | 0.161 | 0.016 | 0.022 | 0.04 |
| B | mg/l | 0.05 | <0.05 | <0.05 | <0.05 | 0.17 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Ba | mg/l | 0.001 | 0.193 | 0.088 | 0.072 | 0.114 | 0.022 | 0.005 | 0.007 | 0.021 | 0.015 | 0.13 |
| Be | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Ca | mg/l | 1 | 4 | 3 | 2 | 20 | <1 | <1 | <1 | <1 | <1 | 2 |
| Cd | mg/l | 0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0002 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Cl | mg/l | 1 | <1 | 1 | 1 | <1 | 2 | 1 | 2 | 2 | <1 | <1 |
| Co | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | 0.024 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Cr | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Cu | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | 0.012 | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 | <0.001 |
| F | mg/l | 0.1 | 1.2 | 2.1 | 3.2 | 0.4 | 2 | 3 | 2.2 | 0.6 | 0.5 | 0.4 |
| Fe | mg/l | 0.05 | <0.05 | 0.08 | 0.21 | 0.35 | 0.06 | 0.1 | 0.1 | 0.07 | 0.06 | 0.09 |
| Hg | mg/l | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| K | mg/l | 1 | 20 | 24 | 30 | 29 | 24 | 15 | 15 | 1 | 2 | 15 |
| Mg | mg/l | 1 | <1 | <1 | <1 | 17 | <1 | <1 | <1 | <1 | <1 | <1 |
| Mn | mg/l | 0.001 | 0.004 | 0.006 | 0.004 | 4.94 | 0.112 | 0.001 | 0.006 | 0.002 | 0.002 | 0.002 |
| Mo | mg/l | 0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 |
| Na | mg/l | 1 | 6 | 6 | 4 | 8 | 6 | 2 | 6 | 5 | 4 | 4 |
| Ni | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | 0.093 | 0.002 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 |
| P | mg/l | 1 | <1 | <1 | <1 | <1 | <1 | <1 | 1 | <1 | <1 | <1 |
| Pb | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Sb | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Se | mg/l | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Si | mg/l | 0.1 | 0.6 | 1.7 | 2.0 | 0.5 | 0.8 | 0.7 | 0.9 | 1.1 | 1.5 | 1.6 |
| Sn | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| SO4 | mg/l | 1 | 18 | 6 | 4 | 160 | 24 | 5 | 9 | <1 | <1 | 1 |
| Sr | mg/l | 0.001 | 0.009 | 0.007 | 0.004 | 0.074 | 0.006 | 0.001 | 0.001 | <0.001 | 0.001 | 0.006 |
| Th | mg/l | 0.001 | <0.001 | 0.004 | 0.004 | <0.001 | <0.001 | 0.005 | <0.001 | <0.001 | <0.001 | <0.001 |
| Tl | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| U | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Zn | mg/l | 0.005 | <0.005 | <0.005 | <0.005 | 0.125 | 0.008 | <0.005 | <0.005 | 0.009 | <0.005 | <0.005 |

*Table D2: Multi-element assay results for peroxide extracts of selected samples from Core Lithium BP33 Project. Measured extract concentrations have been multiplied by five to provide an estimate of likely leachate concentrations from column leach tests. Note sample IDs used here are the EGi Codes. Sample details for each EGi Code can be found in Table A1 (Appendix A).*

| Element | Units | Detection Limit | Sample ID | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 21086 | 21093 | 21095 | 21102 | 21109 | 21134 | 21138 | 21289 | 21290 | 21291 |
| Ag | mg/l | 0.001 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Al | mg/l | 0.01 | 6.2 | 3.75 | 2.2 | 52.35 | 63.35 | 17.55 | 3.05 | <0.05 | <0.05 | <0.05 |
| As | mg/l | 0.001 | 0.03 | 37.45 | 32.45 | 0.605 | 58.45 | 21.95 | 4.37 | 0.345 | 0.605 | 1.27 |
| B | mg/l | 0.05 | 0.45 | 0.5 | 0.55 | 1 | 0.75 | 0.6 | 0.45 | 0.25 | 0.35 | 0.35 |
| Ba | mg/l | 0.001 | 2.66 | 2.085 | 2.415 | 0.51 | 0.61 | 2.95 | 2.72 | 2.09 | 2.31 | 2.495 |
| Be | mg/l | 0.001 | 0.01 | <0.005 | <0.005 | 0.045 | 0.035 | 0.02 | <0.005 | <0.005 | <0.005 | <0.005 |
| Ca | mg/l | 1 | 20 | 85 | 30 | 55 | 85 | 15 | 10 | <5 | <5 | 30 |
| Cd | mg/l | 0.0001 | 0.091 | 0.002 | <0.0005 | 0.003 | 0.001 | 5E-04 | 0.001 | <0.0005 | <0.0005 | <0.0005 |
| Cl | mg/l | 1 | <5 | <5 | 5 | <5 | <5 | <5 | <5 | 15 | 15 | <5 |
| Co | mg/l | 0.001 | 0.4 | 0.135 | 0.055 | 0.36 | 0.485 | 0.45 | 0.05 | <0.005 | <0.005 | <0.005 |
| Cr | mg/l | 0.001 | 0.02 | 0.055 | 0.04 | 0.09 | 0.08 | 0.05 | 0.18 | 0.05 | 0.03 | 0.025 |
| Cu | mg/l | 0.001 | 0.765 | 0.045 | <0.005 | 3.705 | 0.415 | 0.06 | 0.015 | <0.005 | <0.005 | <0.005 |
| F | mg/l | 0.1 | 2.5 | 4 | 4 | 6.5 | 8 | 5.5 | 3 | 1 | 0.5 | 0.5 |
| Fe | mg/l | 0.05 | <0.25 | <0.25 | <0.25 | 93 | 3.6 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Hg | mg/l | 0.0001 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| K | mg/l | 1 | 40 | 50 | 70 | 65 | 80 | 80 | 80 | 15 | 20 | 35 |
| Mg | mg/l | 1 | 15 | 5 | 5 | 20 | 10 | 10 | 10 | <5 | <5 | 5 |
| Mn | mg/l | 0.001 | 1.895 | 4.675 | 0.97 | 23.34 | 1.955 | 0.415 | 2.285 | 0.98 | 0.095 | 0.66 |
| Mo | mg/l | 0.001 | 0.03 | 0.01 | 0.01 | <0.005 | 0.005 | <0.005 | 0.01 | <0.005 | <0.005 | 0.01 |
| Na | mg/l | 1 | 40 | 30 | 40 | 45 | 45 | 45 | 50 | 40 | 40 | 50 |
| Ni | mg/l | 0.001 | 0.755 | 0.285 | 0.11 | 1.145 | 0.675 | 0.705 | 0.115 | <0.005 | <0.005 | <0.005 |
| P | mg/l | 1 | <5 | <5 | <5 | <5 | 15 | <5 | <5 | <5 | <5 | <5 |
| Pb | mg/l | 0.001 | 3.83 | 0.03 | <0.005 | 0.155 | 0.03 | 0.035 | <0.005 | <0.005 | <0.005 | <0.005 |
| Sb | mg/l | 0.001 | <0.005 | 0.01 | 0.01 | <0.005 | <0.005 | 0.015 | 0.005 | <0.005 | <0.005 | <0.005 |
| Se | mg/l | 0.01 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Si | mg/l | 0.1 | 31.65 | 49.7 | 42.3 | 62 | 68 | 49.95 | 60 | 23.2 | 27.3 | 25 |
| Sn | mg/l | 0.001 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| SO4 | mg/l | 1 | 285 | 365 | 160 | 1570 | 1230 | 335 | 185 | 5 | 30 | 95 |
| Sr | mg/l | 0.001 | 0.09 | 0.135 | 0.065 | 0.19 | 2.585 | 0.41 | 0.18 | 0.04 | 0.06 | 0.07 |
| Th | mg/l | 0.001 | <0.005 | <0.005 | <0.005 | 0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Tl | mg/l | 0.001 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.01 | <0.005 | <0.005 | <0.005 | <0.005 |
| U | mg/l | 0.001 | <0.005 | 0.015 | 0.005 | 0.06 | 0.045 | 0.01 | <0.005 | <0.005 | <0.005 | <0.005 |
| Zn | mg/l | 0.005 | 41.925 | 2.04 | 1.1 | 2.505 | 1.71 | 1.475 | 1.505 | 0.87 | 0.945 | 0.915 |

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# APPENDIX E

# Assay Results for DD Drill Core Samples for use in Kinetic Column Testing

*Table E1: Multi-element assay results for oxide DD drill core samples from BP33 deposit. Samples highlighted in brown were composited to produce an oxide sample for use in kinetic leach column testing.*

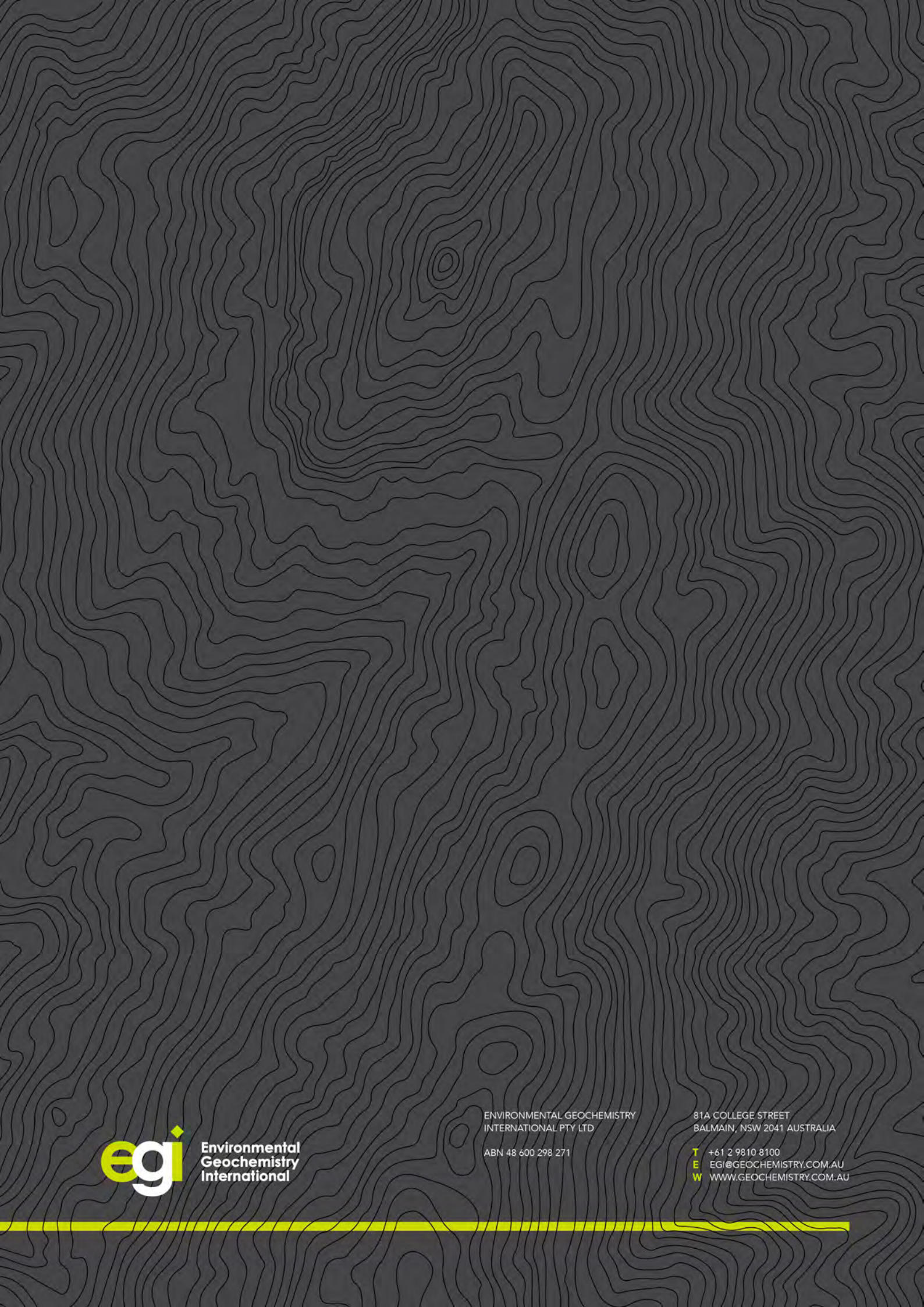
| Hole ID | Easting | Northing | Lithology 1 | Lithology 2 | Weathering | Description | Depth_from | Depth_to | Mean Depth | Sample ID | Type_Method | Date | Cs_ppm | Sr_ppm | Nb_ppm | Sn_ppm | Ta_ppm | U_ppm | Sb_ppm | Li_ppm | Rb_ppm | As_ppm | K_ppm | P_ppm | Fe_ppm | S_ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FDD010 | 694530 | 8593587 | Py | | EW to MW | Saprolite/saprock (phyllite) in weathered/oxidised zone. Variable colour inc pale to dark brown, pale yellow, tan, pale to mid green. | 0 | 40 | 20 | FDD010_WC01 | Composite of corefragments from each metre | 12/12/2020 | 250.64 | 34.07 | 12.96 | 33.25 | 11.03 | 3.14 | 0.16 | 343 | 505 | 193 | 26213 | 103 | 49410 | <20 |
| FDD011 | 694282 | 8593699 | Py | Sst | EW to MW | Saprolite/saprock (phyllite) in weathered/oxidised zone. Variable colour inc pale to mid brown, pale yellow, tan. | 0 | 25 | 12.5 | FDD011_WC01 | Composite of corefragments from each metre | 17/01/2021 | 113.91 | 6.69 | 7.16 | 2.12 | 0.83 | 2.3 | <0.05 | 197 | 533 | 77 | 21208 | L | 39870 | 33 |
| FDD011 | 694282 | 8593699 | Pg | | HW | Clay-weathered pegmatite, often crumbly and broken up into fine powder. Bright white. | 37 | 38 | 37.5 | FDD011_WC03 | Half PQ core split | 17/01/2021 | 34.23 | 1.8 | 110.8 | 21.39 | 180.2 | 0.51 | <0.05 | 48 | 751 | <10 | 20064 | 235 | 818 | <20 |
| FDD012 | 694257 | 8593850 | Py | Sst | EW to MW | Saprolite/saprock (phyllite and sandstone) in weathered/oxidised zone. Variable colour inc pale to dark brown and red-brown, pale yellow, tan, pale to mid green. However, pale dominates. | 0 | 28 | 14 | FDD012_WC01 | Composite of corefragments from each metre | 22/01/2021 | 18.33 | 9.07 | 6.72 | 2.31 | 0.62 | 2.36 | 0.09 | 48 | 275 | 33 | 13457 | 85 | 39465 | 44 |
| FDD012 | 694257 | 8593850 | Sst | Py | HW to MW | Sandstone and lesser phyllite interlayered. Minor (<2%) quartz veins and joints. Mixed loose and coherent core. Some unconsolidated "flowing" sand. More highly weathered than 28-38m interval. Pale grey and yellow. | 38 | 48 | 43 | FDD012_WC03 | Composite of corefragments from each metre | 22/01/2021 | 16.27 | 15.86 | 6.33 | 3.8 | 0.58 | 2.62 | 0.1 | 52 | 238 | 49 | 15961 | 170 | 33420 | <20 |

*Table E2: Multi-element assay results for transition DD drill core samples from BP33 deposit. Samples highlighted in brown were composited to produce a transition sample for use in kinetic leach column testing.*

| Hole ID | Easting | Northing | Lithology 1 | Lithology 2 | Weathering | Description | Depth_from | Depth_to | Mean Depth | Sample ID | Type_Method | Date | Cs_ppm | Sr_ppm | Nb_ppm | Sn_ppm | Ta_ppm | U_ppm | Sb_ppm | Li_ppm | Rb_ppm | As_ppm | K_ppm | P_ppm | Fe_ppm | S_ppm | S_% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FDD010 | 694530 | 8593587 | Py | | SW | Phyllite with fractures at high angle to core axis and minor (<2%) quartz veins in transitional zone. Pale grey. | 46.3 | 47.3 | 46.8 | FDD010_WC02 | Half PQ coresplit | 12/12/2020 | 172.87 | 25.91 | 8.22 | 5.36 | 0.88 | 3.03 | 0.06 | 218 | 292 | 80 | 19404 | 383 | 27630 | 400 | 0.04 |
| FDD011 | 694282 | 8593699 | Py | | MW | Phyllite moderately weathered zone. Coherent core. Pale yellow-brown. | 28 | 29 | 28.5 | FDD011_WC02 | Half PQ core cut | 17/01/2021 | 98.39 | 9.52 | 7.37 | 3.42 | 0.89 | 2.03 | <0.05 | 294 | 602 | 104 | 25251 | 78 | 31320 | <20 | <0.002 |
| FDD011 | 694282 | 8593699 | Sst | | MW | Sandstone, finely laminated/foliated in transitional zone. Minor (<2%) quartz veins. Pale grey. | 53 | 54 | 53.5 | FDD011_WC05 | Half PQ core cut | 17/01/2021 | 183.4 | 58.4 | 10.27 | 4.43 | 0.95 | 3.52 | <0.05 | 383 | 340 | <10 | 22446 | 249 | 32513 | <20 | <0.002 |
| FDD011 | 694282 | 8593699 | Sst | | SW | Sandstone, finely laminated/foliated in transitional zone. Minor joints. Pale grey. | 60 | 61 | 60.5 | FDD011_WC06 | Half PQ core cut | 17/01/2021 | 40.72 | 37.89 | 7.11 | 1.44 | 0.74 | 2.61 | <0.05 | 238 | 226 | <10 | 18095 | 312 | 24503 | <20 | <0.002 |
| FDD012 | 694257 | 8593850 | Sst | Py | MW | Sandstone and lesser phyllite interlayered. Minor (<2%)quartz veins and joints. Mostly coherent core. Pale green, brown and yellow. | 28 | 38 | 33 | FDD012_WC02 | Composite of core fragments from each metre | 22/01/2021 | 21.2 | 21.97 | 8.31 | 3.46 | 0.78 | 2.39 | 1.45 | 92 | 360 | 17 | 26571 | 90 | 39473 | 50 | 0.01 |
| FDD012 | 694257 | 8593850 | Sst | | MW | Sandstone, fine grained banded. Minor (<1%) quartz veins and joints. Coherent core. Pale to mid green-grey,with yellow and red staining pervading along joints. | 50 | 51 | 50.5 | FDD012_WC04 | Half PQ core cut | 26/01/2021 | 33.35 | 32.33 | 7.71 | 3.76 | 0.66 | 2.6 | 0.07 | 104 | 261 | 23 | 21236 | 338 | 32618 | <20 | <0.002 |
| FDD012 | 694257 | 8593850 | Sst | | SW | Sandstone, fine grained banded. Coherent core. Pale to mid green-grey. | 67 | 68 | 67.5 | FDD012_WC06 | Half PQ core cut | 26/01/2021 | 126.33 | 30.73 | 8.78 | 3.92 | 0.64 | 2.77 | <0.05 | 176 | 353 | <10 | 20433 | 192 | 31658 | <20 | <0.002 |
| FDD012 | 694257 | 8593850 | Sst | | MW | Sandstone, fine grained banded. Jointed fractured core.Pale to mid green-grey, with yellow and red staining pervading along joints. More weathered than above. | 73 | 74 | 73.5 | FDD012_WC08 | Half PQ coresplit | 26/01/2021 | 43.13 | 11.44 | 8.32 | 4.97 | 0.66 | 2.02 | <0.05 | 195 | 295 | <10 | 18981 | 351 | 35273 | <20 | <0.002 |

*Table E3: Multi-element assay results for fresh DD drill core samples from BP33 deposit. Samples highlighted in brown were composited to produce a fresh sample for use in kinetic leach column testing.*

| Hole ID | Eastin g | Northing | Litholog y 1 | Litholog y 2 | Weatheri ng | Description | Depth_fr o m | Depth_to | Mean Depth | Sample ID | Type_Me t hod | Photo info | Date | SAMPLE_Lab | Cs_ppm | Sr_ppm | Nb_pp m | Sn_ppm | Ta_ppm | U_ppm | Sb_ppm | Li_ppm | Rb_ppm | As_ppm | K_ppm | P_ppm | Fe_ppm | S_ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FDD010 | 694530 | 8593587 | Py | | FR | Phyllite - soild core with no imperfections. Dark grey. | 91 | 92 | 91.5 | FDD010 _WC04 | Half HQ core cut | Refer to core tray photos | 15/12/2020 | FDD010_WC0 4 | 200 | 18.8 | 10.77 | 5.86 | 1.03 | 3.39 | 0.05 | 337 | 329 | 154 | 32802 | 226 | 42158 | 1074 |
| FDD010 | 694530 | 8593587 | Sst | | FR | Sandstone, highly fractured (partly drilling related but atleast some natural) with no alteration. Dark grey. | 149 | 150 | 149.5 | FDD010 _WC06 | Half HQ core split | Refer to core tray photos | 15/12/2020 | FDD010_WC0 6 | 24.19 | 45.25 | 8.96 | 3.07 | 0.88 | 3.31 | <0.05 | 164 | 206 | 28 | 22022 | 311 | 24203 | 40 |
| FDD010 | 694530 | 8593587 | Py | | FR | Phyllite, foliated and jointed throughout. Dark grey. | 185 | 186 | 185.5 | FDD010 _WC07 | Half HQ core cut | Refer to core tray photos | 19/12/2020 | FDD010_WC0 7 | 23.02 | 21.56 | 9.86 | 4.36 | 0.91 | 2.72 | 0.07 | 178 | 374 | 25 | 38407 | 124 | 44723 | 610 |
| FDD010 | 694530 | 8593587 | Py | | FR | Phyllite, jointed throughout. Dark grey. | 235 | 236 | 235.5 | FDD010 _WC09 | Half HQ core cut | Refer to core tray photos | 19/12/2020 | FDD010_WC0 9 | 17.47 | 27.42 | 9.97 | 4.12 | 0.69 | 3.23 | <0.05 | 120 | 269 | 38 | 29271 | 430 | 28118 | 103 |
| FDD010 | 694530 | 8593587 | Py | Sst | FR | Phyllite with lesser interbands of fine sandstone. Soild core with no imperfections. Dark grey. | 258 | 259 | 258.5 | FDD010 _WC10 | Half HQ core cut | Refer to core tray photos | 19/12/2020 | FDD010_WC1 0 | 18.04 | 37.14 | 5 | 1.79 | 0.44 | 1.83 | <0.05 | 104 | 263 | 50 | 20856 | 310 | 36525 | 37 |
| FDD010 | 694530 | 8593587 | Py | Sst | FR | Phyllite with lesser interbands of fine sandstone. Soild core with no imperfections. Dark grey. | 322 | 323 | 322.5 | FDD010 _WC11 | Half HQ core cut | Refer to core tray photos | 21/12/2020 | FDD010_WC1 1 | 27.01 | 14.46 | 10.03 | 6.6 | 0.95 | 2.94 | <0.05 | 131 | 300 | 78 | 23414 | 440 | 39480 | 82 |
| FDD010 | 694530 | 8593587 | Py | Sst | FR | Phyllite with lesser interbands of fine sandstone. Jointed throughout. Dark grey. | 352 | 353 | 352.5 | FDD010 _WC12 | Half HQ core cut | Refer to core tray photos | 21/12/2020 | FDD010_WC1 2 | 51.39 | 11.39 | 8.06 | 5.85 | 0.74 | 1.67 | 0.06 | 133 | 297 | 264 | 28347 | 445 | 47033 | 937 |
| FDD011 | 694282 | 8593699 | Sst | | FR | Sandstone, finely laminated/foliated in fresh zone. Minor (<2%) quartz veins. Mid grey. | 71 | 72 | 71.5 | FDD011 _WC09 | Half PQ core cut | Refer to core tray photos | 17/01/2021 | FDD011_WC0 9 | 23.35 | 12.82 | 5.84 | 1.67 | 0.6 | 1.35 | <0.05 | 250 | 295 | <10 | 20647 | 372 | 29453 | 51 |



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# Kinetic Geochemical Testing of Waste Rock

Finniss Lithium Project BP33 UG Mine

S1312 / J000662 / R1525

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## FINNISS LITHIUM PROJECT BP33 UG MINE

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# LIST OF ABBREVIATIONS

## ABBREVIATIONS USED IN GEOCHEMICAL ASSESSMENT

| | |
|---|---|
| **ABA** | Acid Base Account |
| **ABCC** | Acid Buffering Characteristic Curve |
| **AC** | Acid Consuming |
| **AMD** | Acid Metalliferous Drainage |
| **ANC** | Acid Neutralising Capacity in kg $H_2SO_4$/t |
| **$ANC_{ABCC}$** | Acid Neutralising Capacity in kg $H_2SO_4$/t estimated from ABCC testing |
| **$ANC_{TC}$** | Carbonate Neutralising Value based on Total C in kg $H_2SO_4$/t |
| **ARD** | Acid Rock Drainage |
| **$CaCO_3$** | Calcium Carbonate |
| **CNV** | Carbonate Neutralising Value in kg $H_2SO_4$/t |
| **CRS** | Chromium Reducible Sulphur |
| **$EC_{1:2}$** | Electrical Conductivity of a sample slurry with a solid to water ratio of 1:2 (by weight) |
| **ECEC** | Effective Cation Exchange Capacity |
| **ESP** | Exchangeable Sodium Percentage |
| **GAI** | Geochemical Abundance Index based on multi-elements of solids |
| **$H_2SO_4$** | Sulphuric Acid |
| **KCl** | Potassium Chloride |
| **MPA** | Maximum Potential Acidity, calculated from total S in kg $H_2SO_4$/t |
| **NAF** | Non-Acid Forming |
| **NAG** | Net Acid Generation (test) |
| **$NAG_{(pH4.5)}$** | NAG acidity titrated to pH 4.5 in kg $H_2SO_4$/t |
| **$NAG_{(pH7.0)}$** | NAG acidity titrated to pH 7.0 in kg $H_2SO_4$/t |
| **NAGpH** | pH of NAG solution before titration |
| **NAPP** | Net Acid Producing Potential, calculated from ANC and total S (or MPA) in kg $H_2SO_4$/t. |
| **NMD** | Neutral Metalliferous Drainage |
| **PAF** | Potentially Acid Forming |
| **PAF-LC** | Potentially Acid Forming - Low Capacity |
| **$pH_{1:2}$** | pH of a sample slurry with a solid to water ratio of 1:2 (by weight) |
| **S** | Sulphur |
| **SD** | Saline Drainage |
| **$SO_4$** | Sulphate |
| **UC** | Uncertain |

## UNITS OF MEASUREMENTS

| | |
|---|---|
| **%** | Percentage |
| **°C** | Degrees Celsius |
| **dS** | Deci Siemen |
| **µm** | Micrometre |
| **mm** | Millimetre |
| **m** | Metre |
| **mg** | Milligram |
| **g** | Gram |
| **kg** | Kilogram |
| **t** | Tonne |
| **L** | Litre |
| **ml** | Millilitre |

## OTHER ABBREVIATIONS

| | |
|---|---|
| **ALS** | Australian Laboratory Services |
| **EGi** | Environmental Geochemistry International Pty Ltd |
| **Project** | Finniss Lithium Project - BP33 Underground Mine |
| **LOM** | Life of Mine |
| **ROM** | Run-of-Mine |

# EXECUTIVE SUMMARY

The Finniss Lithium Project - BP33 Underground Mine will include two separate waste rock dumps (WRD) which will be used for temporary (LOM) storage of waste rock prior to it being used to backfill the underground (UG) mine and box cut. The Box Cut WRD, with a design capacity of 2 million $m^3$, will accept oxide waste rock excavated from the box cut. The UG WRD, with a design capacity of 170,000 $m^3$, will accept transitional and fresh waste rock from the underground. Waste rock from the WRDs will be used to backfill the underground mine and box cut at closure.

Results from an earlier test programme suggested that most waste rock, including oxide and transitional rock excavated during installation of a box cut portal, transitional and fresh rock excavated during construction of the mine decline and ore that will be mined during the project, will present little risk of acid or saline drainage. However, results also suggested that both oxide and fresh rock may contain labile aluminium, arsenic and zinc which could be leached during surface storage.

As a consequence of the findings from these previous investigations, EGi established three kinetic leach column tests which included:

- Oxide waste rock that will be stored in the Box Cut WRD,
- Fresh waste rock that will be stored in the UG WRD, and
- Transition waste rock that will likely be placed in both WRDs.

The kinetic tests progressed through two stages. Stage 1 involved leaching of samples under free draining, oxidising conditions designed to simulate conditions during initial surface storage of waste materials throughout the operational stage. The second stage involved leaching under saturated conditions to simulate leaching of materials that are subsequently placed as backfill within the underground or the box cut and below the depth of rebound of the water table.

In addition to leach column testing, extensive characterisation of the materials used in the leach column tests was undertaken, including acid rock drainage (ARD) testing. Acid Base Accounting and net acid generation (NAG) testing indicated that the acid neutralising capacity of these samples exceeded their acid generating capacity. Kinetic leach column testing confirmed the non-acid forming (NAF) classification of the Oxide, Transition and Fresh waste rock samples tested during this study, demonstrating that this excess alkalinity can be delivered at a rate to match or exceed the rate of acid generation, ensuring neutral pH conditions will be maintained under both oxidising and saturated conditions. This indicates that, if the Oxide sample used in this study reasonably represents oxide waste stored in the Box Cut WRD and subsequently backfilled into the box cut, seepage from the WRD and recharged groundwater in the backfilled box cut will maintain neutral pH together with low sulphate concentrations. Similarly, if the Transition and Fresh samples used in this study reasonably represent transition and fresh waste rock stored in UG WRD and subsequently backfilled into the UG mine, seepage from the WRD and groundwater in the UG mine will maintain neutral pH together with low sulphate concentrations.

The results of leachate analysis for leach column tests were compared with baseline surface and groundwater quality for the BP33 project. This was done to evaluate where leachate chemistry from waste rock varied significantly from background surface and groundwater quality and may therefore represent a potential source for adverse impact on local water bodies and associated ecosystems.

Possible contaminating metal sources and potential receptors are summarised in Table ES1 below. Also listed in the table are the average factor by which leach column leachate concentrations exceed the baseline water quality value for each metal and water type. The concentrations of solutes in leachates from leach column tests are unlikely to be directly relatable to concentrations in seepage/runoff from the WRDs or from backfilled mine wastes. Rather they can provide a qualitative indication of which metals in waste rock leachate may be present at elevated concentrations in comparison with baseline water quality values. Thus, the exceedance factors shown in the table below are not designed to represent a risk factor for adverse impact of particular metals on surface or groundwater quality. Further

studies are required to provide a more quantitative framework for risk evaluation of metal/metalloid contamination of local surface and groundwaters.

*Table ES1: Potential sources and possible receptors for various metals and comparison of column test leachate concentrations with baseline water quality for the corresponding metals.*

| Metal | Source | Receptor | Average Exceedance Factor of Baseline Water Quality[1] |
|---|---|---|---|
| Al[2] | Box Cut WRD | Surface water<br>Shallow ground water<br>Deeper ground water | 15<br>76<br>5 |
| | UG WRD | Surface water<br>Shallow ground water | 6<br>32 |
| As | UG WRD | Surface water<br>Shallow ground water | 39<br>101 |
| Cu | Box Cut WRD | Surface water<br>Shallow ground water | 20<br>14 |
| | Backfilled box cut | Shallow ground water<br>Deeper ground water | 25<br>49 |
| | UG WRD | Surface water<br>Shallow ground water | 16<br>11 |
| Pb | Backfilled mine voids | Deeper ground water | 12 |
| Zn | Backfilled box cut | Shallow ground water<br>Deeper ground water | 18<br>57 |
| | Backfilled mine voids | Deeper ground water | 50 |

1. Calculated as the average leachate concentration from leach column testing under either unsaturated or saturated leaching conditions divided by the corresponding baseline water quality value
2. Concentrations of aluminium measured in leach column testing may include significant amounts of colloidal material, and consequently actual solution concentrations and the calculated corresponding exceedance factors could be much lower.

Results from leach column testing suggest that while acidic drainage from wastes stored in WRD at the BP33 project or following backfilling of mine voids is unlikely, there is potential for water in contact with these materials to contain elevated concentrations of a number of metals/metalloids (arsenic, copper, lead and zinc, and possibly aluminium ) relative to local surface and groundwaters. It is therefore recommended that:

- Run-off from WRDs is contained within run-off/seepage ponds and water quality monitored especially in relation to arsenic, copper and aluminium concentrations and, if required, stored (e.g., mine site dam) for later discharge at times of high flow or treated before discharge if required.
- WRD leachate quality/quantity data be used to calibrate leach column and validate/calibrate modelling results (see below) and the updated/ validated models used to better evaluate any potential impacts on groundwater quality from backfilled mine wastes.
- Mine waste management plans be updated during the operational phase, especially in relation to closure, based on the results of the above monitoring and modelling updates as required, with a view to minimising risk to groundwater quality and potential impacts on associated ecosystems.

While the results from kinetic leach testing provide qualitative evaluation of leachate chemistry in relation to WRD or backfilled waste seepages/leachates, they can also provide quantitative data (dissolution rates and solute loads) as

inputs for solute transport modelling. It is therefore recommended that a useful next step would be to undertake a more quantitative evaluation of the potential for impact on surface and groundwater quality from WRD seepage and leaching from backfilled materials. This could be done using the existing groundwater model combined with development of a conceptual hydrogeological model for the WRDs, using the leaching rates and loads from the leach column tests as inputs. Specifically, this could include:

- Qualitatively assess the risk of migration of leachable metal contaminants from the site by development of a (schematic) hydrogeological conceptual model of the waste rock dumps and underground mining to assess the potential pathways by which leachable metals may migrate into the water environment.
- Quantitatively assess the same by implementation of components of the hydrogeological conceptual model in 2-dimensional finite element models (using Seep/W and CTran/W) to quantify the migration of soluble metal contaminants from temporary surface WRDs and from permanent underground void backfill, including dilution in groundwater due to advection and dispersion, and removal or capture from groundwater due to adsorption, reaction or decay.

This process would add significant value to the column leach tests and provide further evidence for evaluation of environmental risks associated with the Finniss Lithium Project - BP33 UG Mine and can form a basis for updated mine waste and water management plans if required.

# 1. INTRODUCTION

The BP33 deposit is a part of Lithium Developments (Grants NT) Pty Ltd Finniss Lithium Project, located in the Northern Territory on the Cox Peninsula, approximately 23 km southwest of Darwin or 90 km by road. The BP33 proposal involves excavation of a box cut portal to a depth of 60 m and construction of a 400 m long decline from the base of the box cut to access the spodumene deposit located beneath the historically worked open pit.

Two separate waste rock dumps (WRD) will be established for temporary storage of waste rock prior to it being used to backfill the underground (UG) mine and box cut. The Box Cut WRD, with a design capacity of 2 million $m^3$, will accept oxide waste rock excavated from the box cut. The UG WRD, with a design capacity of 170,000 $m^3$, will accept transitional and fresh waste rock from the underground. Waste rock from the WRDs will be used to backfill the underground mine and box cut at closure. Ore mined at BP33 will be transported to the Grants processing facility approximately 7 km to the north-west. A ROM pad will be constructed for temporary storage of mined ore ready for transport to the Grants processing facility. Tailings will be deposited in the Tailings Storage Facility constructed as part of the Grants Project.

Previously, Environmental Geochemistry International Pty Ltd (EGi) were commissioned by EcOz Environmental Consultants to undertake data analysis, interpretation and reporting on physical and geochemical analysis results for drill core samples collected from the BP33 project[1]. This work formed a part of an Environment Protection Act Referral submitted to the NT Environmental Protection Authority (NT EPA) in April 2020 for development of the BP33 Underground mine.

The results from the initial test programme suggested that most waste rock, including oxide and transitional rock excavated during installation of a box cut portal, transitional and fresh rock excavated during construction of the mine decline and ore that will be mined during the project, will present little risk of acid or saline drainage. However, these investigations identified the potential for some potentially acid forming (PAF) waste, particularly in fresh phyllite rock. Results also suggested that both oxide and fresh rock may contain labile aluminium, arsenic and zinc which could be leached during surface storage. As a result of these investigations, EGi recommended the following test work should be conducted to clarify potential environmental issues raised from the study:

- Complete ANC and NAG testing on selected samples, focusing on, but not exclusively, samples with sulphur content >0.2 %S.
- Kinetic testing (leach columns) of oxidised and fresh rock samples to confirm initial results of aluminium, arsenic and zinc leachability and to define the kinetics of this process. Kinetic leach column (KLC) testing should be conducted under oxidising conditions to simulate conditions during storage in the WRD and in the unsaturated zones within the backfilled UG mine and box cut. Following a period of leaching under oxidising conditions, KLC tests should be conducted under saturated conditions to simulate the leaching properties of backfilled waste which will be placed below the water table upon rebound.

In the NT EPA's response to the referral document, a Supplementary Environmental Report (SER) was requested. In relation to waste rock characterisation, their response requested that the additional studies outlined above should be undertaken and reported as a part of the SER. Consequently, EcOz who coordinated the SER on behalf of Lithium Developments (Grants NT) Pty Ltd, requested EGi to undertake the required studies as described in Attachment A, Section 8 Terrestrial environmental quality in the NT EPA referral response[2].

During December 2020 and January 2021, Core Lithium undertook further drilling at the BP33 project. This programme was designed to provide samples for geotechnical testing, and included three diamond drill holes, two of

[1] Environmental Geochemistry International 2020, Geochemical Characterisation of waste rock and ore, Core Lithium BP33 Project, Document Ref 1312/1346, 12 March 2020.
[2] NT EPA 2020. Direction to provide additional information, Finniss Lithium Project BP33 Underground Mine, EP2020/001, NT EPA, 16 October 2020.

which intersected waste rock to a depth of around 70 m, which will be the excavation depth during construction of the box cut. A third hole to a depth around 350 m, which intersected waste rock and ore that will be mined during development of the decline and ore extraction, was also drilled as a part of this programme. Twenty-nine samples were obtained from these three drill holes to investigate the suitability of these materials for kinetic testing, which requires crushed rock available from diamond drill core. Based on assay data, three oxide samples, four transition samples and five fresh samples were composited to produce oxide, transition and fresh rock samples, which subsequently underwent geochemical testing together with 47 samples selected from earlier drill holes.

The results of this study[3] were then combined with the results from geochemical tests conducted previously. Using the combined data set containing 144 samples, criteria were developed to allow identification of non-acid forming (NAF), potentially acid forming – low capacity (PAF-LC) and PAF materials, based around oxidation, type (waste, ore) and Total S content. Using these criteria and a database containing assay data and geological descriptions for around 2500 samples, volumes of NAF, PAF-LC and PAF waste rock and ore were estimated. The results of this analysis showed that:

- Oxide rock excavated from the box cut and which will be placed in the Box Cut WRD is expected to be NAF.
- Ore that will be stored in the ROM pad while awaiting transport to the processing plant is expected to be NAF; and
- Estimates indicate that only around 15,000 tonnes (≈7%) of PAF-LC and PAF waste rock will be moved to the UG WRD through the life of the mine out of a total of 229,000 tonnes of transition and fresh waste rock to be mined, with most of the 15,000 tonnes likely to be classified as PAF-LC with limited acid producing potential.

Preliminary water and hydrogen peroxide extraction testing showed:

- Oxide waste rock stored in the Box Cut WRD, or transition and fresh waste rock stored in the UG WRD would be unlikely to produce low pH saline seepage during short-term surface storage.
- The mobility of Al in all waste rock and As in fresh waste rock on contact with water, could potentially result in elevated concentrations of these elements in seepage during short-term surface storage.
- Should substantial oxidation of fresh waste rock occur during surface storage, the concentrations of a number of metals/metalloids including Al, As, Co, Cr, Cu, U and Zn may by elevated in comparison to desirable environmental conditions, and seepage from the UG WRD could potentially represent a risk of contaminating the receiving environment.

Lastly, comparison of the combined geochemical test results for the oxide, transition and fresh composite waste rock samples proposed for use in KLC testing with results for the corresponding waste types from all drill holes, indicated that these composite samples are representative of waste to be stored in the WRDs at the BP33 project. Kinetic leach column tests using these samples should therefore deliver results which will provide a good indication of the quality of seepage that may result during surface storage of waste and the mobility of solutes in the waste following backfill and inundation by recovering groundwater.

Subsequently EGi established three kinetic leach column tests which included:

- Oxide waste rock that will be stored in the Box Cut WRD,
- Fresh waste rock that will be stored in the UG WRD, and
- Transition waste rock that will likely be placed in both WRDs.

The kinetic tests progressed through two stages. Stage 1 involved leaching of samples under free draining, oxidising conditions designed to simulate conditions during initial surface storage of waste materials throughout the operational stage. The second stage involved leaching under saturated conditions to simulate leaching of materials that are subsequently placed as backfill within the underground or the box cut and below the depth of rebound of the water table.

[3] Environmental Geochemistry International 2021, Static Geochemical Testing of Mine Wastes and Ore Finniss Lithium Project BP33 UG Mine, Document Ref S1312/J000662/R1428, 14 July 2021.

The kinetic test program commenced on 30 July 2021 and ran for a period of 12 months. This report presents results for both stages of column testing.

# 2. SAMPLE SELECTION AND PREPARATION

A total of 29 core intervals from the three diamond drill holes drilled during December 2020 and January 2021 were initially assayed to investigate their suitability for kinetic testing[3]. Based on assay data, three oxide samples, four transition samples and five fresh samples were composited to produce oxide, transition, and fresh rock samples (Table 1). Each composite comprised either 2.5 or 3.0 kg of drill core. Following inspection of the samples they were despatched to Indicum Laboratories for sample preparation, which involved crushing to minus 4 mm size for use in the column leach tests. A sub-sample of crushed sample was also pulverised for initial geochemical characterisation analyses using static test methods.

# 3. LEACH COLUMN TEST PROCEDURES

## 3.1. Free draining (Unsaturated) Leach Column Method

EGi's standard free-draining column leach method was used for the first stage of the kinetic program, as described in the AMIRA ARD Test Handbook[4]. The columns were set-up and maintained at EGi's specialised geochemical laboratory in Sydney. Each column comprises approximately 2.0 kg (dry weight) of crushed solids housed within a plastic Buchner funnel measuring 160 mm ID and 100 mm in height (Figure 1). The funnel configuration provides a free-draining condition and a relatively high exposure area per unit mass of sample, thereby providing conditions amenable to sulphide oxidation should it occur.

Leach column testing of the three samples commenced on 30 July 2021. Immediately following setup, the samples were flushed with 800 mL of deionised water and first-flush leachates were collected for analysis on 2 August 2021. Thereafter, samples were subjected to cyclic wetting and drying on a weekly basis over a four-week leach cycle. During the first three weeks of each cycle the samples were moistened by a once weekly addition of water at a rate of 100 mL/kg. On the fourth week the samples were flushed by addition of 400 mL/kg (solid to liquid ratio (SLR) of 2.5), with the leachates collected in plastic containers positioned immediately beneath the funnel spouts. Typically, 450 to 500 mL of leachate were collected from a column per cycle.

Leachates from the columns were assayed for pH, EC, alkalinity/acidity, and a suite of elements that included Ag, Al, As, B, Ba, Be, Ca, Cd, Cl, Co, Cr, Cu, Cs, F, Fe, Hg, Li, K, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Si, Sn, SO4, Sr, Th, Tl, U and Zn.

The unsaturated leaching phase extended for 16 weeks which, in addition to the initial flush, included four 4-week leach cycles.

[4] **AMIRA. 2002**. ARD Test Handbook. Project P387A. Prediction and Kinetic Control of Acid Mine Drainage, AMIRA International Limited, Melbourne, Australia.

*Table 1: Details of the samples used for kinetic leach column tests*

| | Hole ID | Easting | Northing | Depth from | Depth to | Sample ID | Lithology | Weathering | Description | Type_Method | S (%) | As(ppm) | Mass in Composite Sample (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OXIDE COMPOSITE | FDD010 | 694530 | 8593587 | 0 | 40 | FDD010_ WC01 | Py | EW to MW | Saprolite/saprock (phyllite) in weathered/oxidised zone. Variable colour inc pale to dark brown, pale yellow, tan, pale to mid green. | Composite of core fragments from metre | 0.001 | 193 | 1200 |
| | FDD011 | 694282 | 8593699 | 37 | 38 | FDD011_WC03 | Pg | HW | Clay-weathered pegmatite, often crumbly and broken up into fine powder. Bright white. | Half PQ core split | 0.001 | 5 | 500 |
| | FDD012 | 694257 | 8593850 | 38 | 48 | FDD012_ WC03 | Sst | HW to MW | Sandstone and lesser phyllite interlayered. Minor (<2%) quartz veins and joints. Mixed loose and coherent core. Some unconsolidated "flowing" sand. More highly weathered than 28-38m interval. Pale grey and yellow. | Composite of core fragments from each metre | 0.001 | 49 | 800 |
| TRANSITION COMPOSITE | FDD010 | 694530 | 8593587 | 46.3 | 47.3 | FDD010_ WC02 | Py | SW | Phyllite with fractures at high angle to core axis and minor (<2%) quartz veins in transitional zone. Pale grey. | Half PQ core split | 0.04 | 80 | 750 |
| | FDD011 | 694282 | 8593699 | 53 | 54 | FDD011_ WC05 | Sst | MW | Sandstone, finely laminated/foliated in transitional zone. Minor (<2%) quartz veins. Pale grey. | Half PQ core cut | 0.001 | 5 | 750 |
| | FDD012 | 694257 | 8593850 | 50 | 51 | FDD012_ WC04 | Sst | MW | Sandstone, fine grained banded. Minor (<1%) quartz veins and joints. Coherent core. Pale to mid green-grey, with yellow and red staining pervading along joints. | Half PQ core cut | 0.001 | 23 | 750 |
| | FDD012 | 694257 | 8593850 | 67 | 68 | FDD012_WC06 | Sst | SW | Sandstone, fine grained banded. Coherent core. Pale to mid green-grey. | Half PQ core cut | 0.001 | 5 | 750 |
| FRESH COMPOSITE | FDD010 | 694530 | 8593587 | 149 | 150 | FDD010_ WC06 | Sst | FR | Sandstone, highly fractured (partly drilling related but at least some natural) with no alteration. Dark grey. | Half HQ core split | 0.004 | 28 | 600 |
| | FDD010 | 694530 | 8593587 | 185 | 186 | FDD010_ WC07 | Py | FR | Phyllite, foliated and jointed throughout. Dark grey. | Half HQ core cut | 0.06 | 25 | 600 |
| | FDD010 | 694530 | 8593587 | 258 | 259 | FDD010_ WC10 | Py | FR | Phyllite with lesser interbands of fine sandstone. Soild core with no imperfections. Dark grey. | Half HQ core cut | 0.004 | 50 | 600 |
| | FDD010 | 694530 | 8593587 | 352 | 353 | FDD010_ WC12 | Py | FR | Phyllite with lesser interbands of fine sandstone. Jointed throughout. Dark grey. | Half HQ core cut | 0.09 | 264 | 600 |
| | FDD011 | 694282 | 8593699 | 71 | 72 | FDD011_ WC09 | Sst | FR | Sandstone, finely laminated/foliated in fresh zone. Minor (<2%) quartz veins. Mid grey. | Half PQ core cut | 0.01 | 5 | 600 |

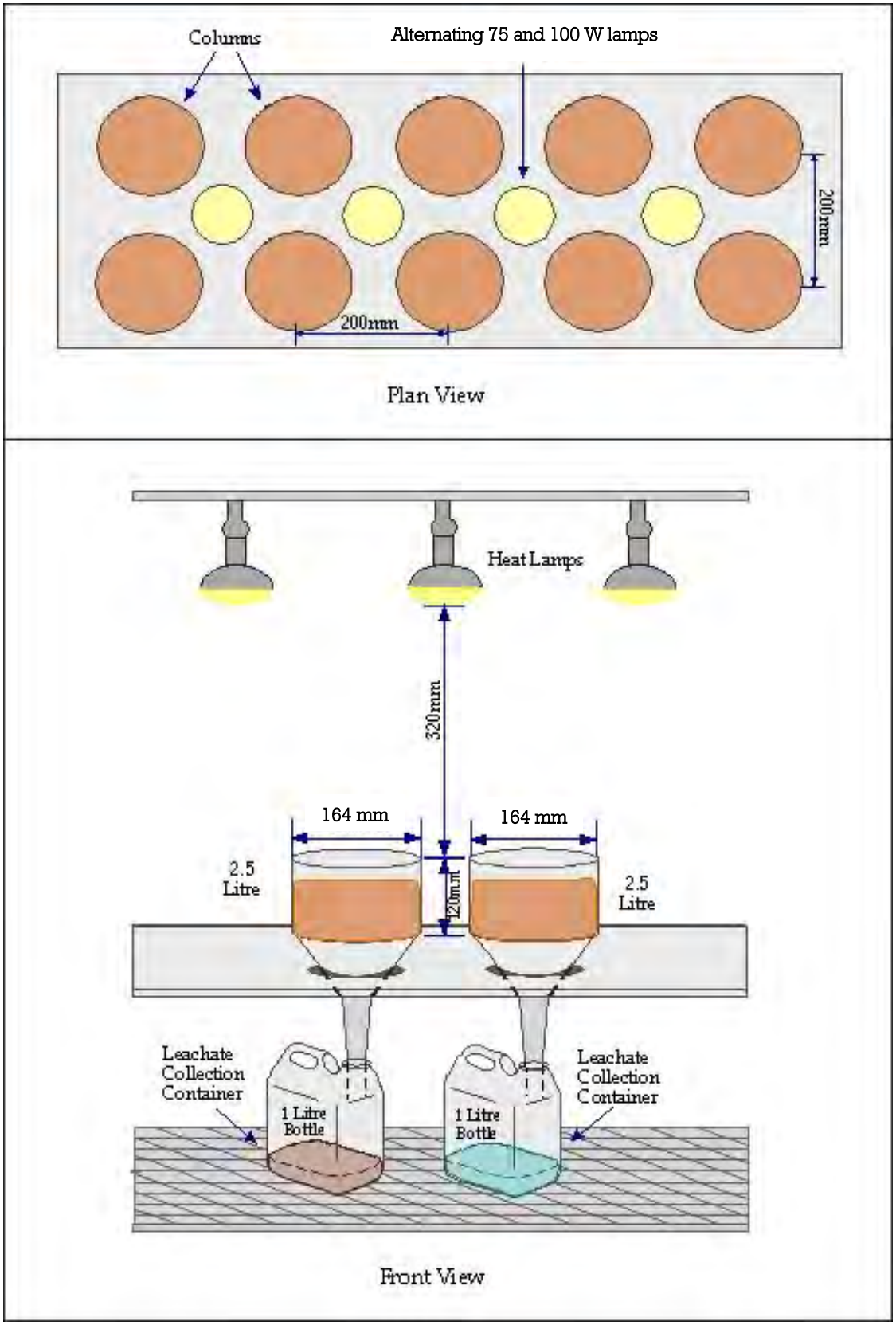


*Figure 1: Schematic diagram of a typical free draining leach column set-up using conventional Buchner funnels.*

## 3.2. Saturated Leach Column Method

The saturated column test is used to investigate the leaching characteristics of waste rock and tailings that are fully submerged or flooded. Columns can be prepared to simulate a period of exposure of waste rock to oxidation conditions followed by inundation in a tailings storage facility (TSF) or being flooded. The results from this column type can be used to provide a guide to the run down in accumulated oxidation products and longer-term solubility-controlled metal/metalloid loadings once waste rock has been inundated. The columns would be initially operated as free draining for a period, before being fully submerged underwater.

The experimental setup used for the saturated phase of the leach column tests is shown in Figure 2. A head of water was maintained throughout the leaching period, which included eight collections conducted over a 32-week period following the free draining leaching period. Approximately one pore volume of water was drained from each column during each collection. The pore volume (Table 2) in each column was calculated using an average particle density estimated from the results of QXRD analysis (see Table 5, Section 4). If it is assumed that there was no mixing of the pore water with the water cover during the 4-week leaching period, then the SLR for the oxide, transition and fresh leach column tests were 3.0, 3.3 and 4.3 respectively. If it is assumed that there is complete mixing of pore water with the water cover, then the SLR for the oxide, transition and fresh leach column tests ranged from 0.84 to 0.86. In practice, it is likely that limited mixing of pore water and the water cover occurred during the leaching period (no active mixing was applied) and the SLR was probably somewhere between these two extremes, possibly similar to the SLR of 2.5 for the unsaturated leach column tests.

Leachates were collected by attaching a sample bag to the column drain via a plastic tube (Figure 2). The bag was lowered to allow water to flow into the bag while maintaining exclusion of oxygen. When one pore volume of water had been collected, the bag was raised above the height of the column and leachate collected from the bag via a tap in the collection bag. Fresh DI water was then added to the top of the column to maintain the same head of water (90 mm) and the cap replaced on the top of the column until the next collection. Collections during the saturated period occurred once every 4 weeks, with leachates being analysed for pH, EC, alkalinity/acidity, and a suite of elements that included Ag, Al, As, B, Ba, Be, Ca, Cd, Cl, Co, Cr, Cu, Cs, F, Fe, Hg, Li, K, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Si, Sn, SO4, Sr, Th, Tl, U and Zn.

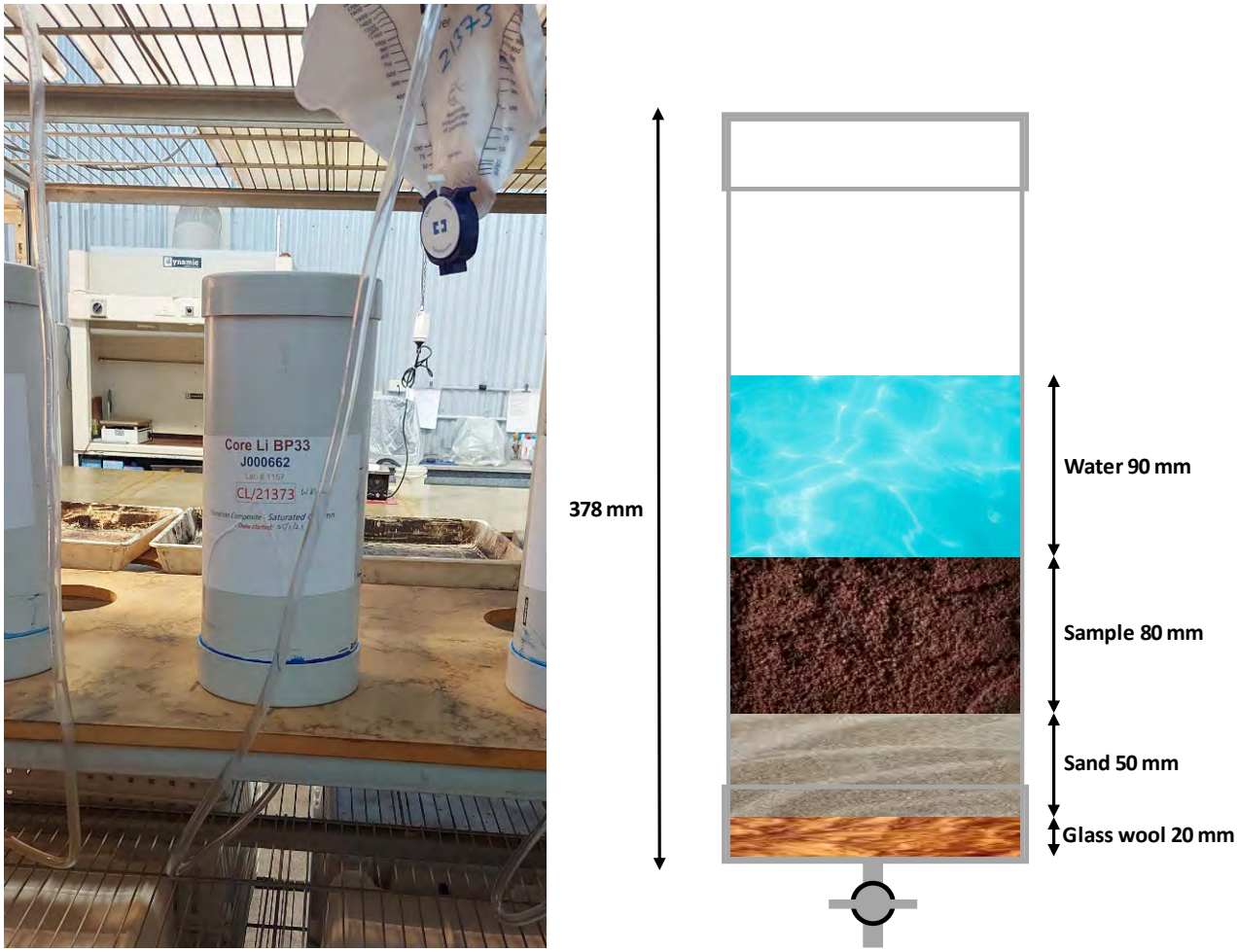


*Figure 2: Photograph (left) and schematic (right) of column setup used for leach column testing conducted under saturated conditions.*

*Table 2: Details of saturated leach column tests.*

| Oxide | 21372 | |
|---|---|---|
| Internal column height | 378 | mm |
| Internal column diameter | 150 | mm |
| Mass of sand | 1501.56 | g |
| Internal column height after sand | 325 | mm |
| Mass dry sample | 1983.27 | g |
| Internal column height after sample | 245 | mm |
| Sample bed height | 80 | mm |
| Sample volume | 1413.7 | $cm^3$ |
| Bulk density | 1.40 | $g/cm^3$ |
| Average particle density | 2.7 | $g/cm^3$ |
| Particle volume | 734.5 | $cm^3$ |
| Porosity | 0.48 | |
| Pore volume | 679 | $cm^3$ |
| Transition | 21373 | |
| Internal column height | 377 | mm |
| Internal column diameter | 150 | mm |
| Mass of sand | 1501.32 | g |
| Internal column height after sand | 327 | mm |
| Mass dry sample | 1987.42 | g |
| Internal column height after sample | 251 | mm |
| Sample bed height | 76 | mm |
| Sample volume | 1343.0 | $cm^3$ |
| Bulk density | 1.48 | $g/cm^3$ |
| Average particle density | 2.7 | $g/cm^3$ |
| Particle volume | 736.1 | $cm^3$ |
| Porosity | 0.45 | |
| Pore volume | 607 | $cm^3$ |
| Fresh | 21374 | |
| Internal column height | 372 | mm |
| Internal column diameter | 150 | mm |
| Mass of sand | 1501.48 | g |
| Internal column height after sand | 319 | mm |
| Mass dry sample | 1988.73 | g |
| Internal column height after sample | 251 | mm |
| Sample bed height | 68 | mm |
| Sample volume | 1201.7 | $cm^3$ |
| Bulk density | 1.65 | $g/cm^3$ |
| Average particle density | 2.7 | $g/cm^3$ |
| Particle volume | 736.6 | $cm^3$ |
| Porosity | 0.39 | |
| Pore volume | 465 | $cm^3$ |

# 4. CHARACTERISATION OF COLUMN LEACH TEST SAMPLES

The three composite samples (oxide, transition and fresh) used in the column leach tests were tested to define their geochemical properties. Testing included analysis or calculation of the following:

- Sulphur and Carbon contents and speciation.
- Acid neutralising capacity (ANC).
- Maximum potential acidity (MPA).
- Net acid producing potential (NAPP).
- Net acid generation (NAG) capacity.
- NAGpH.
- Multi-element analysis of solids.
- XRD Analysis.

The acid forming characteristics of the three composite samples are summarised in Table 3, the multi-element compositions are given in Table 4, and mineralogy data in Table 5. An acid-base account plot for the three samples is presented in Figure 3, and the corresponding ARD classification plot is presented in Figure 4.

Elemental analysis of solids was carried out by ALS and included the following suite of elements: Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Se, Sn, Sr, U, and Zn. In addition, Geochemical Abundance Indices (GAI) were calculated and are presented in Table 4 to provide an indication of which elements are significantly enriched in comparison to median background soil abundance values, where a GAI of 0 indicates the element is present at a concentration similar to, or less than, median soil abundance, a GAI of 1 or 2 represents minor enrichment of an element, and a GAI of 3 to 6 represents significant enrichment above median soil abundance.

The results of the geochemical characterisation tests conducted on column leach test samples can be summarised by the following:

***Oxide Waste***

- Negligible sulphur content (0.01 %S) with essentially a complete absence of sulphides.
- Negligible ANC (4 kg $H_2SO_4$/t) with essentially a complete absence of carbonate.
- Slightly negative NAPP (-4 kg H2SO4/t) and zero NAG, with neutral NAGpH.
- **NAF classification**.
- Significantly enriched (GAI≥3) with arsenic (147 mg/kg) and minor enrichment (GAI 1 or 2) with beryllium (38 mg/kg), bismuth (0.78 mg/kg) and tin (28 mg/kg).
- The results indicate that the sample representing oxide waste is essentially barren with respect to both acid potential and neutralisation potential but has some elemental enrichments that may be environmentally important.

***Transition Waste***

- Negligible sulphur content (0.02 %S).
- Low ANC (8 kg $H_2SO_4$/t) with essentially a complete absence of carbonate.
- Negative NAPP (-7 kg $H_2SO_4$/t) and no evidence of acidification in NAG test.
- **NAF classification.**
- Minor enrichment with arsenic (47 mg/kg).
- Overall, the results indicate the sample representing transition waste is benign with respect to acid potential but has a slightly elevated arsenic content relative to what is regarded as typical for a non-mineralised soil.

***Fresh Waste***

- Minor sulphur content (0.06 %S), mainly as sulphide (0.05 %S).
- Some ANC (13 kg $H_2SO_4$/t), but with limited carbonate content (Inorganic C <0.05 %C, CNV < 4 kg $H_2SO_4$/t).
- Negative NAPP (-11 kg $H_2SO_4$/t) and zero NAG with neutral NAGpH.
- **NAF classification.**
- Significantly enriched with arsenic (88 mg/kg).
- Overall, the results indicate the fresh waste sample is benign with respect to acid potential but has an elevated arsenic content.

QXRD analysis results (Table 5) show the dominant minerals in all three samples are quartz (53.8 - 63.4 wt.%), muscovite (20.6 - 28.4 wt.%) and albite (7.6 - 12.3 wt.%). The three samples also contain minor biotite and kaolinite. Only trace concentrations of pyrite were reported consistent with the low sulphur assay results, and no evidence of dolomite or calcite, consistent with the absence of significant carbonate neutralising capacity (Table 3). This suggests that the limited ANC in these samples is derived from silicate minerals, and as such is unlikely to provide any acid neutralisation at an appreciable rate.

These results suggested that the three leach column tests were unlikely to produce leachates with low pH and significantly elevated metals. The absence of significant sulphide content suggests limited oxidation would occur during leaching under unsaturated conditions, and consequently leaching under saturated conditions is unlikely to significantly reduce any limited sulphide oxidation. This means that under both unsaturated and saturated leaching conditions, neutral pH leachates are likely. Nevertheless, despite the likely neutral pH conditions, mobilisation of metals/metalloids which are soluble under neutral pH conditions (e.g., As and Zn) is possible. Differences in metal/metalloid leaching under unsaturated and saturated conditions may therefore result from possible solubility controls, or differences between the two test conditions resulting in equilibrium as opposed to kinetic control on mineral dissolution/precipitation.

*Table 3: Acid forming characteristics of column leach samples*

| Parameter | Material Type | Oxide | Transition | Fresh |
|---|---|---|---|---|
| | EGi Sample ID | 21372 | 21373 | 21374 |
| **Sulphur Speciation** | | | | |
| - Total-S | (%S) | 0.01 | 0.02 | 0.06 |
| - Sulphate-S | (%S) | 0.01 | <0.01 | 0.01 |
| - Sulphide-S | (%S) | <0.01 | <0.02 | 0.05 |
| - Cr Reducible-S | (%S) | <0.02 | 0.03 | 0.06 |
| **Carbon Speciation** | | | | |
| - Total-C | (%C) | 0.04 | 0.03 | 0.05 |
| - Organic-C | (%C) | 0.03 | 0.02 | <0.02 |
| - Inorganic-C | (%C) | 0.01 | 0.01 | <0.05 |
| **Neutralising Characteristics** | | | | |
| - ANC (Sobek) | (kg $H_2SO_4$/t) | 4 | 8 | 13 |
| - CNV | (kg $H_2SO_4$/t) | 1 | 1 | <4 |
| **Acid Generating Characteristics** | | | | |
| - MPA | (kg $H_2SO_4$/t) | <1 | 1 | 2 |
| - ANC / MPA Ratio | ratio | 13 | 13 | 7 |
| - NAPP | (kg $H_2SO_4$/t) | -4 | -7 | -11 |
| - NAG (to pH7) | (kg $H_2SO_4$/t) | 0 | 0 | 0 |
| - NAGpH | | 7.1 | 7.2 | 7.7 |
| **ARD Classification** | | **NAF** | **NAF** | **NAF** |

**Abbreviations**

*CNV = Carbonate Neutralising Value*
*ANC = Acid Neutralising Capacity*
*MPA = Maximum Potential Acidity*
*NAPP = Net Acid Producing Potential*
*(MPA and NAPP values calculated using Total-S)*
*NAG = Net Acid Generation capacity*
*NAGpH = pH of NAG liquor*
*NAF = Non-Acid Forming*

**Methods**

*Total sulphur - Measured using a Leco sulphur analyser*

*Sulphate-sulphur - Sample leached with hot HCl to remove acid-soluble sulphates. The amount of sulphate within the leachate is then determined by ICPAES.*

*Sulphide-sulphur - Calculated as the difference between Total-S and Sulphate-S values.*

*Cr Reducible S - Sample reacted with hot acidic $CrCl_2$ to reduce (non-sulphate) inorganic sulphur forms to $H_2S$ which are trapped in zinc acetate solution and determined.*

*Total carbon - Measured using a Leco carbon analyser*

*Organic-carbon - Hot HCl to remove any carbonates, then rinsed with distilled water. The residual carbon in the residue (i.e., acid-insoluble carbon) then measured by Leco.*

*Inorganic-carbon - Calculated as the difference between Total-C and Organic-C values.*

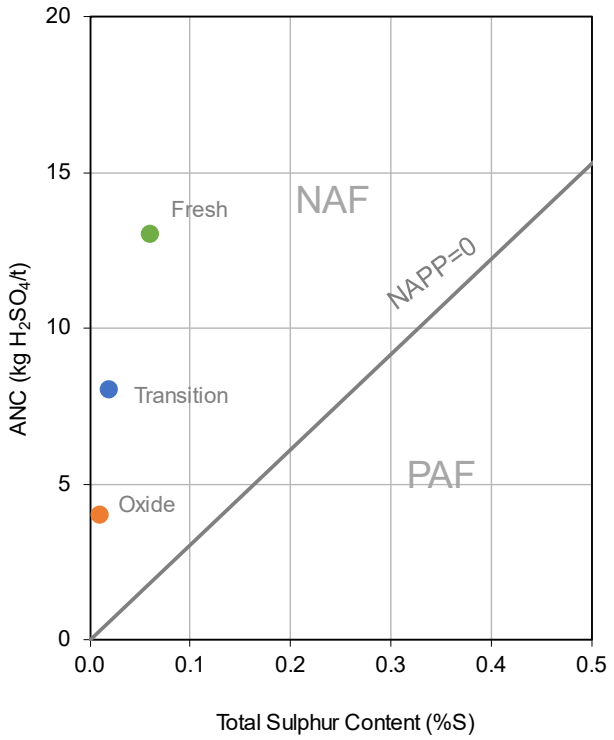


*Figure 3: Acid-base account plot for column leach samples.*

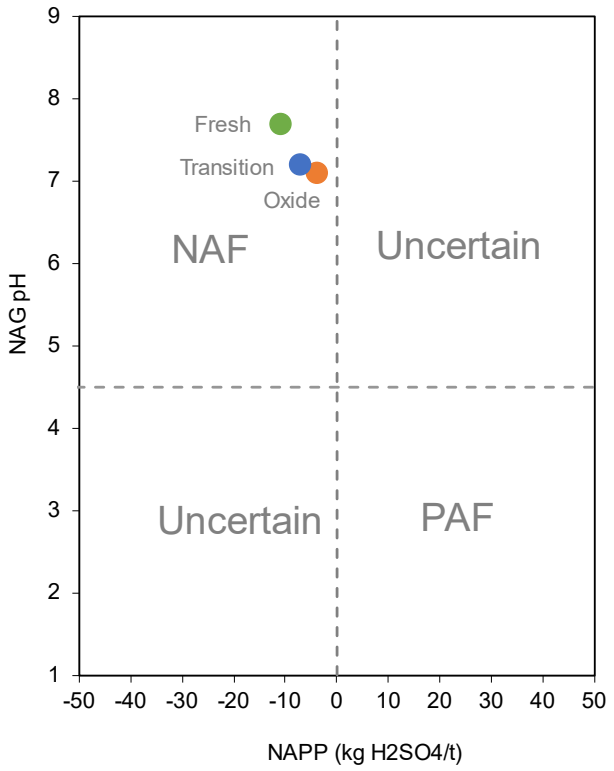


*Figure 4: ARD classification plot for column leach samples.*

*Table 4: Elemental compositions of column leach samples*

| Element | Unit | Limit of Detection | Elemental Composition | | | *Median Soil Content | Geochemical Abundance Indices | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Oxide | Transition | Fresh | | Oxide | Transition | Fresh |
| | | | 21372 | 21373 | 21374 | | 21372 | 21373 | 21374 |
| Al | % | 0.01 | 6.61 | 5.81 | 6.61 | 7.1 | 0 | 0 | 0 |
| Ca | % | 0.01 | 0.06 | 0.24 | 0.29 | 1.5 | 0 | 0 | 0 |
| Fe | % | 0.01 | 3.06 | 2.79 | 3.17 | 4 | 0 | 0 | 0 |
| K | % | 0.01 | 2.22 | 2.35 | 2.82 | 1.4 | 0 | 0 | 0 |
| Mg | % | 0.01 | 0.32 | 0.53 | 0.70 | 0.5 | 0 | 0 | 0 |
| Na | % | 0.01 | 0.97 | 0.55 | 0.65 | 0.5 | 0 | 0 | 0 |
| S | % | 0.01 | 0.01 | 0.02 | 0.06 | 0.07 | 0 | 0 | 0 |
| As | mg/kg | 0.2 | 147 | 47 | 88 | 6 | **4** | **2** | **3** |
| Ba | mg/kg | 10 | 420 | 570 | 580 | 500 | 0 | 0 | 0 |
| Be | mg/kg | 0.05 | 38 | 3 | 2 | 6 | **2** | 0 | 0 |
| Bi | mg/kg | 0.01 | 0.8 | 0.4 | 0.3 | 0.2 | **1** | 0 | 0 |
| Cd | mg/kg | 0.02 | 0.1 | 0.04 | 0.03 | 0.4 | 0 | 0 | 0 |
| Co | mg/kg | 0.11 | 10 | 7 | 8 | 8 | 0 | 0 | 0 |
| Cr | mg/kg | 1 | 31 | 36 | 40 | 70 | 0 | 0 | 0 |
| Cu | mg/kg | 0.2 | 21 | 14 | 19 | 30 | 0 | 0 | 0 |
| Hg | mg/kg | 0.005 | 0.005 | 0.005 | 0.005 | 0.06 | 0 | 0 | 0 |
| Mn | mg/kg | 5 | 383 | 221 | 356 | 1000 | 0 | 0 | 0 |
| Mo | mg/kg | 0.05 | 0.6 | 0.2 | 0.2 | 2 | 0 | 0 | 0 |
| Ni | mg/kg | 0.2 | 14 | 15 | 17 | 50 | 0 | 0 | 0 |
| P | mg/kg | 10 | 300 | 300 | 330 | 800 | 0 | 0 | 0 |
| Pb | mg/kg | 0.5 | 34 | 14 | 13 | 35 | 0 | 0 | 0 |
| Sb | mg/kg | 0.05 | 0.1 | 0.1 | 0.1 | 1 | 0 | 0 | 0 |
| Se | mg/kg | 1 | 1 | 1 | 1 | 0.4 | 0 | 0 | 0 |
| Sn | mg/kg | 0.2 | 28 | 6 | 5 | 4 | **2** | 0 | 0 |
| Th | mg/kg | 0.01 | 12 | 16 | 16 | 9 | 0 | 0 | 0 |
| U | mg/kg | 0.1 | 4 | 4 | 3 | 2 | 0 | 0 | 0 |
| Zn | mg/kg | 2 | 59 | 45 | 48 | 90 | 0 | 0 | 0 |

***GAI Enrichment Factors***

| | | |
|---|---|---|
| *GAI = 0* | *Little or No Enrichment:* | *< 3 times median soil* |
| *GAI=1 or 2* | *Minor Enrichment:* | *1=3 to 6 times, 2=6 to 12 times* |
| *GAI = 3 to 6* | *Significant Enrichment:* | *3=12 to 24 times, 4=24 to 48 times, 5= 48 to 96 times, or 6 ≥ 96 times* |

**** Median soil data from:***

*Bowen, H.J.M. (1979) Environmental Chemistry of the Elements. Academic Press, London.*

*Berkman, D.A. (1976) Field Geologists' Manual, The Australian Institute of Mining and Metallurgy,Australia.*

*Table 5: Quantitative XRD Results (wt.%) for column leach samples*

| Mineral | Oxide | Transition | Fresh |
|---|---|---|---|
| | 21372 | 21373 | 21374 |
| Quartz | 53.8 | 63.4 | 58.4 |
| Albite | 12.3 | 7.6 | 10.1 |
| Muscovite 2M | 28.4 | 20.6 | 21.9 |
| Siderite | 0 | 0 | 0 |
| Clinochlore | 0 | 0.2 | 1 |
| Calcite | 0 | 0 | 0 |
| Dolomite | 0 | 0 | 0 |
| Kaolinite | 3.1 | 0.2 | 0.5 |
| Pyrite | 0.1 | 0 | 0.1 |
| Biotite | 1.7 | 7.7 | 7.4 |
| Orthoclase | 0.6 | 0.3 | 0.6 |
| Sum of Input | 100 | 100 | 100 |

**SOURCE** - McKnight Mineralogy

**METHOD** - X-ray diffraction traces were obtained from the samples with a Panalytical Aeris Powder Diffractometer and Pixcel linear detector. Operating conditions were CoKα, 40kV/15mA, Fe Kß filter, step scan 0.01/29 secs˚2Θ at, 1/4˚ divergence and a 1.0˚ ant-scatter slit. Scan range was 5° to 90° 2Θ. Phases were identified by computer search-match of the ICDD PDF4 2020 Minerals and 2021 COD Databases. Quantitative results have been determined with full pattern Rietveld refinement software.

# 5. LEACH COLUMN TEST RESULTS

## 5.1. Differences in Unsaturated and Saturated Leach Conditions

The unsaturated leaching phase extended for 16 weeks which, in addition to the initial flush, included four 4-week leach cycles. Leaching under unsaturated conditions was discontinued after 16 weeks based on the results of leachate analysis over this period in combination with the geochemical characterisation results. Since all the tested materials were clearly classified as NAF, no decrease in leachate pH and associated increase in metal solubility was expected for these materials. In addition, the concentrations of metals and metalloids in leachates had all plateaued, suggesting that peak leaching concentrations had been reached. Although sulphate concentrations in the leachates from the fresh waste rock column were still increasing, the low sulphide content and clear NAF classification of this material, indicated that high sulphate release was unlikely and continuation of leaching under unsaturated conditions unwarranted.

Following leaching under unsaturated conditions where oxygen is expected to be readily available such that any pore water in contact with sulphide surfaces would be saturated with oxygen, leaching was continued under a blanket of water for a further 32 weeks, where oxygen transfer to the sulphide surfaces would involve diffusion across this water layer. If oxygen was consumed by sulphide oxidation at a rate significantly greater than the diffusion rate, then the oxidation rate would be diffusion controlled and likely significantly slower than oxidation under unsaturated conditions.

A second difference between leaching conducted under unsaturated and saturated conditions is the contact time between the flushing water and the solids. In the free draining columns, the solids are flushed with water every 4 weeks, with contact between the solids and the flushing solution limited to between a few hours and a few days, depending on how quickly the flush water moves through the solids bed. Under saturated conditions, the flush water is in contact with the solids for a period of 4 weeks. It is likely that over this extended period, equilibrium is reached between the minerals in the solids and the flushing solution. In the free draining column where contact time between the solids and the flushing solution is reduced, equilibrium between the solids and the aqueous phase may or may not be achieved. This may result in only partial dissolution of some phases which would fully dissolve under saturated conditions.

A third potential difference between the two leaching conditions is the SLR of the two test conditions. Under unsaturated conditions, an SLR of 2.5 operates, while under unsaturated conditions, the SLR may vary between around 3 to 4 and about 0.85, depending on the amount of mixing which occurs between the pore water and the water cover during the 4-week leaching period between flushes. It is likely that the SLR under saturated conditions is similar to that under unsaturated conditions and consequently solute concentrations can be compared between the two leaching regimes.

A further difference between the two leaching conditions is that under unsaturated conditions the columns constituted an open system, while under saturated conditions, the column was capped (Figure 2) and therefore represents a closed system. Under these conditions, any $CO_2$ generated through sulphide oxidation and concomitant carbonate dissolution will be retained in the sample potentially increasing carbonate dissolution.

## 5.2. Leachate Chemistry and Geochemical Processes

The results of leachate analysis across the 48 weeks of leaching for the three columns are provided in Appendix A. As expected, all columns produced leachates with neutral pH (oxide 7.1 – 7.7, Transition 6.8 – 7.7, Fresh 7.2 – 7.7) during the entire leach test, with no difference in pH between unsaturated and saturated leaching. Despite the uniformity of leachate pH, all column tests gave an increase in leachate alkalinity after the change from unsaturated to saturated leaching. Leachate sulphate concentrations were low in all three columns, with the lowest concentrations from the Oxide column. There were no appreciable differences in sulphate concentrations between unsaturated and saturated leaching.

Figure 5 shows plots of leachate calcium plus magnesium concentrations as a function of alkalinity. The grey line shows the equivalent calcium plus magnesium (measured as mg Ca/L) concentrations corresponding to the alkalinity (measured as mg $CaCO_3$/L). For the Oxide sample, all leachate samples plotted below the equivalence line, suggesting limited alkalinity derived from calcium and magnesium carbonate dissolution, in agreement with C speciation and XRD analysis. For the Transition leachate samples, calcium plus magnesium concentrations plot around the equivalent alkalinity line suggesting calcium and magnesium in the leachates are principally derived from carbonate dissolution. In the Fresh leachate samples, calcium plus magnesium concentrations generally plot above the line under saturated conditions, suggesting that some calcium and magnesium in the leachates is derived from processes, e.g., cation exchange, which do not lead to dissolved carbonate that is measured as alkalinity.

For all materials, there was a general increase in calcium plus magnesium concentration with increasing alkalinity which appears to increase under saturated conditions. This may reflect the fact that when leaching was conducted under saturated conditions, the column was closed, which will increase dissolved carbonate alkalinity if pyrite oxidation results in carbonate dissolution and $CO_2$ cannot be removed from the closed system.

Figure 6 shows time series plots of the Ca + Mg:SO4 mole ratio in leachates for the three columns. For the Oxide column, the Ca + Mg:SO4 ratios were generally above one, increasing significantly under saturated conditions. This increase results from an increase in Ca concentrations in saturated leachates. For the Transition sample leachates, the Ca + Mg:SO4 mole ratio remained close to unity throughout both unsaturated and saturated leaching except for a short period after changing to saturated leaching. Given that the solutions were significantly below gypsum saturation, it is likely that the Ca + Mg:SO4 ratio represents dissolution of carbonate to match acidity ($H_2SO_4$) generated from sulphide oxidation. For the Fresh sample, the Ca + Mg:SO4 mole ratio in leachates remained around 1 during unsaturated leaching, but increased during saturated leaching. This indicates the rate of carbonate dissolution matched acid generation from sulphide oxidation during leaching under unsaturated conditions. The increase in the Ca + Mg:SO4 mole ratio after the column was saturated, corresponds to an increase in calcium and magnesium from carbonate dissolution and decreased sulphate, possibly from a slight reduction in sulphide oxidation.

Intrinsic oxidation rates (IOR) were calculated from leachate sulphate concentrations. The calculation of IOR from sulphate assumes pyrite oxidation by oxygen according to the stoichiometry shown in Equation 1. It also assumes all sulphate resulting from oxidation is dissolved into leachates and is not retained as insoluble secondary minerals, or that sulphate that does report to the leachate is not derived from dissolution of previously formed secondary sulphate minerals. The results for these IOR calculations are shown in Figure 7. For the Oxide sample, calculated IOR are in the order of $10^{-10}$ kg $O_2m^{-3}s^{-1}$. However, because of the lack of sulphides in the Oxide sample, as demonstrated by sulphur speciation analysis, it is unlikely that the sulphate found in leachates is derived from sulphide oxidation and so IOR calculated from sulphate do not represent sulphide oxidation rates. For the Transition and Fresh samples, IOR were similar and in the order of $10^{-9}$ kg $O_2m^{-3}s^{-1}$ and do not vary significantly between leaching conducted under unsaturated and saturated conditions. An IOR in the order of $10^{-9}$ kg $O_2m^{-3}s^{-1}$ is at the very low end of sulphide oxidation rates for waste rock and reflects the very limited amount of sulphide present in these materials. It is also likely that at such a slow rate, oxygen diffusion does not constrain sulphide oxidation, in agreement with the calculated IOR being similar under both unsaturated and saturated conditions.

$$FeS_2 + 3.75O_2 + 3.5H_2O = Fe(OH)_3 + 2SO_4^{2-} + 2H^+ \qquad [1]$$

These results confirm the NAF classification of the Oxide, Transition and Fresh waste rock samples tested during this study. While Acid Base Accounting and NAG testing indicated that the acid neutralising capacity of these materials exceeds their acid generating capacity, kinetic testing demonstrates that this excess alkalinity can be delivered at a rate to match or exceed the rate of acid generation, ensuring neutral pH conditions will be maintained under both oxidising and saturated conditions. This indicates that, if the Oxide sample used in this study reasonably represents oxide waste stored in the Box Cut WRD and subsequently backfilled into the box cut, seepage from the WRD and rebounded groundwater in the backfilled box cut will maintain neutral pH together with low sulphate concentrations. Similarly, if the Transition and Fresh samples used in this study reasonably represent transition and fresh waste rock stored in UG WRD and subsequently backfilled into the UG mine, seepage from the WRD and groundwater in the UG mine will maintain neutral pH together with low sulphate concentrations.

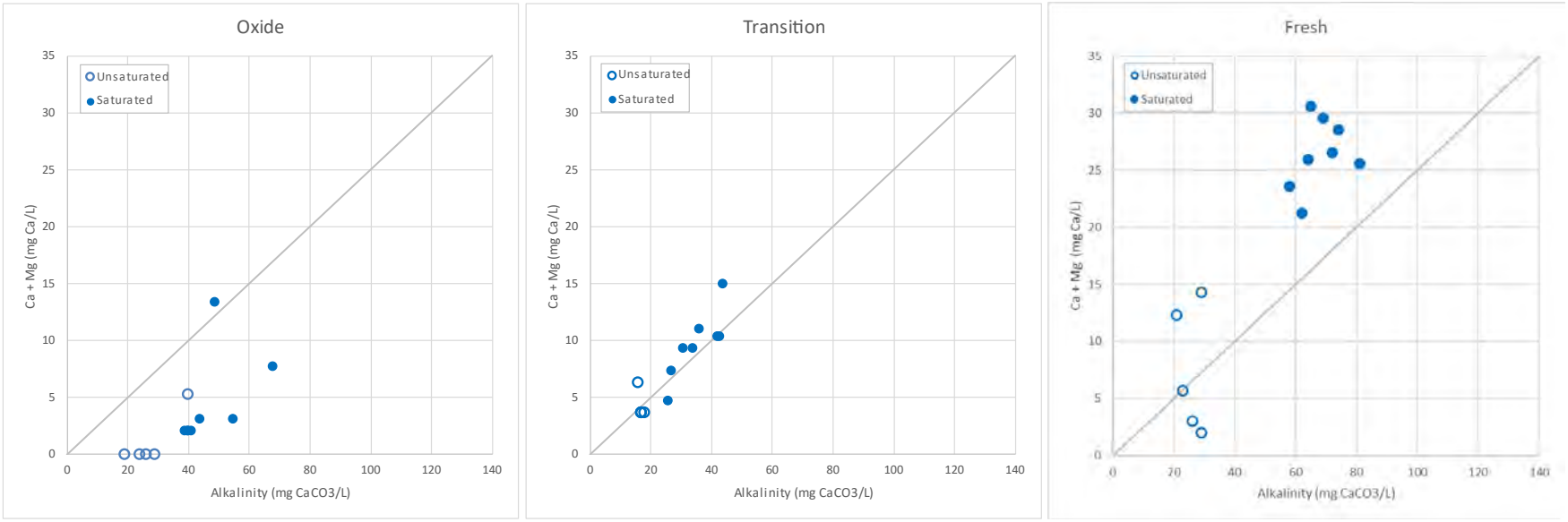


*Figure 5: Comparison of Ca + Mg concentrations and alkalinity in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

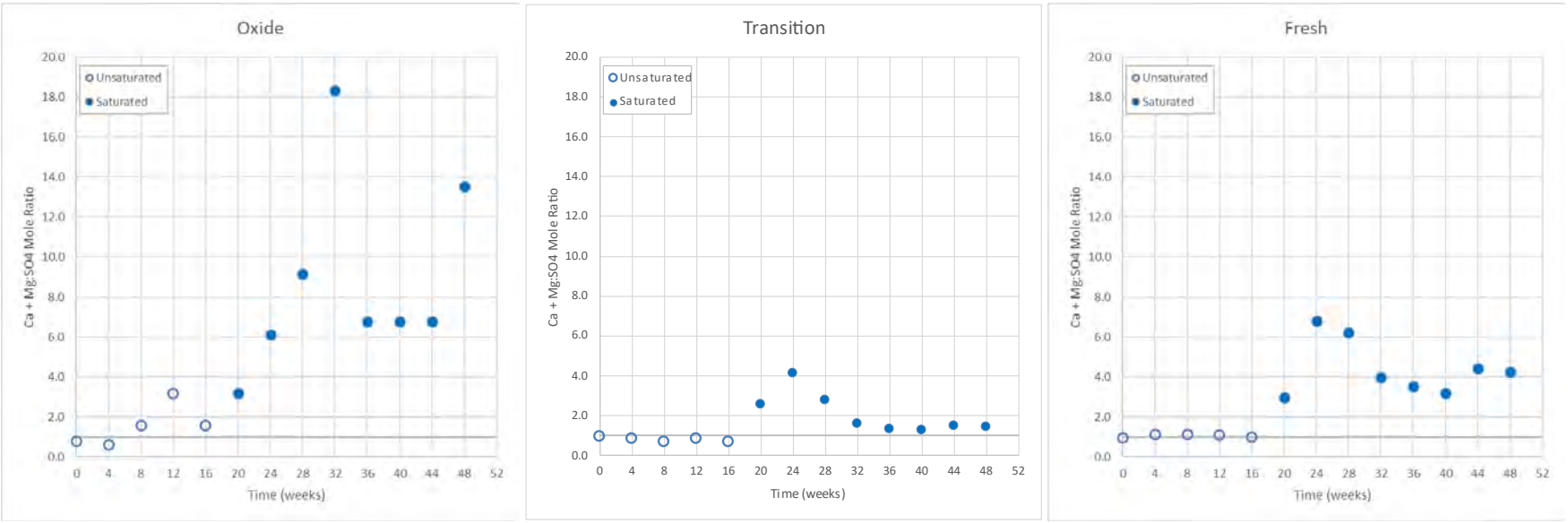


*Figure 6: Ca + Mg:SO4 mole ratio in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

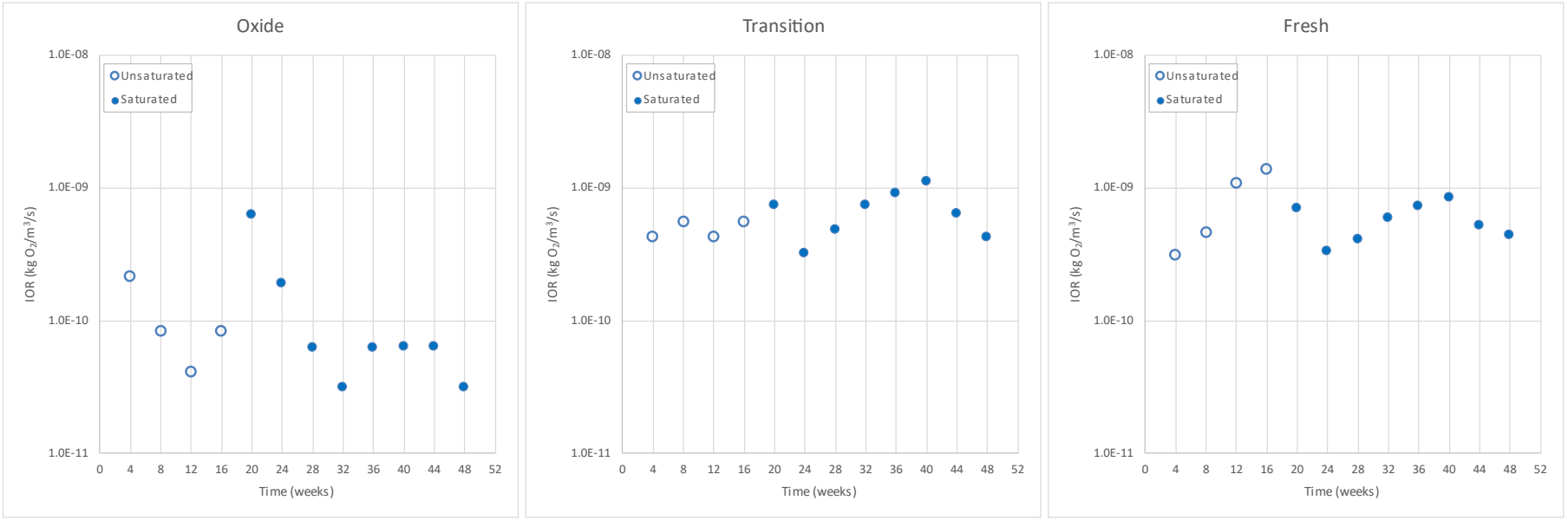


*Figure 7: IOR calculated from SO4 concentrations in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

## 5.3. Comparison of Leachate Solute Concentrations with Baseline Water Quality

While the results of leach column testing suggest that low pH metal laden drainage emanating from waste rock stored either above surface or in backfilled mine voids is unlikely, testing did suggest that elevated concentrations of some metals and metalloids, in particular aluminium, arsenic and zinc, could be present in seepage from oxide, transition and fresh NAF waste rock. As such, waste rock stored in WRDs or in backfilled mine voids, or mine void walls could represent potential sources of these metals/metalloids.

Surface and groundwater studies conducted for the BP33 project[5], suggest that ecosystems associated with these water systems may represent receptors for contaminants originating from mining activities. These include aquatic ecosystems on the Charlotte River and in ephemeral water courses which flow into the Charlotte River to the east and west of the mine. The mine development will intersect groundwaters, including a shallow alluvial aquifer which is largely ephemeral and in close proximity to drainage lines. The mine will also intercept the deeper Burrell Creek Formation (BCF) aquifer which typically lies at the transitional – fresh rock boundary. This aquifer is a low yielding water source and as such is not likely to be used as a water supply, but it may feed some groundwater dependant ecosystems.

As a part of the Draft Environmental Approvals issued by the NT EPA in their assessment report for the BP33 SER, Approval Condition4-1(2) states that "*Discharge of any mine-affected water from the action must not cause water quality at the downstream compliance point(s) to exceed the guideline values*."[6] Guideline values were stipulated as ANZECC Freshwater Default Guideline Values (DGV) using a 95% species protection[7], or where baseline water quality exceeds the DGV, derive a guideline value based on baseline water quality.

Surface water monitoring points located upstream and downstream from the mine footprint were used to collect water quality data to establish baseline water quality for surface water systems. Similarly, bores screened in the alluvial sediments and weathered BCF at shallow depths (to 8 mBGL), in the weathered BCF at intermediate depths (to 36 mBGL) and in the deeper weathered and fresh BCF at depths greater than 36 mBGL, were used to collect water quality data to provide characterisation of pre-mining groundwater quality for detecting and assessing potential impacts once mining commences[8].

Appendix B contains time series plots of various water quality parameters from leach column tests. Each plot also overlays baseline surface water and shallow and deep groundwater quality[9]. Comparison of concentrations of various solutes in leachates from the leach column tests with baseline water quality is not meant to imply significant impact to baseline water quality will occur for surface waters receiving seepages/runoff from WRD, or in groundwater in backfilled mine voids or open mine voids following groundwater recharge. Rather these comparisons can be used to highlight where solute concentrations in leach column leachates significantly exceed baseline water quality and therefore potentially represent a risk of surface or groundwater contamination during mining operations and after

[5] Core Lithium 2021. Finniss Lithium Project BP33 Underground Mine Supplementary Environmental Report, November 2021.
[6] NT EPA 2022. Assessment Report 94, Finniss Lithium Project BP33 Underground Mine, Core Lithium Ltd., NT EPA April 2022.
[7] ANZG (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines
[8] Core Lithium 2021. Finniss Lithium Project BP33 Underground Mine Water Management Plan, November 2021.
[9] Baseline water quality values for various solutes were derived from the 80$^{th}$ percentile values of groundwater metal/metalloid concentrations (20$^{th}$ and 80$^{th}$ percentiles for pH), and from the ANZG DGV (95% species protection, freshwater) for most surface water metals/metalloids, with the exception of Al and Fe (80$^{th}$ percentile), Li (Ecotoxcity Assessment) and pH (20$^{th}$ and 80$^{th}$ percentiles).

closure. Where a potential risk is identified, this would indicate that particular attention should be paid to monitoring of these parameters in seepage/runoff, receiving surface waters and in downgradient monitoring bore water samples.

The results of leachate analysis for leach column tests conducted on Oxide, Transition and Fresh samples under both unsaturated and saturated leaching conditions and comparison with baseline water quality can be summarised by the following:

- pH, EC and alkalinity – There is little difference between leachates from Oxide, Transition and Fresh wastes under both unsaturated and saturated leaching conditions with measured values similar to baseline water quality for surface and groundwaters (Figure B1, Figure B2 and Figure B4).
- Sulphate – Concentrations in leachates from Oxide waste either during unsaturated or saturated leaching are similar to baseline water quality for surface and groundwater. For leachates from Transition and Fresh waste rock samples sulphate concentrations are relatively low, but significantly above baseline water quality for surface and groundwater (Figure B3).
- Calcium, magnesium, sodium, potassium and lithium – Leachates from Fresh waste rock contained calcium concentrations which are significantly higher than baseline water quality for surface water, while magnesium, sodium, potassium and leachate concentrations were slightly higher than surface water baseline water quality. Lithium concentrations in leachates were low for all waste rock types and below baseline water quality for surface and groundwater (Figure B5, Figure B6, Figure B7, Figure B8 and Figure B9).
- Cadmium, chromium, iron, manganese and nickel – Leachate concentrations under unsaturated and saturated leaching conditions were near or below baseline water quality for surface and groundwaters, suggesting these metals are unlikely to pose a significant environmental risk to surface or groundwater receptors (Figure B15, Figure B16, Figure B12, Figure B18 and Figure B19).
- Copper and lead – Concentrations in leachates from the Fresh waste rock leach column test were not elevated relative to baseline water quality, suggesting fresh rock is unlikely to be a significant source of these metals. The Transition waste rock leach column test produced leachates with copper and lead concentrations significantly above SSGV under unsaturated and saturated conditions respectively. This may suggest that transition waste rock could be a source of copper during surface storage and a source of lead if saturated in backfilled mine voids. Concentrations of both metals in leachates from the Oxide waste leach column test were significantly above baseline water quality under unsaturated and saturated leaching conditions. This may suggest that oxide waste rock could be a source of copper and lead during surface storage and if saturated in backfilled mine voids (Figure B17 and Figure B20).

Although concentrations of the metals described above in column leachates were in some instances above baseline water quality, concentrations were in the microgram per litre range. Leachate concentrations of aluminium, arsenic and zinc also exceeded baseline water quality under some conditions, but concentrations of these metals/metalloids were significantly higher, typically in the milligram per litre range.

*Aluminium (*Figure B13*):*

Concentrations of aluminium significantly exceeded baseline water quality in leachates from Oxide and Transition column tests under unsaturated conditions. Aluminium concentrations were also elevated relative to baseline water quality in leachates from the Oxide column under saturated conditions.

Solution speciation modelling conducted on leachate from the Oxide column suggested that these solutions were saturated with respect to several aluminium and iron phases, which may imply the possibility that aluminium and iron concentrations measured in leachate solutions include colloidal as well as solution species. Figure 8 to Figure 10 show concentrations of aluminium, iron and fluoride in leachates from Oxide, Transition and Fresh columns respectively. These figures show that trends in the concentrations of these elements in leachates are similar throughout the leach column test, under both unsaturated and saturated conditions. It is unlikely that aluminium and iron will have the same solubility controls as fluoride, suggesting that at least some of the measured aluminium, iron and fluoride in leachates was derived from colloidal particles which are smaller than 450 nm (samples were filtered through a 0.45 μm membrane prior to analysis). QXRD analysis (Table 5) indicated the presence of clay (kaolinite [$Al_2Si_2O_5(OH)_4$]) and micas (biotite [$K(Mg,Fe)_3(AlSi_3O_{10})(OH,F)_2$], muscovite [$KAl_2(Si_3Al)O_{10}(OH,F)_2$]), with higher clay content in the more

weathered Oxide sample. Colloidal forms of these minerals may be the source of some of the measured aluminium, iron and fluoride in leachates. During column flushing, leachate collection times were in the order Oxide>Transition>Fresh, possibly consistent with higher clay and colloid content in Oxide leachates which reduces filterability.

The lower concentrations of aluminium, iron and fluoride in leachates obtained during the saturated phase of testing in comparison with leachates from unsaturated leaching, may also be consistent with at least some of the measured concentrations of these elements in leachates associated with colloidal material. In the free draining column, leachate is filtered through a filter paper (nominal pore size 30 μm) prior to collection, while when operated in saturated mode, the leachate must first pass through a 50 mm bed of sand and then a 20 mm layer of glass wool, which effectively acts as a multi-media filter.

Previously we have examined the colloidal content of leachates from leach column tests containing material with significant clay content and high aluminium and iron concentrations in neutral pH leachates. Ultrafiltration of a leachate samples with high aluminium, iron and silicon showed that essentially all the aluminium and iron and about 30% of the silicon was present as species greater than 1 nm in size, i.e., present as colloidal material (colloids are defined as particles between 1 nm and 1000 nm[10]), and not dissolved species. Solution modelling calculations showed that if iron was allowed to precipitate as ferrihydrite and aluminium and silicon as kaolinite, modelled solution concentrations matched those of the UF filtered leachate, with aluminium and iron concentrations generally below detection limits and reduced silicon concentrations. These results were consistent with the idea that elevated concentrations of aluminium, iron and iron in leachates were due to small (1 – 450 nm) colloidal iron oxyhydroxides and kaolinite (the sample contained ~10% kaolinite) in equilibrium with the solution. The solution speciation calculations suggested that true solution concentrations of aluminium and iron were likely to be below the measurement detection limit and the measured concentrations in leachates should not be considered as dissolved concentrations. As colloidal species of aluminium are unlikely to have the same toxicity as dissolved aluminium species[11], aluminium was not expected to be present in waste rock drainage at concentrations which will adversely impact receiving environments.

The similarity of leachate chemistry and mineral content of the Oxide and Transition leach columns in this study to the earlier study, suggests the possibility that the high aluminium concentrations in leachates from leach column tests relative to the baseline water quality, may contain a high proportion of colloidal material and consequently a reduced environmental risk. However, further testing would be required to confirm if this is the case.

*Arsenic (*Figure B14*):*

Arsenic concentrations in leachates from the Oxide leach column were similar to baseline water quality for surface water and shallow groundwater and well below the baseline water quality for deeper groundwater and similar under unsaturated and saturated leaching conditions. Concentrations in leachates from the Transition and Fresh waste rock leach columns were higher than for the Oxide column and significantly higher than surface water and shallow groundwater baseline water quality during unsaturated leaching. The change to leaching under saturated conditions resulted in a substantial decrease in leachate arsenic concentrations for the Fresh and Transition waste rock columns.

The arsenic content of the three materials used for leach column testing was in the order Oxide>Fresh>Transition, while the concentrations of arsenic in leachates was generally in the order Fresh>Transition>Oxide. QXRD analysis did not reveal arsenic mineral associations, probably because of the relatively low arsenic content (QXRD typically has a detection limit in the order of 0.1% or higher). However, it is probable that arsenic in the fresh sample is principally associated with sulphide minerals, most likely arsenic enriched pyrite. The source of arsenic in leachates in this case is most likely oxidation of the arsenic enriched sulphide, resulting in release of arsenic, probably as arsenate which is quite soluble at neutral pH and therefore mobile. The higher arsenic in the oxide sample is unlikely to be associated

[10] R. Liu, A. Wilding, A. Hibberd and J.L. Zhou, 2005. Partition of endocrine-disrupting chemicals between colloids and dissolved phase as determined by cross-flow ultrafiltration, *Environ. Sci. Technol*., **39**, 2753 – 2761.
[11] S.L. Simpson et al., 2014. Metal speciation and potential bioavailability changes during discharge and neutralisation of acidic drainage water, *Chemosphere*, **103**, 172 – 180.

with sulphides as this material is largely devoid of any sulphides. Arsenic may therefore be associated with less soluble minerals such as ferric arsenate in the oxide sample and consequently, the arsenic is less mobile when leached. The decrease in arsenic concentration in leachates from Fresh and Transition leach columns when operated under saturated conditions may reflect slower oxidation rates for arsenic enriched sulphides, although IOR calculated from released sulphate (Figure 7) did not indicate a significant decrease in the oxidation rate between unsaturated and saturated leaching.

These results suggest that storage of fresh and to a lesser extent transition waste rock in a WRD prior to back filling the mine voids and inundation, may provide a source of arsenic via seepage/runoff from the WRD which could potentially contain concentrations significantly above the baseline water quality for surface waters and shallow groundwater systems. Following backfilling of mine voids and groundwater rebound, leaching of arsenic is likely to be reduced and given the relatively high background arsenic concentrations in the deeper groundwater system, backfilled mine waste is less likely to present an environmental risk to groundwater through arsenic contamination.

*Zinc (*Figure B21*):*

Concentrations of zinc in leachates from all three leach column tests were very low and similar to baseline water quality for both surface and groundwaters when operated under unsaturated conditions. When these materials were leached under saturated conditions, there was a significant increase in leachate zinc concentrations which in all cases exceeded the baseline water quality by a considerable margin. As with arsenic, QXRD analysis did not reveal zinc mineral associations because of the low zinc content of the samples, and so the source of zinc in the leachates is not known. Nevertheless, the results of leach column testing conducted under saturated conditions do indicate that backfilling of mine voids with oxide, transition or fresh waste rock could potentially provide a source of zinc when saturated after groundwater recharge, which may adversely impact groundwater quality.

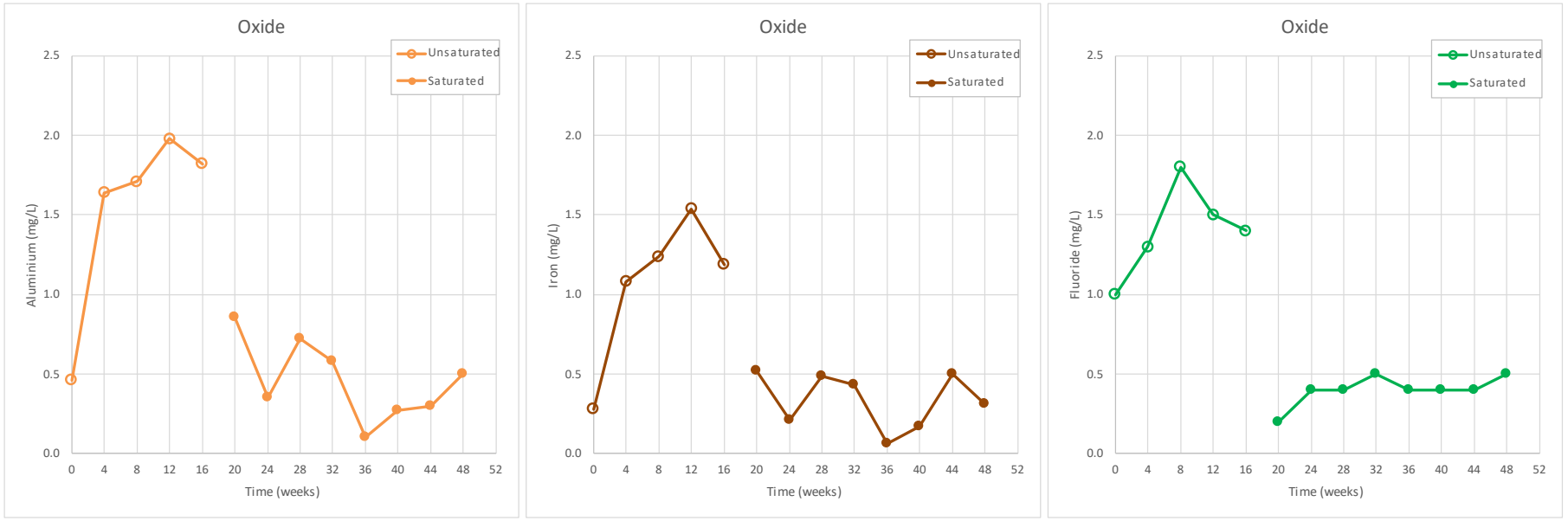


*Figure 8: Concentrations of aluminium (left), iron (middle) and fluoride (right) in leachates from the oxide leach column.*

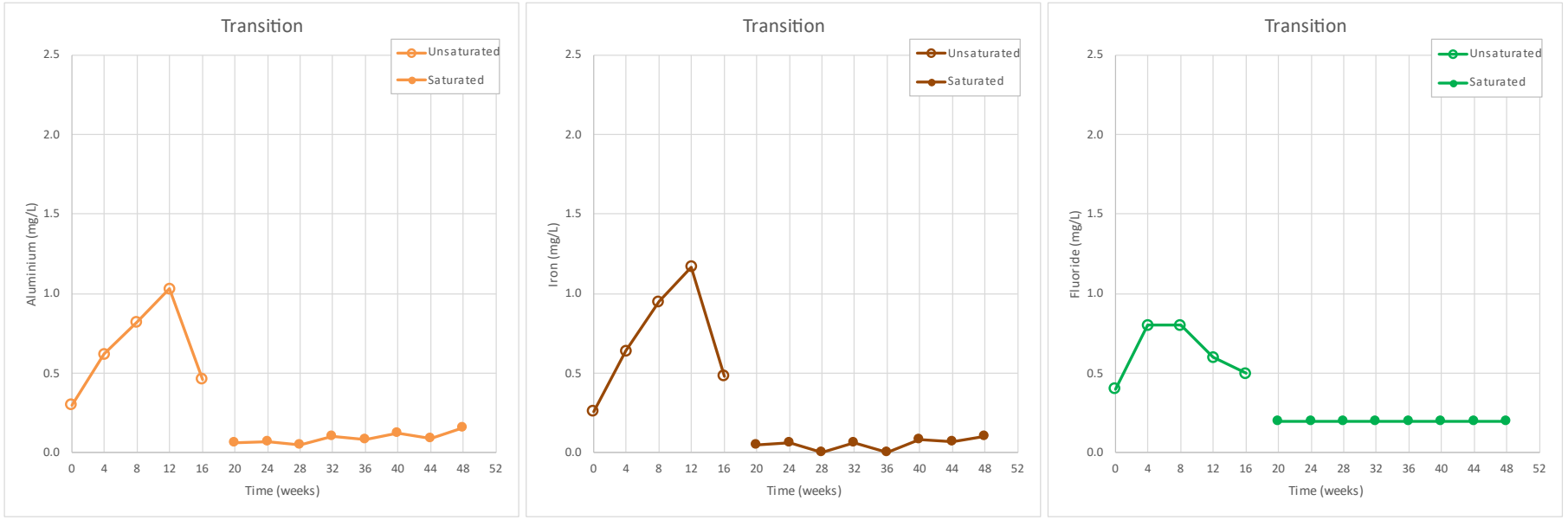


*Figure 9: Concentrations of aluminium (left), iron (middle) and fluoride (right) in leachates from the transition leach column.*

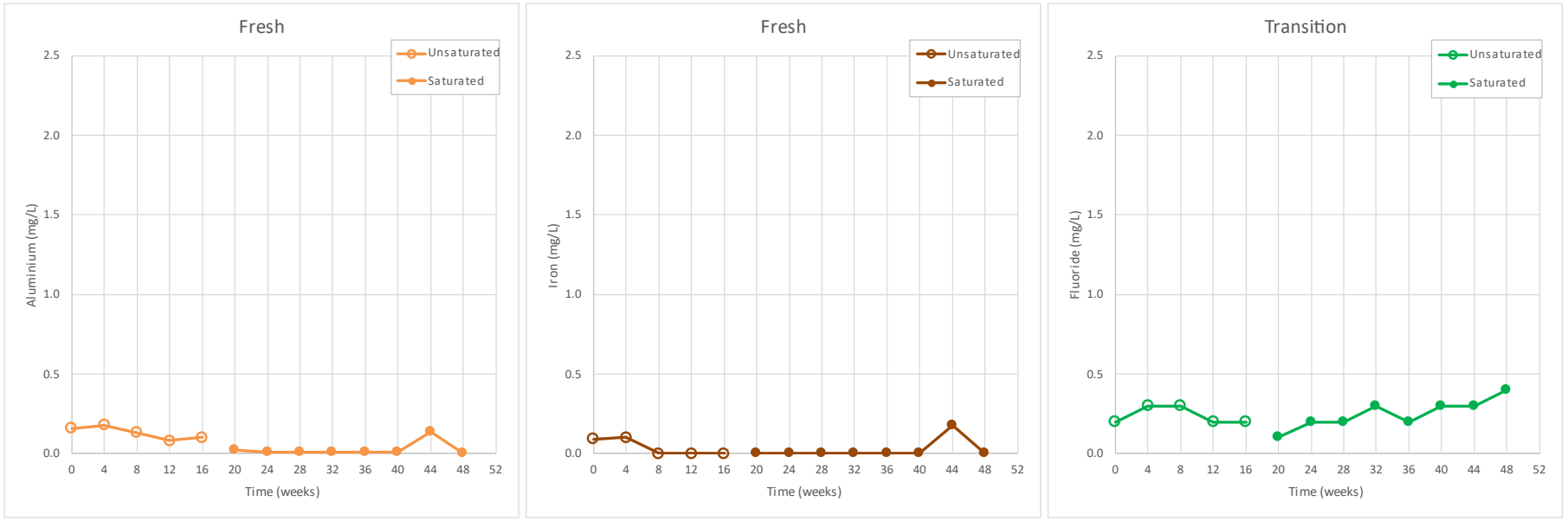


*Figure 10: Concentrations of aluminium (left), iron (middle) and fluoride (right) in leachates from the fresh leach column.*

# 6. CONCLUSIONS AND RECOMMENDATIONS

## 6.1. Study Conclusions

Leach column testing was conducted on three waste rock samples which were blended to be representative of oxide, transition and fresh waste rock from the BP33 deposit. Leach columns were conducted successively under unsaturated and saturated leaching regimes to simulate storage of waste rock in a WRD followed by inundation in backfilled mine voids. Static testing of these blended materials suggested NAF classification for the three materials, which was confirmed by kinetic leach column tests.

If the three materials used for leach column tests are generally representative of oxide, transition and fresh waste rock which will be mined as a part of the BP33 project, then results from column leach testing suggest the following about waste rock stored in the WRD and later backfilled into mine voids:

- Seepage/runoff from waste stored in the WRDs is likely to have neutral pH, low salinity and major cation concentrations probably similar to baseline concentrations in local surface and groundwaters.
- Concentrations of a number of metals including cadmium, chromium, iron, manganese and nickel in seepage/runoff from waste stored in the WRDs are likely to be very low and potentially similar to baseline concentrations in local surface and groundwaters.
- Groundwater contacted with waste which is backfilled in mine voids (including the box cut) following a period of storage in the WRDs is likely to have neutral pH, low salinity and major cation concentrations and potentially similar to baseline concentrations in local groundwaters.
- Concentrations of a number of metals including cadmium, chromium, iron, manganese and nickel in groundwater contacted with waste which is backfilled in mine voids (including the box cut) following a period of storage in the WRDs are likely to be very low and probably similar to baseline concentrations in local groundwaters.

The results of a leach column testing also suggest that, if the tested materials are representative of waste rock which will be mined as a part of the BP33 project, then there is the possibility for potential contamination by several metals of local surface and groundwaters from seepage/runoff from WRDs or of groundwater in contact with backfilled mine wastes. These metals include arsenic, copper, lead and zinc and possibly aluminium. Possible contaminating metal sources and potential receptors are summarised in Table 6 below. Also listed in the table are the average factor by which leach column leachate concentrations exceed the baseline water quality for each metal and water type.

As indicated previously, the concentrations of solutes in leachates from leach column tests are unlikely to be directly relatable to concentrations in seepage/runoff from the WRDs or from backfilled mine wastes. Rather they can provide a qualitative indication of which metals in waste rock leachate may be present at elevated concentrations in comparison with baseline water quality values. Thus, the exceedance factors shown in Table 6 are not designed to represent a risk factor for adverse impact of particular metals on surface or groundwater quality. For example, seepage from the WRDs is most likely to occur during periods of high rainfall when the stockpile is flushed by infiltrating rain, but at the same time surface water flows are likely to be highest due to the same event and consequently leachate dilution highest during such events. Further studies are required to provide a more quantitative framework for risk evaluation of metal/metalloid contamination of local surface and groundwaters.

*Table 6: Potential sources and possible receptors for various metals and comparison of column test leachate concentrations with baseline water quality for the corresponding metals.*

| Metal | Source | Receptor | Average Exceedance Factor of baseline water quality [1] |
|---|---|---|---|
| Al[2] | Box Cut WRD | Surface water<br>Shallow ground water<br>Deeper ground water | 15<br>76<br>5 |
| | UG WRD | Surface water<br>Shallow ground water | 6<br>32 |
| As | UG WRD | Surface water<br>Shallow ground water | 39<br>101 |
| Cu | Box Cut WRD | Surface water<br>Shallow ground water | 20<br>14 |
| | Backfilled box cut | Shallow ground water<br>Deeper ground water | 25<br>49 |
| | UG WRD | Surface water<br>Shallow ground water | 16<br>11 |
| Pb | Backfilled mine voids | Deeper ground water | 12 |
| Zn | Backfilled box cut | Shallow ground water<br>Deeper ground water | 18<br>57 |
| | Backfilled mine voids | Deeper ground water | 50 |

1. Calculated as the average leachate concentration from leach column testing under either unsaturated or saturated leaching conditions divided by the corresponding baseline water quality
2. Concentrations of aluminium measured in leach column testing may include significant amounts of colloidal material, and consequently actual solution concentrations and the calculated corresponding exceedance factors could be much lower.

## 6.2. Recommendations

Results from leach column testing suggest that while acidic drainage from wastes stored in WRD at the BP33 project or following backfilling of mine voids is unlikely, there is potential for water in contact with these materials to contain elevated concentrations of a number of metals/metalloids relative to local surface and groundwaters. While modelling suggests that movement of groundwater away from the mine post closure will be limited[12], contamination of groundwater by metals sourced from backfilled mine waste rock and/or mine voids walls is a possibility. It is therefore recommended that:

- Run-off from WRDs is contained within run-off/seepage ponds and water quality monitored especially in relation to arsenic, copper and aluminium concentrations and, if required, stored (e.g., mine site dam) for later discharge at times of high flow or treated before discharge if required.
- WRD leachate quality/quantity data be used to calibrate leach column results and validate/calibrate modelling results (see below) and the updated/ validated models used to better evaluate any potential impacts on groundwater quality from backfilled mine wastes.
- Mine waste management plans be updated during the operational phase, especially in relation to closure, based on the results of the above monitoring and modelling updates as required, with a view to minimising risk to groundwater quality and potential impacts on associated ecosystems.

As outlined above (Sections 5.3 and 6.1), scaling of metal concentrations in leachate from leach tests to possible concentrations in seepage from the WRDs is difficult, due to likely differences in solid to liquid ratio between the leach tests and the WRD among other factors such as flow regimes of both water and air (oxygen) within the WRD. Consequently, the results from kinetic leach testing provide qualitative evaluation of leachate chemistry in relation to

[12] CloudGMS 2021. Finniss Lithium Project BP33 Groundwater Modelling Report Final Version 3.0, October 2021

WRD or backfilled waste seepages/leachates, but can also provide quantitative data (dissolution rates and solute loads) as inputs to solute transport modelling. It is therefore recommended that a useful next step would be to undertake a more quantitative evaluation of the potential for impact on surface and groundwater quality from WRD seepage and leaching from backfilled materials. This could be done using the existing groundwater model combined with development of a conceptual hydrogeological model for the WRDs, using the leaching rates and loads from the leach column tests as inputs. Specifically, this could include:

- Qualitatively assess the risk of migration of leachable metal contaminants from the site by development of a (schematic) hydrogeological conceptual model of the waste rock dumps and underground mining to assess the potential pathways by which leachable metals may migrate into the water environment.
- Quantitatively assess the same by implementation of components of the hydrogeological conceptual model in 2-dimensional finite element models (using Seep/W and CTran/W) to quantify the migration of soluble metal contaminants from temporary surface WRDs and from permanent underground void backfill, including dilution in groundwater due to advection and dispersion, and removal or capture from groundwater due to adsorption, reaction or decay.

This process would add significant value to the column leach tests and provide further evidence for evaluation of environmental risks associated with the Finniss Lithium Project - BP33 UG Mine and can form a basis for updated mine waste and water management plans if required.

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# APPENDIX A
# Leach Column Test Results

*Table A1: Leachate analysis results from the Oxide leach column (21372)*

| Parameters | | Column Leachate Analyses - Oxide NAF waste | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Initial | Unsaturated Phase | | | | Saturated Phase | | | | | | | | |
| | | Flush | Week 4 | Week 8 | Week 12 | Week 16 | Week 20 | Week 24 | Week 28 | Week 32 | Week 36 | Week 40 | Week 44 | Week 48 | Week 52 |
| Volume | mls | 486 | 463 | 452 | 446 | 449 | 681 | 683 | 680 | 679 | 680 | 681 | 682 | 682 | |
| pH | - | 7.1 | 7.2 | 7.1 | 7.2 | 7.3 | 7.1 | 7.7 | 7.1 | 7.4 | 7.3 | 7.1 | 7.3 | 7.4 | |
| EC | dS/m | 0.23 | 0.12 | 0.10 | 0.089 | 0.076 | 0.10 | 0.13 | 0.11 | 0.11 | 0.10 | 0.10 | 0.08 | 0.08 | |
| Alkalinity | mg/l | 40 | 29 | 26 | 24 | 19 | 49 | 68 | 55 | 44 | 40 | 41 | 40 | 39 | |
| Acidity | mg/l | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Ag | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Al | mg/l | 0.46 | 1.64 | 1.71 | 1.98 | 1.82 | 0.86 | 0.35 | 0.72 | 0.58 | 0.10 | 0.27 | 0.30 | 0.50 | |
| As | mg/l | 0.020 | 0.024 | 0.026 | 0.028 | 0.024 | 0.012 | 0.009 | 0.009 | 0.009 | 0.005 | 0.005 | 0.00 | 0.01 | |
| B | mg/l | 0.13 | 0.08 | <0.05 | <0.05 | <0.05 | 0.11 | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | |
| Ba | mg/l | 0.020 | 0.032 | 0.028 | 0.037 | 0.035 | 0.067 | 0.020 | 0.016 | 0.018 | 0.013 | 0.019 | 0.011 | 0.010 | |
| Be | mg/l | <0.001 | 0.002 | 0.002 | 0.002 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Ca | mg/l | 2 | <1 | <1 | <1 | <1 | 10 | 6 | 3 | 3 | 2 | 2 | 2 | 2 | |
| Cd | mg/l | 0.0002 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0002 | <0.0001 | 0.00 | 0.0001 | 0.0001 | 0.0006 | 0.0001 | <0.0001 | |
| Cl | mg/l | 29 | 4 | 1 | 1 | 2 | 6 | 2 | 1 | <1 | <1 | <1 | 1 | <1 | |
| Co | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.002 | <0.001 | |
| Cr | mg/l | <0.001 | 0.004 | 0.001 | 0.001 | 0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Cs | mg/l | 0.001 | 0.008 | 0.010 | 0.01 | 0.007 | 0.002 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Cu | mg/l | 0.028 | 0.030 | 0.028 | 0.028 | 0.025 | 0.042 | 0.012 | 0.040 | 0.035 | 0.032 | 0.054 | 0.028 | 0.022 | |
| F | mg/l | 1.0 | 1.3 | 1.8 | 1.5 | 1.4 | 0.2 | 0.4 | 0.4 | 0.5 | 0.4 | 0.4 | 0.4 | 0.5 | |
| Fe | mg/l | 0.28 | 1.1 | 1.2 | 1.5 | 1.2 | 0.52 | 0.21 | 0.49 | 0.43 | 0.06 | 0.17 | 0.50 | 0.31 | |
| Hg | mg/l | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | |
| K | mg/l | 2 | 1 | 1 | <1 | <1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | |
| Li | mg/l | 0.042 | 0.019 | 0.016 | 0.016 | 0.012 | <0.001 | 0.001 | 0.001 | <0.001 | 0.002 | <0.001 | <0.001 | 0.001 | |
| Mg | mg/l | 2 | <1 | <1 | <1 | <1 | 2 | 1 | <1 | <1 | <1 | <1 | <1 | <1 | |
| Mn | mg/l | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.004 | 0.003 | 0.004 | 0.004 | 0.001 | 0.001 | 0.002 | 0.001 | |
| Mo | mg/l | 0.001 | <0.001 | <0.001 | 0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Na | mg/l | 39 | 11 | 7 | 6 | 5 | 27 | 19 | 14 | 13 | 10 | 9 | 9 | 7 | |
| Ni | mg/l | 0.004 | 0.004 | 0.003 | 0.004 | 0.004 | 0.005 | 0.002 | 0.003 | 0.003 | 0.002 | 0.004 | 0.005 | 0.003 | |
| P | mg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | |
| Pb | mg/l | 0.002 | 0.007 | 0.007 | 0.008 | 0.007 | 0.007 | 0.005 | 0.010 | 0.018 | 0.010 | 0.010 | 0.009 | 0.005 | |
| Sb | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Se | mg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| Si | mg/l | 4 | 6 | 12 | 13 | 13 | 7.8 | 10.4 | 9.6 | 10.4 | 9.9 | 9.2 | 9.4 | 8.4 | |
| Sn | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| $SO_4$ | mg/l | 16 | 5 | 2 | 1 | 2 | 10 | 3 | 1 | <1 | 1 | 1 | 1 | <1 | |
| Sr | mg/l | 0.022 | 0.008 | 0.006 | 0.006 | 0.007 | 0.03 | 0.03 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | |
| Th | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Tl | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| U | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Zn | mg/l | 0.014 | 0.013 | 0.015 | 0.015 | 0.014 | 0.67 | 0.09 | 0.51 | 0.35 | 0.45 | 0.79 | 0.49 | 0.47 | |

< indicates that the concentration is less than the limit of detection

*Table A2: Leachate analysis results from the Transition leach column (21373)*

| Parameters | | Column Leachate Analyses - Transition NAF waste | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Initial | Unsaturated Phase | | | | Saturated Phase | | | | | | | | |
| | | Flush | Week 4 | Week 8 | Week 12 | Week 16 | Week 20 | Week 24 | Week 28 | Week 32 | Week 36 | Week 40 | Week 44 | Week 48 | Week 52 |
| Volume | mls | 470 | 491 | 488 | 494 | 492 | 610 | 611 | 613 | 610 | 609 | 610 | 610 | 610 | |
| pH | - | 6.8 | 6.9 | 6.8 | 7.1 | 6.9 | 6.9 | 7.7 | 7.0 | 7.1 | 7.1 | 7.0 | 7.2 | 7.3 | |
| EC | dS/m | 0.13 | 0.12 | 0.11 | 0.092 | 0.087 | 0.18 | 0.14 | 0.12 | 0.12 | 0.11 | 0.11 | 0.068 | 0.069 | |
| Alkalinity | mg/l | 16 | 18 | 17 | 17 | 17 | 44 | 42 | 43 | 31 | 34 | 36 | 27 | 26 | |
| Acidity | mg/l | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Ag | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Al | mg/l | 0.30 | 0.62 | 0.82 | 1.03 | 0.46 | 0.06 | 0.07 | 0.05 | 0.10 | 0.08 | 0.12 | 0.09 | 0.16 | |
| As | mg/l | 0.024 | 0.116 | 0.161 | 0.176 | 0.149 | 0.010 | 0.014 | 0.028 | 0.012 | 0.012 | 0.010 | 0.014 | 0.015 | |
| B | mg/l | <0.05 | 0.05 | <0.05 | <0.05 | <0.05 | 0.09 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | |
| Ba | mg/l | 0.011 | 0.012 | 0.015 | 0.018 | 0.009 | 0.047 | 0.028 | 0.024 | 0.024 | 0.021 | 0.023 | 0.017 | 0.012 | |
| Be | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Ca | mg/l | 3 | 2 | 2 | 2 | 2 | 10 | 7 | 7 | 6 | 6 | 6 | 4 | 3 | |
| Cd | mg/l | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0004 | 0.0003 | 0.0001 | 0.0002 | <0.0001 | <0.0001 | |
| Cl | mg/l | 6 | <1 | <1 | <1 | 2 | 3 | <1 | <1 | <1 | <1 | <1 | <1 | 2 | |
| Co | mg/l | <0.001 | 0.001 | 0.001 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Cr | mg/l | <0.001 | 0.004 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Cs | mg/l | 0.001 | 0.002 | 0.003 | 0.004 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Cu | mg/l | 0.053 | 0.015 | 0.018 | 0.016 | 0.009 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| F | mg/l | 0.4 | 0.8 | 0.8 | 0.6 | 0.5 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | |
| Fe | mg/l | 0.26 | 0.64 | 0.95 | 1.17 | 0.48 | 0.05 | 0.06 | <0.05 | 0.06 | <0.05 | 0.08 | 0.07 | 0.10 | |
| Hg | mg/l | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | |
| K | mg/l | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 3 | 2 | |
| Li | mg/l | 0.227 | 0.222 | 0.175 | 0.156 | 0.128 | 0.017 | 0.017 | 0.013 | 0.012 | 0.018 | 0.011 | 0.018 | 0.018 | |
| Mg | mg/l | 2 | 1 | 1 | 1 | 1 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | |
| Mn | mg/l | 0.027 | 0.030 | 0.024 | 0.027 | 0.017 | <0.001 | <0.001 | 0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Mo | mg/l | <0.001 | 0.001 | 0.001 | 0.001 | <0.001 | 0.001 | 0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Na | mg/l | 10 | 9 | 7 | 6 | 6 | 19 | 8 | 6 | 5 | 4 | 3 | 2 | 2 | |
| Ni | mg/l | 0.002 | 0.004 | 0.003 | 0.003 | 0.002 | 0.002 | <0.001 | 0.002 | 0.004 | 0.002 | 0.002 | 0.001 | <0.001 | |
| P | mg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | |
| Pb | mg/l | <0.001 | 0.001 | 0.002 | 0.002 | <0.001 | 0.005 | 0.010 | 0.016 | 0.022 | 0.014 | 0.009 | 0.001 | 0.001 | |
| Sb | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Se | mg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| Si | mg/l | 1.4 | 3.9 | 4.7 | 5.1 | 4.9 | 7.5 | 7.2 | 6.6 | 7.0 | 6.6 | 6.0 | 5.2 | 4.3 | |
| Sn | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| $SO_4$ | mg/l | 16 | 10 | 13 | 10 | 13 | 14 | 6 | 9 | 14 | 17 | 21 | 12 | 8 | |
| Sr | mg/l | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 | |
| Th | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Tl | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| U | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Zn | mg/l | 0.010 | <0.005 | <0.005 | <0.005 | <0.005 | 0.35 | 0.18 | 0.52 | 0.83 | 0.50 | 0.61 | 0.25 | 0.24 | |

< indicates that the concentration is less than the limit of detection

*Table A3: Leachate analysis results from the Fresh leach column (21374)*

| Parameters | | Column Leachate Analyses - Fresh NAF waste | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Initial | Unsaturated Phase | | | | Saturated Phase | | | | | | | | |
| | | Flush | Week 4 | Week 8 | Week 12 | Week 16 | Week 20 | Week 24 | Week 28 | Week 32 | Week 36 | Week 40 | Week 44 | Week 48 | Week 52 |
| Volume | mls | 476 | 500 | 494 | 510 | 516 | 471 | 470 | 471 | 470 | 467 | 468 | 469 | 471 | |
| pH | - | 7.2 | 7.4 | 7.6 | 7.7 | 7.6 | 7.3 | 7.4 | 7.4 | 7.3 | 7.3 | 7.3 | 7.4 | 7.5 | |
| EC | dS/m | 0.096 | 0.092 | 0.11 | 0.12 | 0.13 | 0.22 | 0.22 | 0.27 | 0.20 | 0.18 | 0.18 | 0.16 | 0.16 | |
| Alkalinity | mg/l | 29 | 26 | 23 | 21 | 29 | 58 | 81 | 74 | 72 | 69 | 65 | 64 | 62 | |
| Acidity | mg/l | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Ag | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Al | mg/l | 0.16 | 0.18 | 0.13 | 0.08 | 0.10 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.14 | <0.01 | |
| As | mg/l | 0.031 | 0.484 | 0.790 | 0.616 | 0.615 | 0.095 | 0.065 | 0.082 | 0.089 | 0.103 | 0.115 | 0.147 | 0.186 | |
| B | mg/l | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.09 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | |
| Ba | mg/l | 0.003 | 0.003 | 0.002 | 0.007 | 0.004 | 0.137 | 0.080 | 0.062 | 0.050 | 0.043 | 0.042 | 0.032 | 0.022 | |
| Be | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Ca | mg/l | 2 | 3 | 4 | 9 | 11 | 17 | 19 | 22 | 20 | 23 | 24 | 21 | 18 | |
| Cd | mg/l | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0014 | 0.0001 | <0.0001 | 0.0002 | <0.0001 | <0.0001 | |
| Cl | mg/l | 4 | 2 | 2 | 1 | 4 | 2 | <1 | <1 | <1 | 6 | <1 | <1 | <1 | |
| Co | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Cr | mg/l | <0.001 | 0.003 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Cs | mg/l | 0.001 | 0.002 | 0.002 | 0.003 | 0.003 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.003 | <0.001 | <0.001 | |
| Cu | mg/l | 0.012 | 0.009 | 0.004 | 0.004 | 0.004 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.003 | <0.001 | <0.001 | |
| F | mg/l | 0.2 | 0.3 | 0.3 | 0.2 | 0.2 | 0.1 | 0.2 | 0.2 | 0.3 | 0.2 | 0.3 | 0.3 | 0.4 | |
| Fe | mg/l | 0.09 | 0.1 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.18 | <0.05 | |
| Hg | mg/l | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | |
| K | mg/l | 7 | 7 | 8 | 10 | 10 | 8 | 7 | 8 | 6 | 6 | 6 | 5 | 4 | |
| Li | mg/l | 0.076 | 0.105 | 0.092 | 0.095 | 0.073 | <0.001 | 0.001 | <0.001 | 0.002 | 0.001 | <0.001 | <0.001 | 0.002 | |
| Mg | mg/l | <1 | <1 | 1 | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 2 | |
| Mn | mg/l | 0.030 | 0.054 | 0.047 | 0.069 | 0.025 | 0.001 | 0.004 | 0.006 | 0.001 | 0.001 | <0.001 | 0.003 | <0.001 | |
| Mo | mg/l | 0.001 | 0.004 | 0.004 | 0.005 | 0.003 | 0.002 | 0.002 | 0.002 | 0.002 | 0.001 | 0.003 | 0.003 | 0.004 | |
| Na | mg/l | 7 | 9 | 7 | 6 | 6 | 18 | 6 | 5 | 3 | 10 | 2 | 2 | 2 | |
| Ni | mg/l | 0.002 | 0.006 | 0.002 | 0.001 | <0.001 | 0.003 | 0.003 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | <0.001 | |
| P | mg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | |
| Pb | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.002 | 0.002 | 0.002 | 0.001 | 0.001 | 0.002 | <0.001 | |
| Sb | mg/l | <0.001 | 0.002 | 0.001 | <0.001 | <0.001 | 0.002 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | <0.001 | <0.001 | |
| Se | mg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| Si | mg/l | 0.7 | 0.7 | 1.1 | 1.6 | 1.6 | 5.5 | 5.5 | 4.9 | 5.3 | 5.0 | 4.6 | 4.2 | 3.7 | |
| Sn | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| | mg/l | 7 | 8 | 12 | 27 | 34 | 19 | 9 | 11 | 16 | 20 | 23 | 14 | 12 | |
| Sr | mg/l | 0.01 | 0.02 | 0.02 | 0.05 | 0.05 | 0.06 | 0.06 | 0.07 | 0.07 | 0.08 | 0.08 | 0.07 | 0.06 | |
| Th | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Tl | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| U | mg/l | <0.001 | 0.002 | 0.003 | 0.002 | 0.003 | 0.001 | <0.001 | 0.001 | 0.002 | 0.002 | 0.003 | 0.005 | 0.005 | |
| Zn | mg/l | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.31 | 0.34 | 0.33 | 0.26 | 0.22 | 0.29 | 0.24 | 0.15 | |
| < indicates that the concentration is less than the limit of detection | | | | | | | | | | | | | | | |

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# APPENDIX B

# Comparison of Leach Column Test Results with Baseline Water Quality

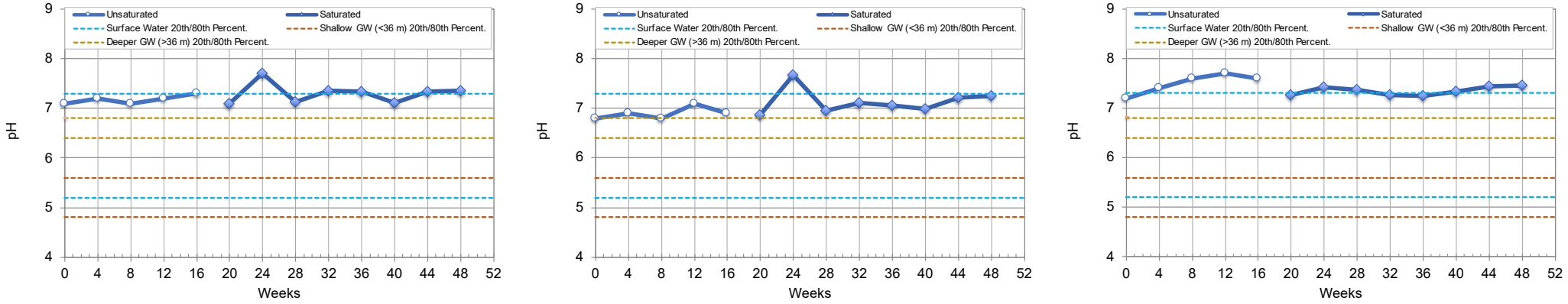



*Figure B1: pH of leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

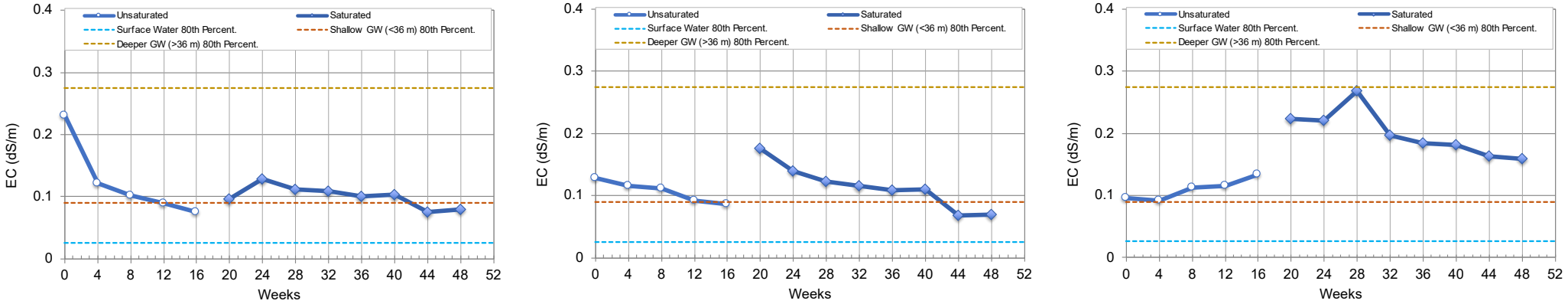



*Figure B2: EC of leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

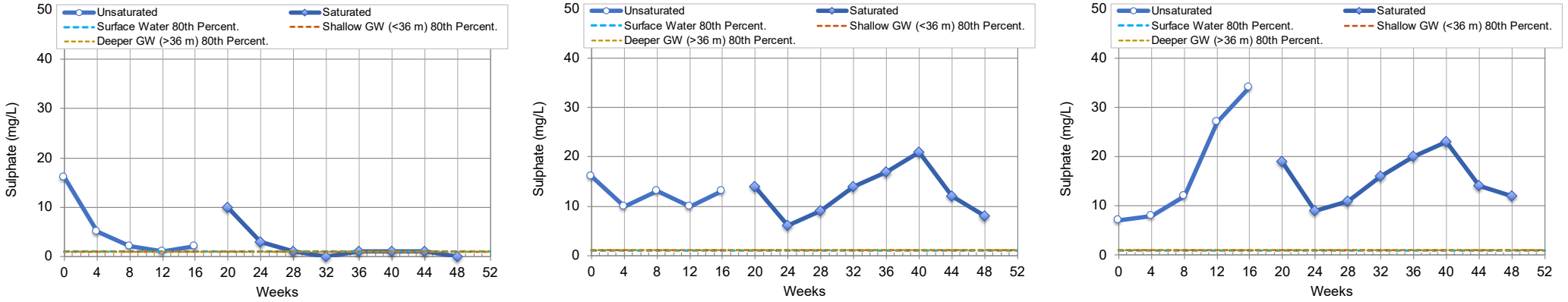



*Figure B3: Sulphate in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

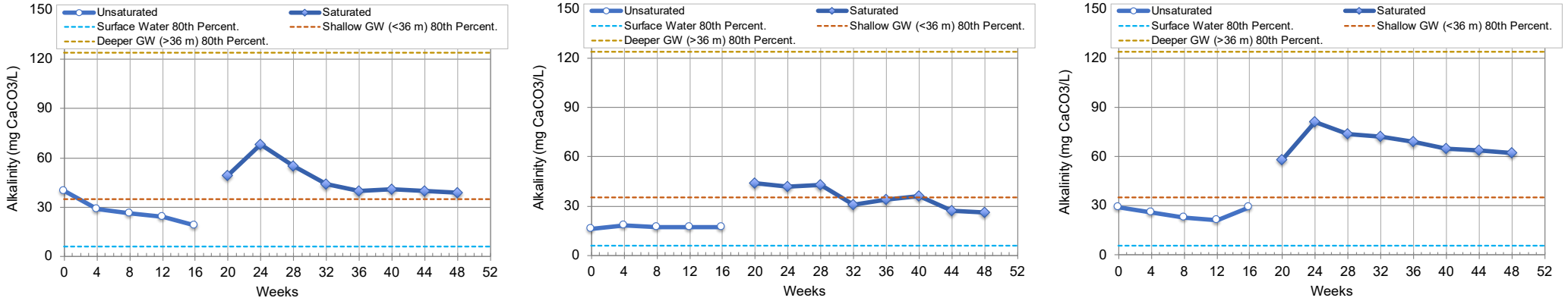



*Figure B4: Alkalinity in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

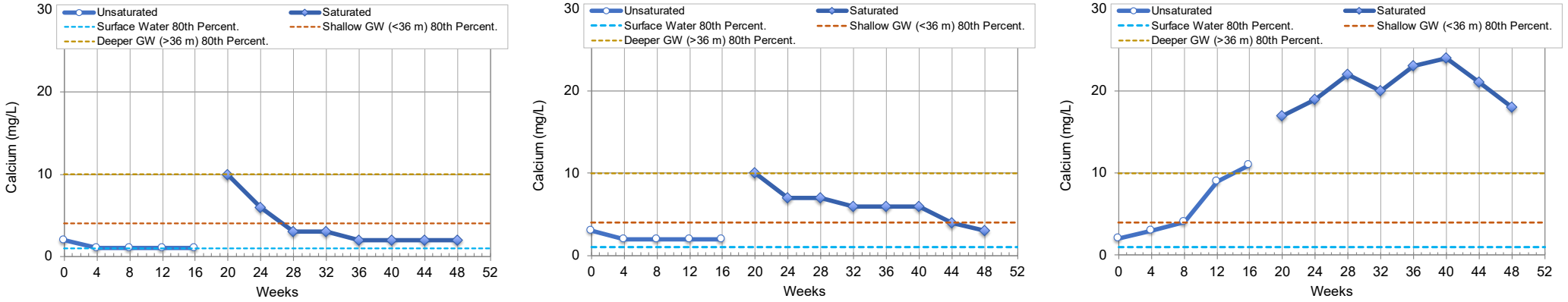
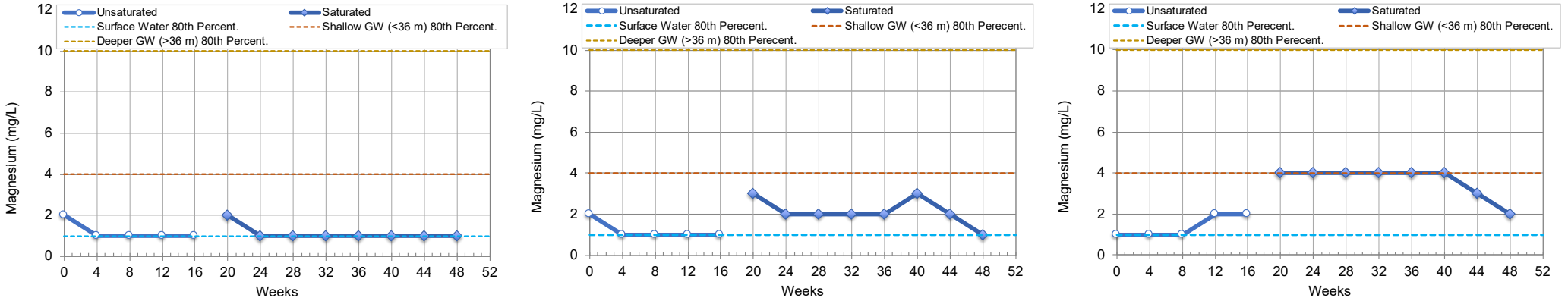



*Figure B5: Calcium in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

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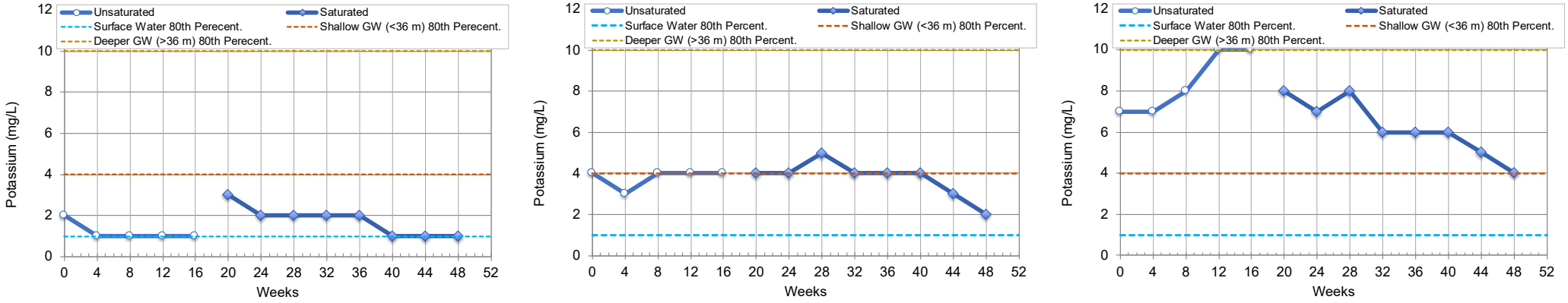


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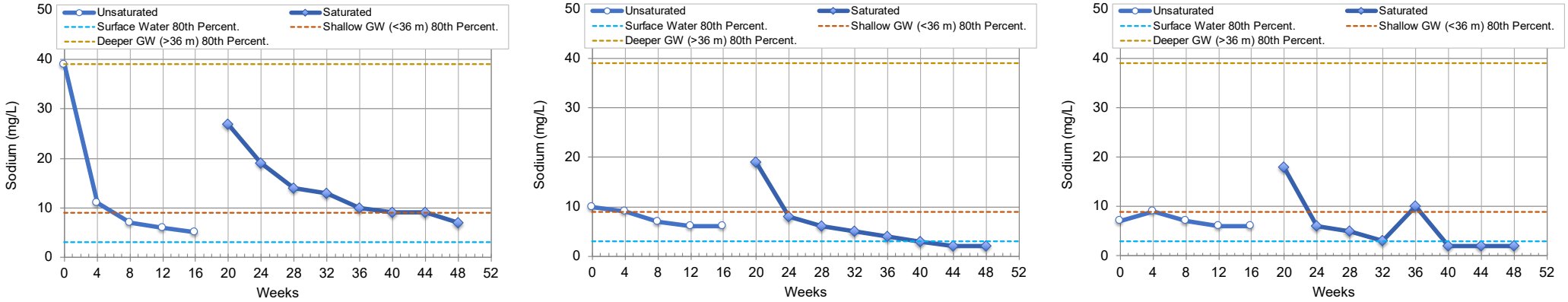


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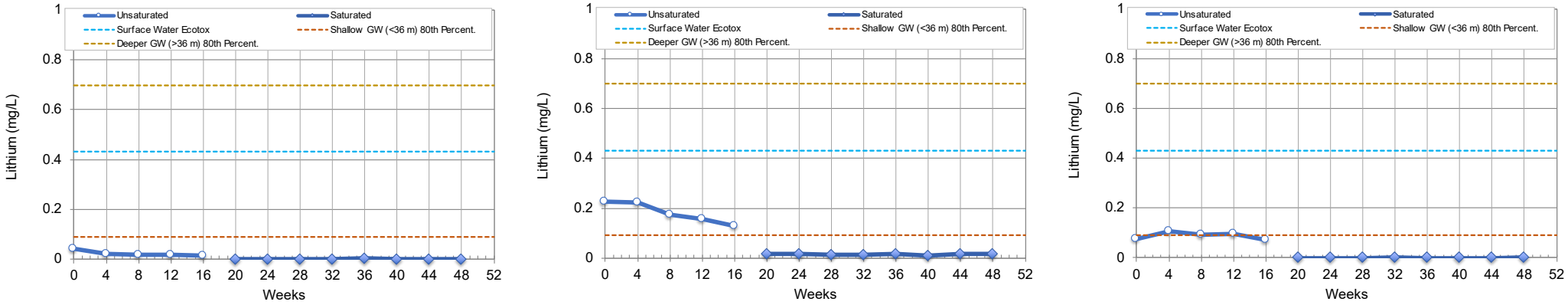


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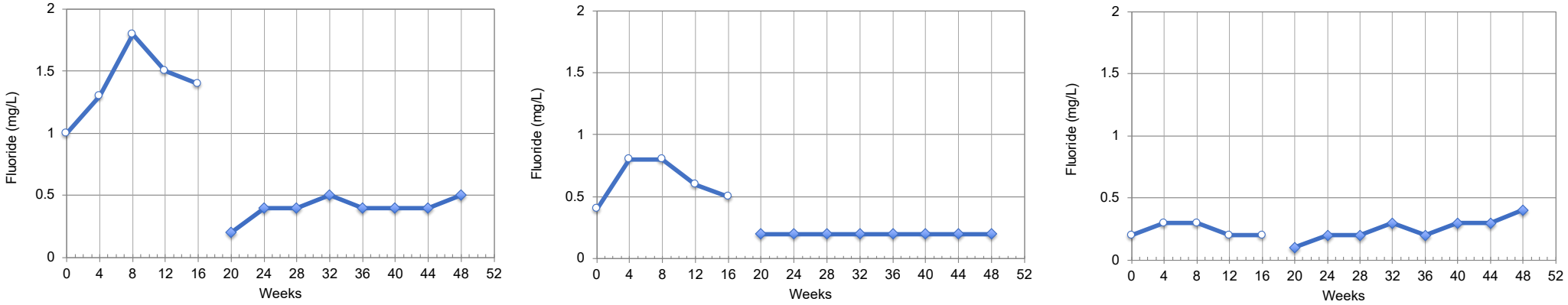


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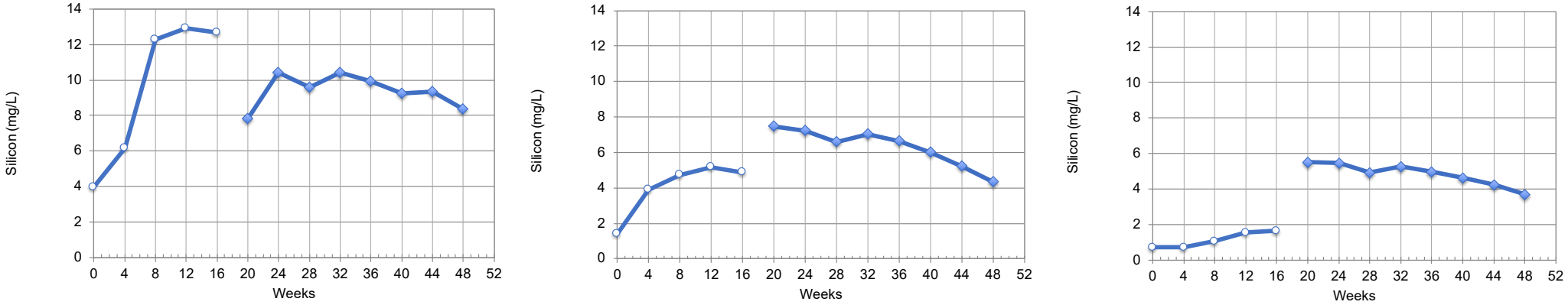


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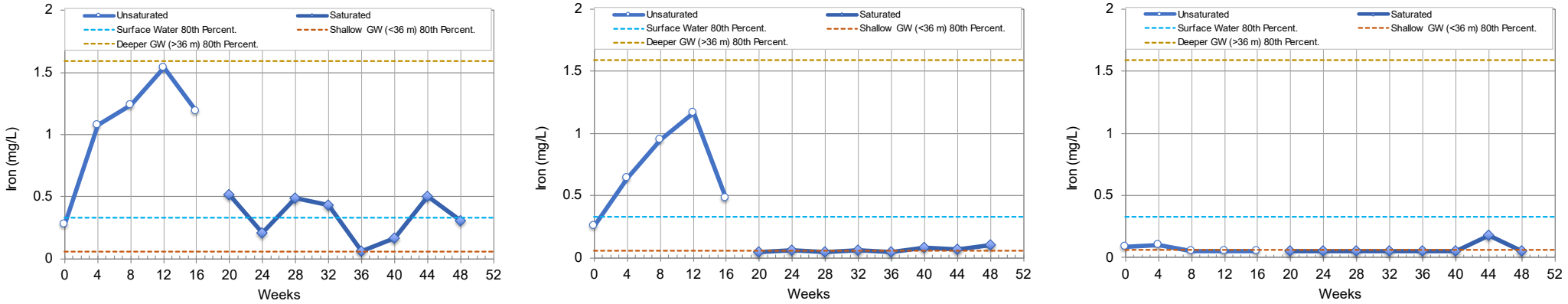


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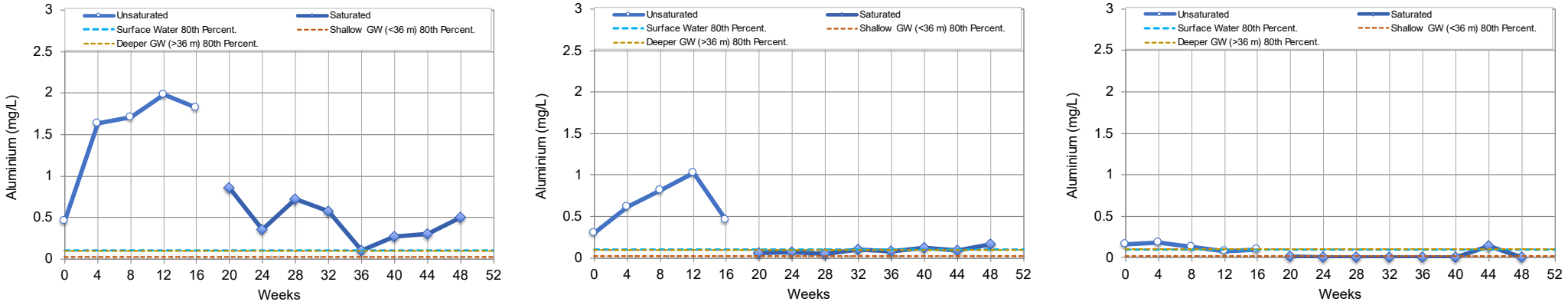


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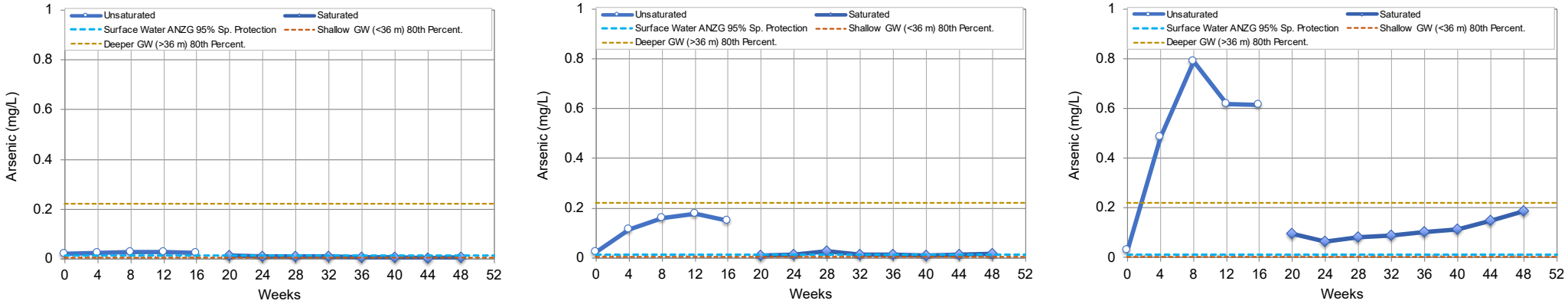


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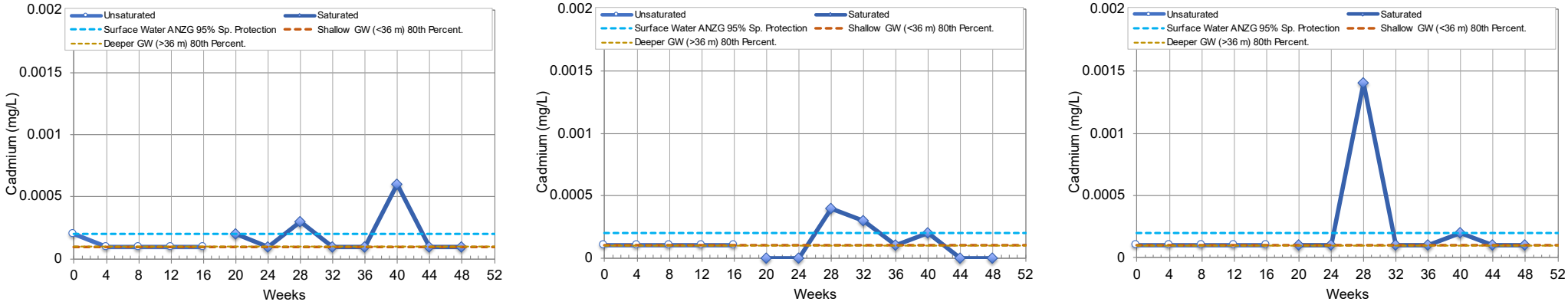


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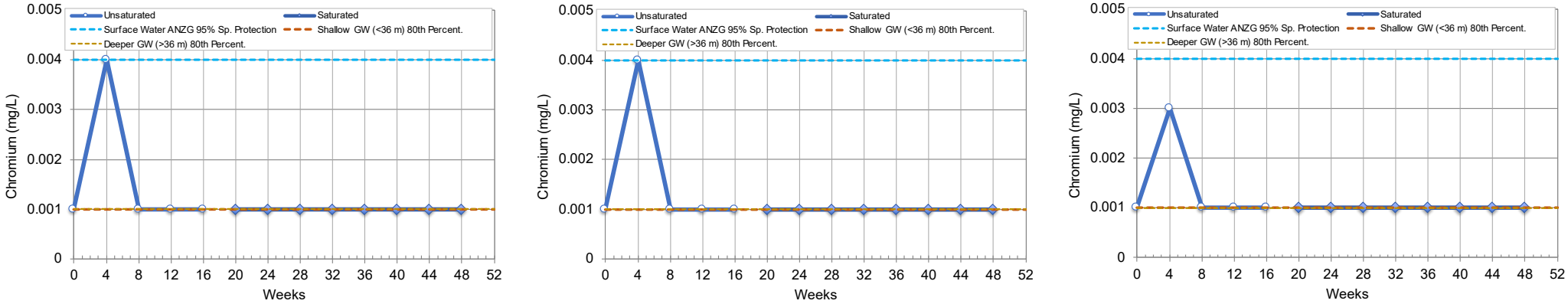


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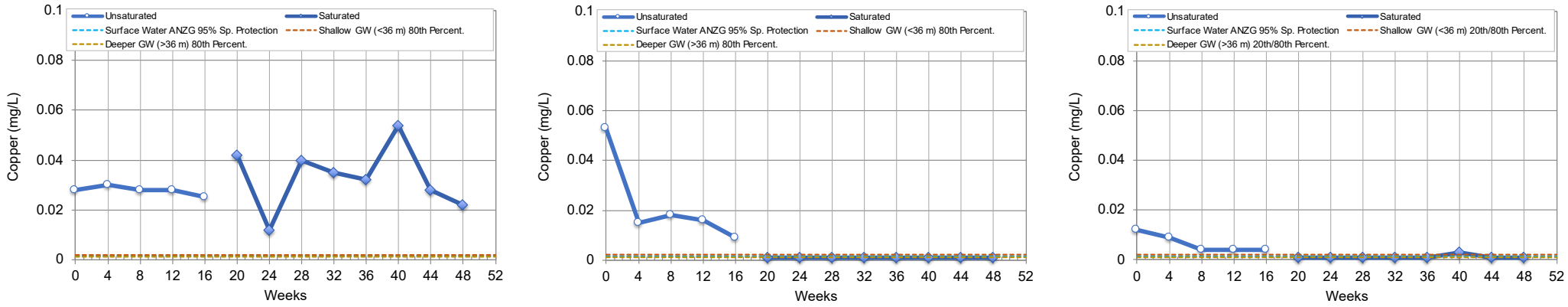


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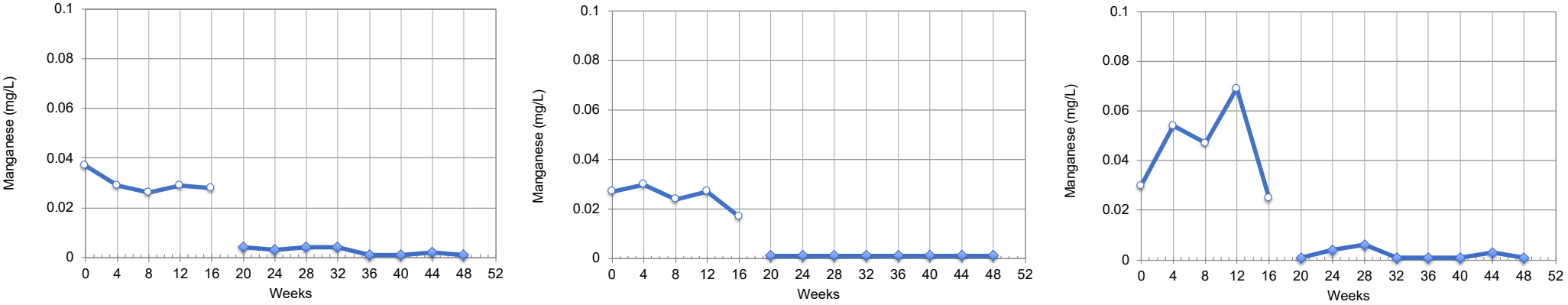


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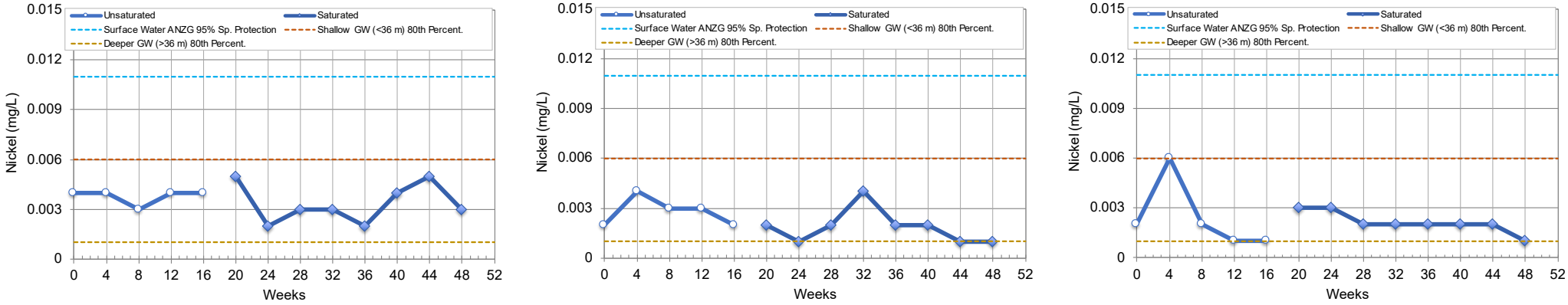


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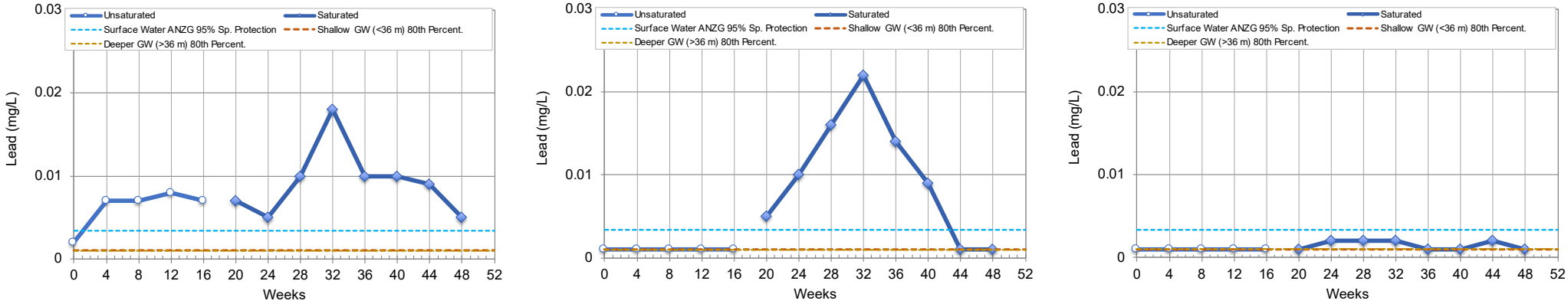


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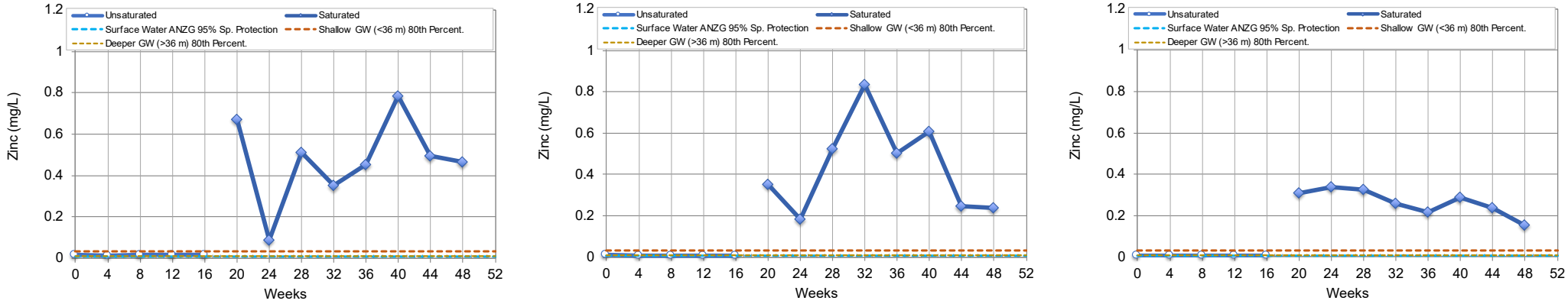


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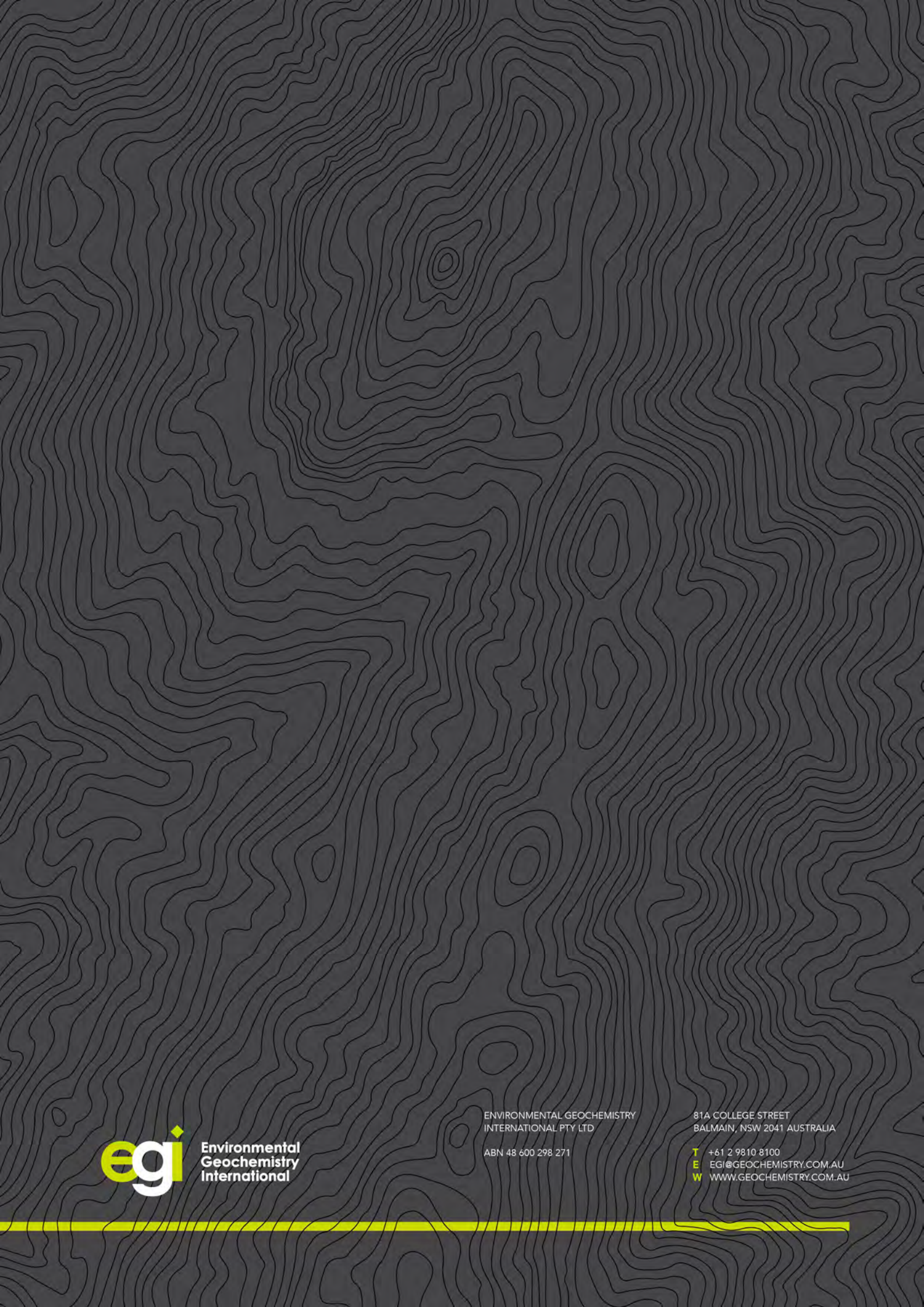

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# Geochemical Characterisation of Cemented Paste Backfill

Finniss Lithium BP33 Underground

J000844 / R1666

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## FINNIS LITHIUM BP33 UNDERGROUND

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# LIST OF ABBREVIATIONS

## ABBREVIATIONS USED IN GEOCHEMICAL ASSESSMENT

| | |
|---|---|
| **ARD** | Acid Rock Drainage |
| **AMD** | Acid, Metalliferous and Saline Drainage |
| **NMD** | Neutral and Metalliferous Drainage |
| **ABA** | Acid Base Account |
| **$pH_{1:2}$** | pH of a sample slurry with a solid to water ratio of 1:2 (by weight) |
| **$EC_{1:2}$** | Electrical Conductivity of a sample slurry with a solid to water ratio of 1:2 (by weight) |
| **ESP** | Exchangeable Sodium Percentage |
| **ECEC** | Effective Cation Exchange Capacity |
| **S** | Sulphur |
| **CRS** | Chromium Reducible Sulphur |
| **KCl** | Potassium Chloride |
| **$H_2SO_4$** | Sulphuric Acid |
| **$SO_4$** | Sulphate |
| **$CaCO_3$** | Calcium Carbonate |
| **ANC** | Acid Neutralising Capacity in kg $H_2SO_4$/t |
| **$ANC_{ABCC}$** | Acid Neutralising Capacity in kg $H_2SO_4$/t estimated from ABCC testing |
| **CNV** | Carbonate Neutralising Value in kg $H_2SO_4$/t |
| **MPA** | Maximum Potential Acidity, calculated from total S in kg $H_2SO_4$/t |
| **NAPP** | Net Acid Producing Potential, calculated from ANC and total S (or MPA) in kg $H_2SO_4$/t. |
| **NAG** | Net Acid Generation (test) |
| **NAGpH** | pH of NAG solution before titration |
| **$NAG_{(pH4.5)}$** | NAG acidity titrated to pH 4.5 in kg $H_2SO_4$/t |
| **$NAG_{(pH7.0)}$** | NAG acidity titrated to pH 7.0 in kg $H_2SO_4$/t |
| **ABCC** | Acid Buffering Characteristic Curve |
| **GAI** | Geochemical Abundance Index based on multi-elements of solids |
| **PAF** | Potentially Acid Forming |
| **PAF-LC** | Potentially Acid Forming - Low Capacity |
| **NAF** | Non-Acid Forming |
| **UC** | Uncertain |
| **AC** | Acid Consuming |

## UNITS OF MEASUREMENTS

| | |
|---|---|
| **%** | Percentage |
| **°C** | Degrees Celsius |
| **dS** | Deci Siemen |
| **µm** | Micrometre |
| **mm** | Millimetre |
| **m** | Metre |
| **mg** | Milligram |
| **g** | Gram |
| **kg** | Kilogram |
| **t** | Tonne |
| **L** | Litre |
| **ml** | Millilitre |
| **s** | Second |
| **mV SHE** | Millivolt Standard Hydrogen Electrode |

## OTHER ABBREVIATIONS

| | |
|---|---|
| **ALS** | Australian Laboratory Services |
| **EGi** | Environmental Geochemistry International Pty Ltd |
| **Project** | Finniss Lithium BP33 Underground |
| **UG** | Underground |

# EXECUTIVE SUMMARY

As a part of their Finniss Lithium Project, Core Lithium are planning to mine spodumene hosted in pegmatite ore from the BP33 deposit involving underground mining. As a part of the mining operation there is a plan to backfill mine voids in the underground operation using cemented paste backfill generated from ore processing waste streams (coarse rejects, fine tailings and possibly milled tailings). Recently, Minefill Services undertook a study to investigate the properties of these existing or potential waste streams to produce cemented paste. Based on the results of these tests, two waste/binder combinations were found to provide superior geotechnical properties for mine backfill. Subsequently, these mixtures require geochemical characterisation, including leaching characteristics, to assess any potential for impact on groundwater quality when backfilled mine voids are flooded at cessation of mining.

Environmental Geochemistry International (EGi) was contracted by Core Lithium to undertake geochemical characterisation of cemented paste backfill samples, including both acid rock drainage(ARD) potential and leaching characteristics when these materials are subjected to submersion in groundwater. The later test program involves a time series batch leach extraction method with a total leaching time of 63 days. This interim report provides results for analysis of the ARD characteristics of the cemented paste backfill, and for the first 14 days of batch leach testing.

Two cemented paste backfill samples were supplied for testing, namely:

- Milled Tailings with 10% LH Binder[1]
- A 50:50 mixture of Coarse Rejects and Fine Tailings with 5.5% LH Binder

Results from ARD characterisation tests conducted on the two cemented paste backfill samples can be summarised as follows:

- These materials are characterised by very low S content.
- Both samples appear to have significant neutralising capacity. Both acid neutralising capacity (ANC) and the effective ANC measured using the ABCC method are around 100 and 50 kg $H_2SO_4$/t for the milled tailings/10% LH binder and coarse rejects/fine tailings/5.5% LH binder mixtures, respectively.
- Unusually, neutralising capacity calculated from the inorganic carbon content of these samples is substantially less the effective ANC. The binder lime content is likely to account for all or most of the difference between the carbonate ANC and effective ANC of these materials.
- High NAGpH values corroborate the lack of acid generating potential of these samples, indicating that the cemented paste backfill materials can be classified as non-acid forming (NAF).

**These results suggest that should cemented paste, as represented by the samples tested, remain exposed to air in backfilled mine voids for an extended period prior to inundation, oxidation to produce ARD which could adversely impact groundwater quality is extremely unlikely.**

Testing of groundwater used for batch leach testing shows that the groundwater from the Finniss project has near neutral pH with low salinity, principally derived from Na, Ca, K and bicarbonate and Cl. The groundwater alkalinity is moderately high, together with moderately high Si and slightly elevated Ba and Sr. Li and Zn were also present in groundwater at low concentrations with other metals/metalloids close to or below the detection limit.

Batch leach testing was undertaken using US EPA Method 1315. Method 1315 is designed to provide the mass transfer rates (release rates) of inorganic analytes contained in a monolithic or compacted granular material, under diffusion-

[1] LH Binder is a mixture of 30% General Purpose Cement (otherwise known as Ordinary Portland Cement) and 70% blast furnace slag.

controlled release conditions, as a function of leaching time. These tests provide conditions that will most closely simulate the leaching conditions of cemented paste backfill in inundated mine voids.

Calculation of diffusion rates within the porous structure of the cemented paste backfill samples show that diffusion is sufficiently slow such that during the first 48 hours, internal leaching of the cemented paste is limited, with the majority of leaching occurring at the outer surface. However, over a longer period of time, leaching of solutes dissolved from the internal structure of the cemented paste cylinders becomes the dominant process. These findings provide confidence that leach tests conducted over periods significantly longer than about 2 days, will provide results indicative of the leaching properties of cemented paste in the backfilled mine voids of the BP33 UG mine when contacted with groundwater.

Leaching results from batch leach tests conducted on the two cemented paste backfill samples can be summarised as follows:

- Over very short periods (2 hours) there was little change to the groundwater pH, alkalinity or TDS on contact with cemented paste backfill.
- After 2 days there was a significant increase in groundwater pH, alkalinity and TDS, indicative of (surface) dissolution of alkaline minerals, most probably lime present in the LH binder.
- Over a longer period of up to 14 days, the pH of groundwater in contact with the cemented paste backfill samples dropped, but still remained high at above 9.5. Alkalinity and TDS in leachates remained only slightly higher than in the original groundwater samples, indicative of much slower diffusion-controlled dissolution of minerals in the cemented paste backfill samples.
- Solutes in the cemented paste backfill that dissolved during the first 14 days of contact with groundwater included Al, As, K, Li, Na, Sr and SO4. Dissolution occurred in the order K > Na > SO4 >> Li >> Al, Sr >> As, with the amounts of K, Na and SO4 in the order of 1000s of mg/m$^2$, Li in the 10 – 100s mg/m$^2$, Al and Sr in the 1 – 10 mg/m$^2$ and As <1 mg/m$^2$. In the main, the origin of these solutes is most likely the binder used in the cemented paste backfill.
- Several solutes present in the groundwater sample appear to have precipitated (or have been adsorbed) on contact with the cemented paste backfill samples. Solution speciation modelling of the leachate solutions suggests that Ba is likely to be precipitated as barite ($BaSO_4$), Ca and Mg as dolomite, Fe as ferrihydrite or goethite and Si as a semi-crystalline silica.
- There was no evidence of significant leaching of metals/metalloids into the groundwater following contact with the cemented paste backfill samples.

**These results suggest that should cemented paste backfilled mine voids, as represented by the samples tested, be inundated by rebounding groundwater, deterioration of groundwater quality at the BP33 project will be minimal.**

Batch leach testing is ongoing and will continue for a total of 63 days. Results from the final 49 days of leaching will be provided in an updated report on completion of the test program.

# 1. INTRODUCTION

As a part of their Finniss Lithium Project, Core Lithium are planning to mine spodumene hosted in pegmatite ore from the BP33 deposit. Ore extraction is expected to involve underground mining using conventional long hole stoping. Pegmatite ore from BP33 will be processed at the nearby Grants Dense Medium Separation (DMS) plant where ore mined from the Grants open pit mine is currently processed. The DMS plant produces two waste streams, a coarse rejects stream and fine tailings stream. The use of flotation to process pegmatite ore, if implemented, would involve comminution producing a finer "milled" tailings waste stream.

Recently, Minefill Services (2023) undertook a study to investigate the properties of these existing or potential waste streams to produce cemented paste material to backfill mine voids at the BP33 underground operation. Investigations included cemented aggregates and pastes produced by combining one or more of the above waste streams with various binders. Based on the results of this test work, two waste/binder combinations were found to provide superior geotechnical properties for mine backfill. Subsequently, these mixtures require geochemical characterisation, including leaching characteristics, to assess any potential for impact on groundwater quality when backfilled mine voids are flooded at cessation of mining.

Environmental Geochemistry International (EGi) was contracted by Core Lithium to undertake geochemical characterisation of cemented paste backfill samples, including both acid rock drainage(ARD) potential and leaching characteristics when these materials are subjected to inundation in groundwater. The later test program involves a time series batch leach extraction method with a total leaching time of 63 days. This interim report provides results for analysis of the ARD characteristics of the cemented paste backfill, and for the first 14 days of batch leach testing. The results of the full 63 days of leach testing will be provided in a future report.

# 2. SAMPLES AND CHARACTERISTION

## 2.1. Samples

EGi received two cemented paste backfill samples prepared by Minefill Services (Table 1). Samples were cast in 50 mm cylindrical moulds producing a cemented cylinder with 50 mm diameter and approximately 100 mm length (Figure 1). Each sample was received in triplicate, with one sample dried at 60°C to a constant weight and the dry weight recorded. The dried sample was crushed and then pulverised to -75 µm for geochemical analysis. A second cylinder was retained in the sealed casing until it was used for batch leach testing. The third sample was kept as a witness sample for further testing if required.

*Table 1: Cemented paste backfill samples used for this test program*

| EGI CODE | WASTE MATERIAL | BINDER CONTENT[1] | CURE TIME[2] (Days) |
|---|---|---|---|
| 26581 | Milled Tailings | 10% LH Binder | 28 |
| 26582 | 50:50 Coarse Rejects/Fine Tailings | 5.5% LH Binder | 28 |

1. Low Heat (LH) Binder is a mixture containing 30% General Purpose Cement (GPC) and 70% blast furnace slag with the percentage binder calculated on a dry weight basis.
2. Curing was undertaken at 35 ± 2°C and >95% relative humidity.

*Figure 1:Cemented paste cylinder of Milled Tailings plus 10% LH binder.*

In addition to the two cemented paste backfill materials, a groundwater sample collected from the BP33 deposit was also supplied to undertake batch leaching tests. 60 L (3 x 20 L drums) of groundwater were received and pH, EC and ORP measurements demonstrated equivalence of the three drums and the water samples were subsequently treated as a single sample.

## 2.2. ARD Characterisation

The results from ARD characterisation of the two cemented paste backfill samples are presented in Table 2. These materials are characterised by very low S content, in agreement with previous testing which demonstrated that pegmatite ores from the Finniss project are largely devoid of sulphides (EGi 2021), which would suggest that coarse rejects and tailings from ore processing must also have a low S content.

In contrast to a lack of acid generating potential due to the lack of sulphides, both samples appear to have significant neutralising capacity. Acid neutralising capacity (ANC) measured using the standard Sobek method gave a neutralising capacity closely matching the effective ANC measured using the ABCC method (Figure 2) of around 100 and 50 kg $H_2SO_4$/t for the Milled Tailings/10% LH binder and Coarse Rejects/Fine Tailings/5.5% LH binder mixtures respectively.

Unusually, the carbonate neutralising value (CNV) calculated from the inorganic carbon content of these samples provided CNVs substantially less that the effective ANCs measured by the ABCC method. The CaO content of LH Binder used to produce these samples is around 48% (Minefill Services, 2023). If it is assumed that all of the Ca is present as lime, this provides a maximum ANC of 84 and 46 kg $H_2SO_4$/t at 10% and 5.5% binder content in the Milled Tailings and

Coarse Rejects/Fine Tailings cemented backfill samples respectively. The differences between the effective ANC and CNV values measured for these two samples are 64 and 40 kg $H_2SO_4$/t (Table 2), suggesting that the binder lime content is likely to account for all or most of the difference between the carbonate ANC and effective ANC of these materials.

The significant effective ANC measured for these materials together with the negligible S content suggests these materials are unlikely to generate acidity on oxidation. The high NAGpH values (Table 2) corroborate the lack of acid generating potential of these samples, indicating that the cemented paste backfill materials can be classified as non-acid forming (NAF).

As blast furnace slag constitutes the majority of the binder used to produce the cemented paste backfill samples and a very large proportion of the slag is likely glass (amorphous and X-ray invisible) material, XRD analysis was not undertaken on the cement paste samples. However, XRD analysis has previously been conducted on the coarse rejects and fine tailings used to produce the cemented paste samples (Minefill Services, 2023). The results of this analysis (Table 3) show there is very little difference between the mineralogy of the two materials. Major phases in both samples include quartz, sodium (albite) and potassium (microcline) plagioclase, all of which are relatively inert minerals. The other major phase in the waste materials used to produce the cemented paste samples is spodumene, together with other minor Li containing minerals. Trace carbonates also identified include calcite and dolomite, in agreement with the results of ABCC testing which indicates the presence of both minerals in the two cemented paste backfill samples.

In addition to ARD characterisation, mutli-element assays were also undertaken for the two cemented paste backfill samples. The full results are presented in Table A1 in Appendix A. Results were used to calculate the geochemical abundance index (GAI) which provides a measure of the concentration of each element in a sample relative to average background concentrations. The results of GAI calculations are also shown in Table A1 and suggest these samples are enriched (GAI ≥ 3) in Li, Ca, Ta and Sn, which is expected as the pegmatites in the Finniss Lithium deposits are classified as LCT (Lithium-Caesium-Tantalum) type. Significantly, with the exception of Be and Bi, there appears to be no enrichment in other metals/metalloids which might adversely impact groundwater quality should they be leached from cemented paste backfill.

## 2.3. Groundwater Analysis

The groundwater used for batch leach testing was analysed to provide baseline water quality for comparison with the water quality of leachates produced after immersion of the cemented paste backfill cylinders in groundwater during batch leach testing. The results (Table A2, Appendix A) show that the groundwater from the Finniss project has near neutral pH with low salinity, principally derived from Na, Ca, K and bicarbonate and Cl. The groundwater alkalinity is moderately high, together with moderately high Si and slightly elevated Ba and Sr. Li and Zn were also present in groundwater at low concentrations with other metals/metalloids close to or below the detection limit.

*Table 2: ARD properties of cemented paste backfill samples*

| EGi Code | Description | Moisture Content (%) | ACID-BASE ANALYSIS | | | | | | | | | | | | NAG TEST | | | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total S (%) | Total C (%) | Organic C (%) | Inorganic C (%) | MPA | ANC | CNV | ABCC | NAPP | ANC/MPA | $NAPP_{IC}$ | $NAPP_{Eff}$ | NAGpH | $NAG_{(pH4.5)}$ | $NAG_{(pH7.0)}$ | |
| 26581 | Milled Tailings + 10% LH Binder | 27 | 0.08 | 0.53 | 0.10 | 0.43 | 2 | 95 | 35 | 99 | -93 | 38.8 | -33 | -97 | 9.5 | 0 | 0 | NAF |
| 26582 | Coarse Rejects/ Fine Tailings + 5.5% LH Binder | 16 | 0.04 | 0.33 | 0.11 | 0.22 | 1 | 51 | 18 | 58 | -50 | 41.7 | -17 | -57 | 8.8 | 0 | 0 | NAF |

MPA = Maximum Potential Acidity calculated as Total S x 30.6 (kg $H_2SO_4$/t)
ANC = Acid Neutralising Capacity (kg $H_2SO_4$/t)
NAPP = Net Acid Producing Potential calculated as MPA - ANC (kg $H_2SO_4$/t)
CNV = Carbonate Neutralising Value calculated as Inorganic C * 81.7 (kg $H_2SO_4$/t)
ABCC = Acid Buffering Characterisitic Curve calculated as the neutralising capacity to pH 4 (kg $H_2SO_4$/t)
$NAPP_{IC}$ = NAPP calculated as MPA - CNV (kg $H_2SO_4$/t)
$NAPP_{Eff}$ = NAPP calculated as MPA - ABCC (kg $H_2SO_4$/t)

NAGpH = pH of NAG liquor
$NAG_{(pH4.5)}$ = Net Acid Generation capacity to pH 4.5 (kg $H_2SO_4$/t)
$NAG_{(pH7.0)}$ = Net Acid Generation capacity to pH 7.0 (kg $H_2SO_4$/t)

NAF = Non-Acid Forming
PAF = Potentially Acid Forming
PAF-LC = PAF - lower capacity
UC = Uncertain Classification
(expected classification in brackets)

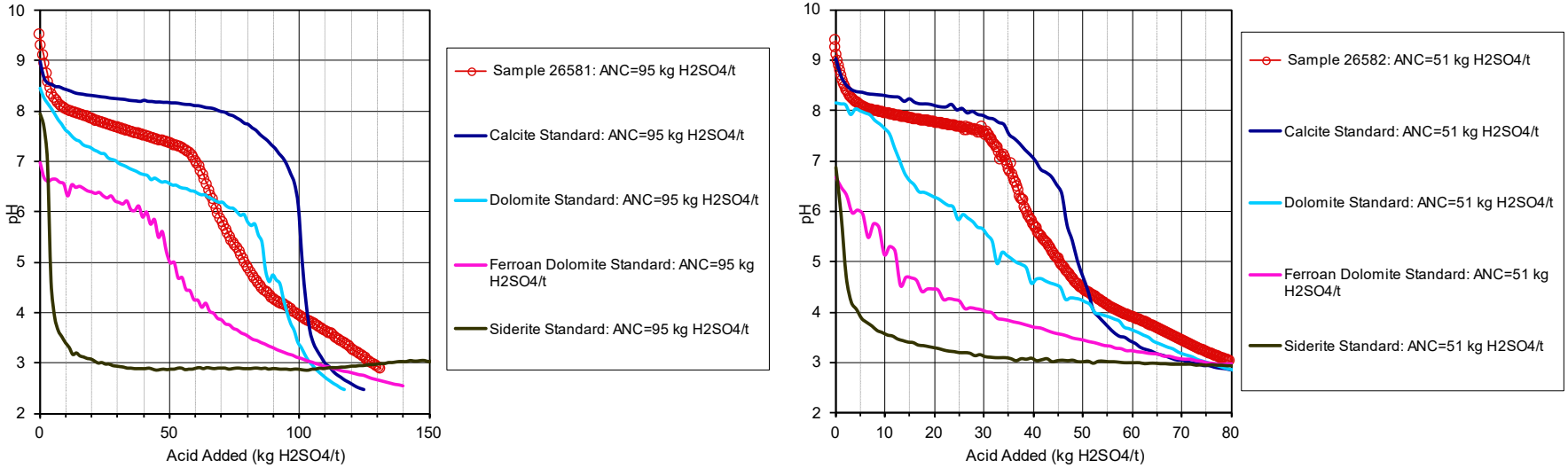


*Figure 2:ABCC profiles for cemented paste cylinders of Milled Tailings plus 10% LH binder (left) and Coarse Rejects/Fine Tailings plus 5.5% LH binder (right).*

*Table 3: Mineralogy of Coarse Rejects and Fine Tailings used for producing the cemented paste backfill samples*[2]

| MINERAL | COMPOSITION (%) | |
|---|---|---|
| | COARSE REJECTS | FINE TAILINGS |
| Albite | 47.0 | 39.5 |
| Quartz | 31.3 | 34.4 |
| Microcline – Na | 12.9 | 7.3 |
| Spodumene | 5.6 | 15.7 |
| Muscovite – 2M | 2.7 | 2.6 |
| Elbaite | 0.2 | 0.2 |
| Dolomite | 0.1 | 0.1 |
| Petalite | 0.1 | 0.1 |
| Calcite | 0.1 | 0.1 |

# 3. BATCH LEACH TESTING

## 3.1. Batch Leach Testing Methodology

Batch leach testing was undertaken using US EPA Method 1315 (US EPA, 2017). Method 1315 is designed to provide the mass transfer rates (release rates) of inorganic analytes contained in a monolithic or compacted granular material, under diffusion-controlled release conditions, as a function of leaching time. These tests provide conditions that will most closely simulate the leaching conditions of cemented paste backfill in inundated mine voids. For this test, the intact cemented paste samples were contacted with groundwater from the Finniss Lithium Project site, at a specified liquid to surface area ratio (L/A) of approximately 9 mL/cm$^2$.

The setup used for leaching the cemented paste samples is illustrated in Figure 3. The cemented paste cylinders were placed in a plastic holder and then placed into a plastic container together with 2 L of groundwater. The cylinder was supported by the plastic holder to ensure the entire sample surface area was exposed to the leaching fluid in a 3D configuration. At the end of each predetermined leaching interval (Table 4) the cemented cylinder was removed from the leach container to freely drain before the weight was recorded. The sample was then placed in another leach container with fresh groundwater. The eluate from each leaching interval was measured for pH, EC, ORP and alkalinity. A sub-sample was filtered through a 0.45 micron membrane filter and analysed by ALS Environmental Laboratory in Sydney for a suite of 34 elements. At the time of this report, leachates to an accumulated leach time of 14 days had been sampled and analysed.

[2] Data from Minefill Services, 2023.

*Table 4: Leachate collection scheme.*

| LEACHATE SAMPLE | LEACHING INTERVAL | CUMULATIVE LEACH TIME |
|---|---|---|
| Leachate 1 | 2 hours | 0.08 days |
| Leachate 2 | 1.9 days | 2 days |
| Leachate 3 | 2 days | 4 days |
| Leachate 4 | 3 days | 7 days |
| Leachate 5 | 7 days | 14 days |
| Leachate 6 | 14 days | 28 days |
| Leachate 7 | 14 days | 42 days |
| Leachate 8 | 7 days | 49 days |
| Leachate 9 | 14 days | 63 days |

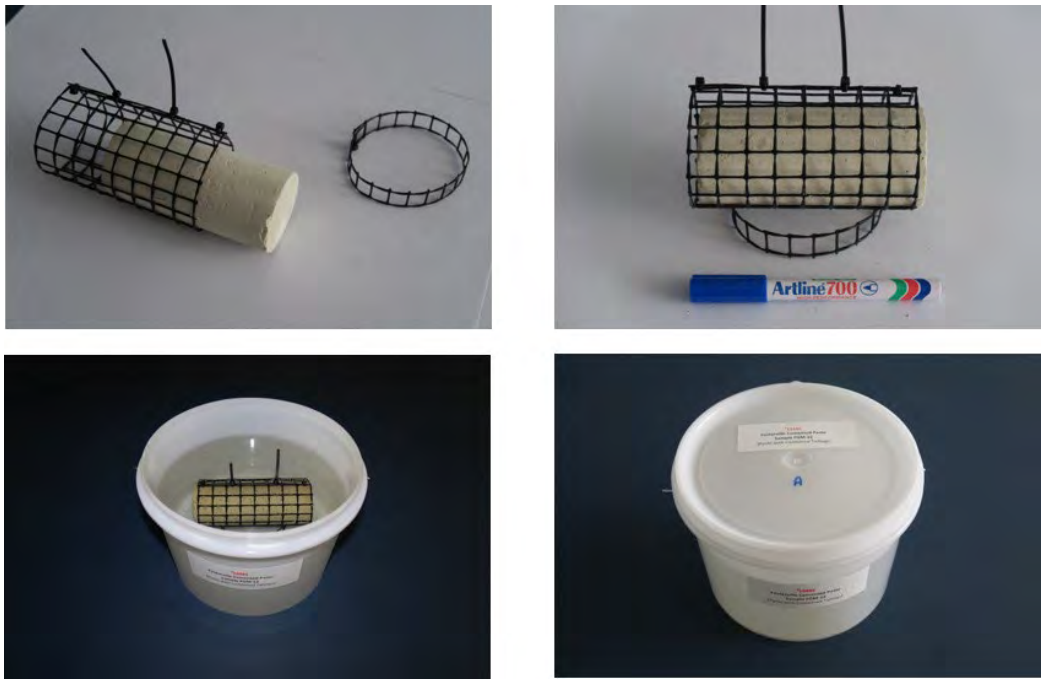


*Figure 3:Illustration of Method 1315 setup.*

## 3.2. Batch Leach Testing Results

Batch leaching tests for the two cemented paste backfill samples in groundwater have been completed up to 14 days leaching and will be continued up to a total leach time of 63 days. The results of leachate analysis are provided in Table B1 and Table B2 in Appendix B. As described above, the conditions of these leach tests are designed to investigate mass transfer rates (release rates) of inorganic analytes contained in a monolithic material under diffusion-controlled release conditions as a function of leaching time. When mass transfer of each element is plotted against time, the slope of the line can be used to identify the mechanism of release. A slope of near 0 indicates continuing surface dissolution. A slope near to 1 is indicative of surface wash-off, while a slope of around 0.5 indicates diffusion-controlled release (Heasman et al., 1997).

Representative plots of mass transfer for Li and Na as a function of time for the two cemented paste samples are shown in Figure 4. Other elements provide similar plots. The plots show that during the first 2 days the slope of the plot of mass transfer as a function of leaching time is between 0.5 and 1, suggesting that during this initial period, both surface wash-off and diffusion-controlled leaching is occurring. From about day 2 onwards, the slope drops to below but close to 0.5, indicating the major dissolution process operating is diffusion controlled. This suggests that the diffusion rate within the porous structure of these materials is sufficiently slow such that during the first 48 hours, internal leaching of the cemented paste is limited, with the majority of leaching occurring at the outer surface. However, over a longer period of time leaching of solutes dissolved from the internal structure of the cemented paste cylinders becomes the dominant process. These findings provide confidence that leach tests conducted over periods significantly longer than about 2 days, e.g., the 63-day period of the current tests, will provide results indicative of the leaching properties of cemented paste in the backfilled mine voids of the BP33 UG mine when contacted with groundwater.

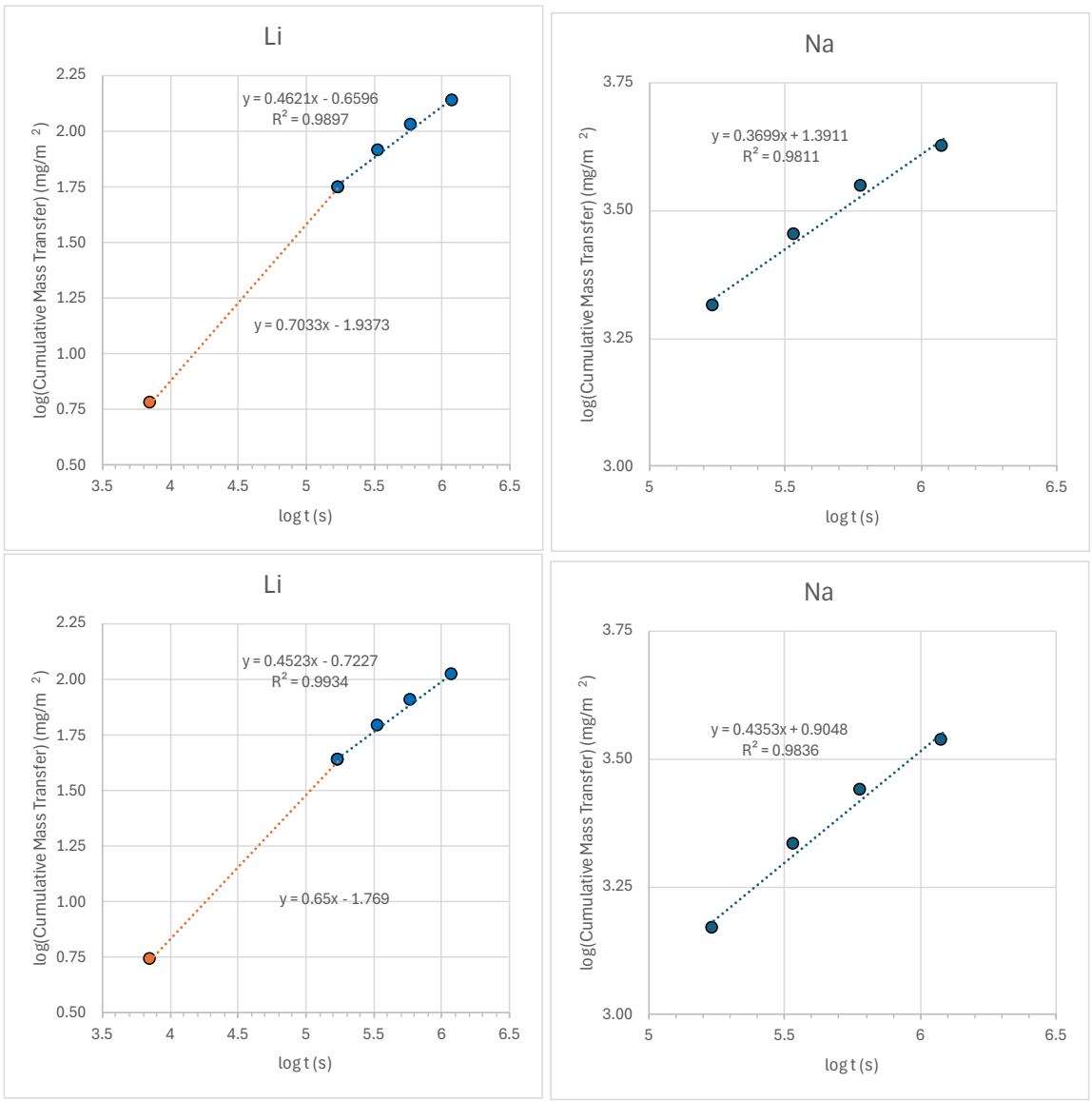


*Figure 4: Plots of cumulative mass transfer as a function of leach time for Li and Na for Milled Tailings (top) and Coarse Rejects/Fine Tailings (bottom) cemented paste samples in groundwater. Orange dotted lines represent linear regression of leachate data over the first 2 days and blue dotted lines linear regression of leachate data from day 2 to day 14.*

Figure 5 shows plots of groundwater pH, alkalinity and TDS (calculated form EC) as a function of time following contact with the two cemented paste backfill samples. The results indicate that over very short periods (2 hours) there is little change to the groundwater pH, alkalinity or TDS. However, after 2 days there has been a significant increase in pH, alkalinity and TDS, indicative of (surface) dissolution of alkaline minerals, most probably lime present in the LH binder. Over the longer period of up to 14 days, the pH of groundwater in contact with the cemented paste backfill samples dropped, but still remained high at above 9.5. Alkalinity and TDS in leachates remained only slightly higher than in the original groundwater samples, indicative of much slower diffusion-controlled dissolution of minerals in the cemented paste backfill samples.

Three different processes appear to be occurring when the cemented paste backfill samples are contacted with groundwater namely; dissolution of minerals in the cemented paste backfill, precipitation of various solutes present in the groundwater and a lack of dissolution of most metals/metalloids in present in the cemented paste backfill samples.

Solutes in the cemented paste backfill that dissolved during the first 14 days of contact with groundwater included Al, As, K, Li, Na, Sr and SO4 (Table 5). Dissolution occurred in the order K > Na > SO4 >> Li >> Al, Sr >> As, with the amounts of K, Na and SO4 in the order of 1000s of mg/m$^2$, Li in the 10 – 100s mg/m$^2$, Al and Sr in the 1 – 10 mg/m$^2$ and As <1 mg/m$^2$ (Table B3 and Table B4). In the main, the origin of these solutes is most likely the binder used in the cemented paste backfill (Table 6), with soluble K, Na, and SO4 typically present in GPC. The origin of dissolving Li is uncertain, but may be derived from the various Li-bearing minerals present in the coarse rejects or fine tailings from ore processing.

Several solutes present in the groundwater sample appear to have precipitated (or have been adsorbed) on contact with the cemented paste backfill samples (Table 5). Solution speciation modelling of the leachate solutions suggests that Ba is likely to be precipitated as barite ($BaSO_4$), Ca and Mg as dolomite, Fe as ferrihydrite or goethite and Si as a semi-crystalline silica (Table 7).

While both the cemented paste backfill samples undergoing batch leach testing showed little or no enrichment in heavy metal/metalloid content (Table A1), this does not preclude leaching of these species, albeit concentrations will likely be lower than for samples where there is elevated metal content. However, there was no evidence of significant leaching of metals/metalloids into the groundwater following contact with the cemented paste backfill samples, indicating either a lack of dissolution of any phases containing heavy metals/metalloids, or immediate re-precipitation of any dissolved metals following dissolution, most likely as hydroxides and/or carbonates in solutions with elevated pH and alkalinity.

In summary, contact of groundwater over a period of 14 days with either Milled Tailings or Coarse Rejects/Fine Tailings cemented paste backfill produced by mixing processing waste streams with LH binder, resulted in limited change in the character of the groundwater. The main change was an increase in pH from around 6.6 to between 9.5 and 10, accompanied by a slight increase in alkalinity from 84 to around 100 to 120 mg $CaCO_3$/L. TDS (calculated from EC measurements) also increased slightly from 70 mg/L in the groundwater to around 100 mg/L following contact with the cemented paste backfill samples. The small increases in dissolved solute concentrations were principally associated with dissolution of K, Na and SO4, most likely from dissolution of minerals present in the LH binder. Concentrations of a number of solutes in the groundwater, principally Ba, Mg and Si, decreased on contact with the cemented paste backfill samples, most likely due to precipitation of these solutes in the presence of higher pH/alkalinity conditions. There was no evidence of significant metal/metalloid dissolution into groundwater after contact with the cemented paste backfill samples over the first 14 days of leaching.

Batch leach testing is ongoing and will continue for a total of 63 days. Results from the final 49 days of leaching will be provided in an updated report on completion of the test program.

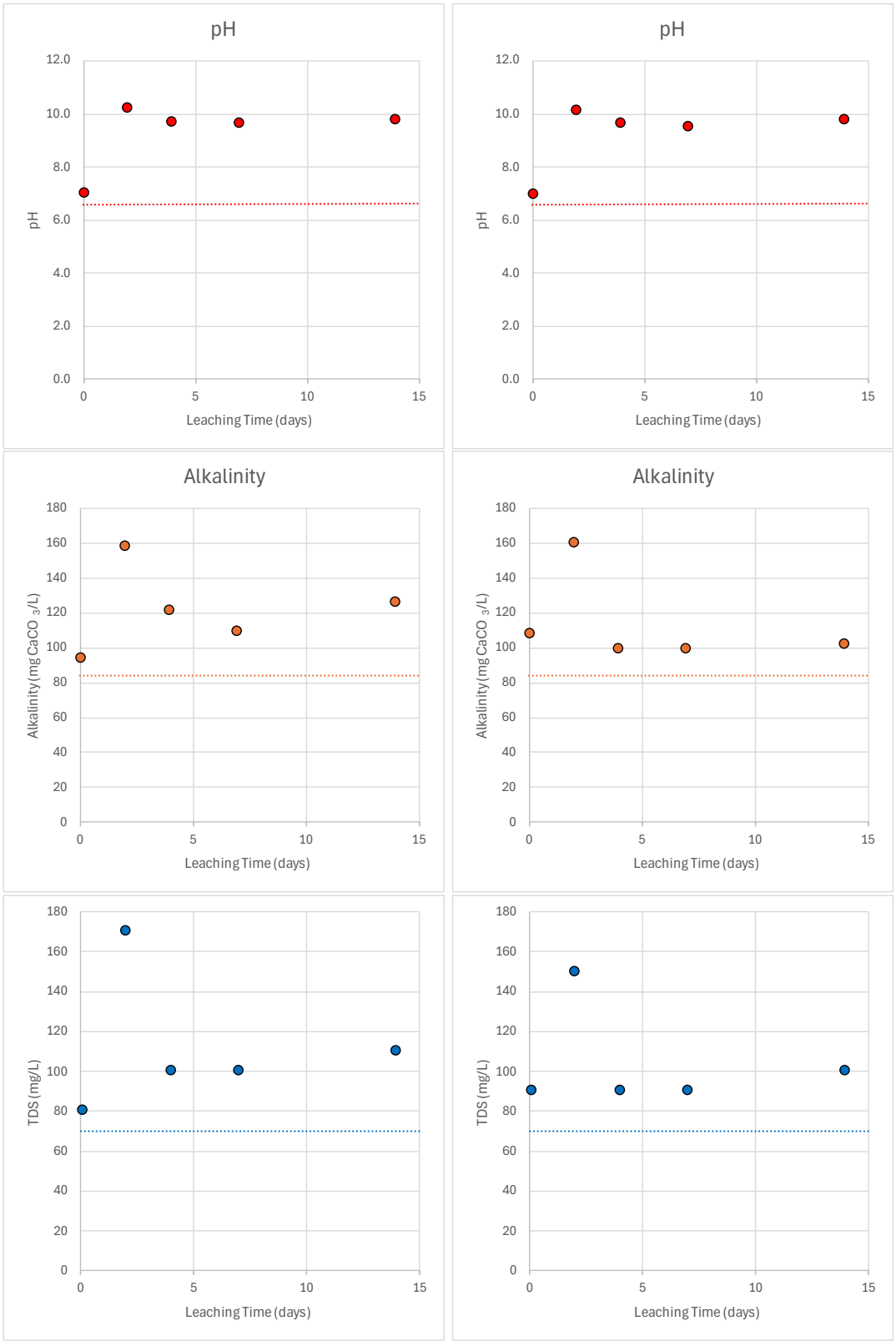


*Figure 5:Leachate pH, alkalinity and TDS as a function of leach time for Milled Tailings (left) and Coarse Rejects/Fine Tailings (right) cemented tailings samples in groundwater. The dotted lines represent the values in groundwater prior to contact with the cemented paste samples.*

*Table 5: Fate of various elements for Milled Tailings and Coarse Rejects/Fine Tailings cemented paste backfill samples contacted with groundwater.*

| PROCESS | MILLED TAILINGS | COARSE REJECTS/FINE TAILINGS |
|---|---|---|
| Dissolving | Al, As, Ca?, K, Li, Na, SO4, Sr | Al, As, Ca, Cl, Fe?, K, Li, Na, SO4, Sr, Zn? |
| Precipitating | Ba, Ca?, Cu, Mg, Si, Zn | Ba, Cu, Mg, Si, Zn |
| Unchanged/Not detected | Ag, Be, Cl, Cd, Co, Cr, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Th, Tl, U | Ag, Be, Cd, Co, Cr, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Th, Tl, U |

*Table 6: Possible dissolving phases for Milled Tailings and Coarse Rejects/Fine Tailings cemented paste backfill samples contacted with groundwater.*

| ELEMENT | POSSIBLE DISSOLVING PHASES |
|---|---|
| Al | Surface precipitate? (initial sample only) |
| As | As bearing Pyrite? (ore origin) |
| K | $K_2SO_4$, KOH, $K_2CO_3$ (binder origin) |
| Li | Spodumene, Elbaite, Petalite (ore origin) |
| Na | $Na_2SO_4$, NaOH, $Na_2CO_3$ (binder origin) |
| SO4 | Gypsum, Ettringite, $K_2SO_4$, $Na_2SO_4$ (binder origin), As bearing Pyrite? (ore origin) |

*Table 7: Possible precipitating phases for Milled Tailings and Coarse Rejects/Fine Tailings cemented paste backfill samples contacted with groundwater.*

| ELEMENT | POSSIBLE PRECIPITATING PHASES |
|---|---|
| Ba | Barite |
| Ca, Mg | Dolomite |
| Cu | *Adsorption, co-precipitation?* |
| Fe | Ferrihydrite, Goethite |
| Si | Semi-crystalline silica? |

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# APPENDIX A
# Multi-Element Analysis Results

*Table A1: Multi-element assay results for cemented paste backfill samples. Results are in ppm unless indicated.*

| Element | Detection Limit | Content | | Element | Median Soil Abundance* | GAI | |
|---|---|---|---|---|---|---|---|
| | | 26581 | 26582 | | | 26581 | 26582 |
| Ag | 0.01 | 0.06 | 0.06 | Ag | 0.05 | - | - |
| Al | 0.01% | 6.45% | 6.61% | Al | 7.1% | - | - |
| As | 0.2 | 4.3 | 4.6 | As | 6 | - | - |
| Ba | 10 | 150 | 80 | Ba | 500 | - | - |
| Be | 0.05 | 85.1 | 93.5 | Be | 0.3 | 8 | 8 |
| Bi | 0.01 | 2.25 | 4.59 | Bi | 0.2 | 3 | 4 |
| Ca | 0.01% | 3.28% | 1.82% | Ca | 1.5% | 1 | - |
| Cd | 0.02 | 1.52 | 1.21 | Cd | 0.35 | 2 | 1 |
| Ce | 0.01 | 16.5 | 9.96 | Ce | 50 | - | - |
| Co | 0.1 | 5 | 1 | Co | 8 | - | - |
| Cr | 1 | 322 | 73 | Cr | 70 | 2 | - |
| Cs | 0.05 | 57.2 | 67.6 | Cs | 4 | 3 | 3 |
| Cu | 0.2 | 21.3 | 3.6 | Cu | 30 | - | - |
| Fe | 0.01% | 0.76% | 0.50% | Fe | 4.0% | - | - |
| Ga | 0.05 | 17.5 | 16.65 | Ga | 20 | - | - |
| Ge | 0.05 | 0.14 | 0.13 | Ge | 1 | - | - |
| Hf | 0.01 | 2.3 | 1.9 | Hf | 6 | - | - |
| Hg | 0.005 | 0.006 | <0.005 | Hg | 0.06 | - | - |
| In | 0.005 | <0.005 | <0.005 | In | 1 | - | - |
| K | 0.01% | 1.86% | 2.17% | K | 1.4% | - | - |
| La | 0.5 | 7.7 | 4.9 | La | 40 | - | - |
| Li | 0.2 | 4930 | 3510 | Li | 25 | 7 | 7 |
| Mg | 0.01% | 0.40% | 0.22% | Mg | 0.5% | - | - |
| Mn | 5 | 1065 | 781 | Mn | 1000 | - | - |
| Mo | 0.05 | 8.61 | 0.63 | Mo | 1.2 | 2 | - |
| Na | 0.01% | 2.30% | 2.77% | Na | 0.5% | 2 | 2 |
| Nb | 0.1 | 43.4 | 40.6 | Nb | 10 | 2 | 1 |
| Ni | 0.2 | 197.5 | 3.9 | Ni | 50 | 1 | - |
| P | 10 | 1400 | 1440 | P | 800 | - | - |
| Pb | 0.5 | 12.4 | 12.5 | Pb | 35 | - | - |
| Rb | 0.1 | 494 | 636 | Rb | 150 | 1 | 1 |
| Re | 0.002 | 0.002 | <0.002 | Re | 0 | - | - |
| S | 0.01% | 0.10% | 0.05% | S | 0.07% | - | - |
| Sb | 0.05 | 0.22 | 0.11 | Sb | 1 | - | - |
| Sc | 0.1 | 2.2 | 1.4 | Sc | 7 | - | - |
| Se | 1 | 1 | <1 | Se | 0.4 | 1 | 1 |
| Sn | 0.2 | 81.2 | 61.9 | Sn | 4 | 4 | 3 |
| Sr | 0.2 | 92.3 | 65.8 | Sr | 250 | - | - |
| Ta | 0.05 | 22.6 | 24.3 | Ta | 2 | 3 | 3 |
| Te | 0.05 | <0.05 | <0.05 | Te | 0 | - | - |
| Th | 0.2 | 2.76 | 2.09 | Th | 9 | - | - |
| Ti | 0.005% | 0.08% | 0.05% | Ti | 0.50% | - | - |
| Tl | 0.02 | 3.23 | 3.95 | Tl | 0.2 | 3 | 4 |
| U | 0.1 | 6.7 | 6.2 | U | 2 | 1 | 1 |
| V | 1 | 13 | 7 | V | 90 | - | - |
| W | 0.1 | 3.4 | 1.7 | W | 1.5 | 1 | - |
| Y | 0.1 | 7.6 | 4.7 | Y | 40 | - | - |
| Zn | 2 | 95 | 71 | Zn | 90 | - | - |
| Zr | 0.5 | 50.8 | 36.9 | Zr | 400 | - | - |

*Table A2: Multi-element assay results for groundwater used in batch leach testing.*

| Parameter | | Detection Limit | Groundwater 26585 - GW |
|---|---|---|---|
| pH | | | 6.6 |
| ORP | mV | | 265 |
| EC | dS/m | 0.001 | 0.138 |
| Alkalinity | mg $CaCO_3$/L | 1 | 80 |
| | | | |
| Ag | mg/L | 0.001 | <0.001 |
| Al | mg/L | 0.01 | 0.03 |
| As | mg/L | 0.001 | 0.004 |
| B | mg/L | 0.05 | 0.06 |
| Ba | mg/L | 0.001 | 0.581 |
| Be | mg/L | 0.001 | <0.001 |
| Ca | mg/L | 1 | 8 |
| Cd | mg/L | 0.0001 | <0.0001 |
| Cl | mg/L | 1 | 8 |
| Co | mg/L | 0.001 | <0.001 |
| Cr | mg/L | 0.001 | <0.001 |
| Cu | mg/L | 0.001 | 0.002 |
| F | mg/L | 0.1 | 0.5 |
| Fe | mg/L | 0.05 | <0.05 |
| Hg | mg/L | 0.0001 | <0.0001 |
| K | mg/L | 1 | 4 |
| Li | mg/L | 0.001 | 0.046 |
| Mg | mg/L | 1 | 4 |
| Mn | mg/L | 0.001 | <0.001 |
| Mo | mg/L | 0.001 | <0.001 |
| Na | mg/L | 1 | 25 |
| Ni | mg/L | 0.001 | <0.001 |
| P | mg/L | 1 | <1 |
| Pb | mg/L | 0.001 | <0.001 |
| Sb | mg/L | 0.001 | 0.001 |
| Se | mg/L | 0.01 | <0.01 |
| Si | mg/L | 0.1 | 33.7 |
| Sn | mg/L | 0.001 | <0.001 |
| SO4 | mg/L | 1 | 1 |
| Sr | mg/L | 0.001 | 0.104 |
| Th | mg/L | 0.001 | <0.001 |
| Tl | mg/L | 0.001 | <0.001 |
| U | mg/L | 0.001 | <0.001 |
| Zn | mg/L | 0.005 | 0.094 |

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# APPENDIX B
# Leachate Analysis Results

*Table B1: Leachate analysis results for the Milled Tailings cemented paste backfill sample[3].*

| | | | | | | |
|---|---|---|---|---|---|---|
| **Total Time** | (day) | 0.08 | 2.0 | 4.0 | 7.0 | 14.0 |
| **Interval Time** | (day) | 0.08 | 1.9 | 2.0 | 3.0 | 7.0 |
| **Leachate Volume** | (mL) | 1996.14 | 1999.10 | 2000.30 | 1999.20 | 1998.80 |
| **Temp.** | ($^{o}$C) | 20.7 | 20.8 | 20.5 | 20.2 | 19.7 |
| **pH** | | 7.0 | 10.2 | 9.7 | 9.6 | 9.8 |
| **ORP** | (mV) | 192 | 121 | 127 | 121 | 120 |
| **Eh** | (mV SHE) | 400 | 329 | 335 | 329 | 328 |
| **EC** | (µS/cm) | 155 | 305 | 184 | 176 | 193 |
| **TDS** | (mg/L) | 80 | 170 | 100 | 100 | 110 |
| **Alkalinity** | (mg CaCO3/L) | 94 | 158 | 121 | 109 | 126 |
| **Ag** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Al** | (mg/L) | 0.09 | 0.07 | 0.03 | 0.02 | 0.03 |
| **As** | (mg/L) | 0.005 | 0.007 | 0.006 | 0.006 | 0.006 |
| **B** | (mg/L) | <0.05 | 0.06 | 0.06 | 0.06 | 0.06 |
| **Ba** | (mg/L) | 0.047 | 0.458 | 0.491 | 0.506 | 0.433 |
| **Be** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Ca** | (mg/L) | 8 | 10 | 7 | 8 | 11 |
| **Cd** | (mg/L) | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **Cl** | (mg/L) | 7 | 10 | 8 | 8 | 9 |
| **Co** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Cr** | (mg/L) | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 |
| **Cu** | (mg/L) | 0.006 | 0.002 | <0.001 | <0.001 | 0.001 |
| **F** | (mg/L) | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| **Fe** | (mg/L) | 0.19 | <0.05 | <0.05 | <0.05 | <0.05 |
| **Hg** | (mg/L) | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **K** | (mg/L) | 10 | 35 | 18 | 15 | 15 |
| **Li** | (mg/L) | 0.107 | 0.554 | 0.314 | 0.294 | 0.358 |
| **Mg** | (mg/L) | 4 | 1 | 2 | 2 | 1 |
| **Mn** | (mg/L) | 0.007 | <0.001 | <0.001 | 0.002 | <0.001 |
| **Mo** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Na** | (mg/L) | 25 | 46 | 33 | 32 | 32 |
| **Ni** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **P** | (mg/L) | <1 | <1 | <1 | <1 | <1 |
| **Pb** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Sb** | (mg/L) | 0.001 | <0.001 | 0.001 | 0.001 | <0.001 |
| **Se** | (mg/L) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **Si** | (mg/L) | 33.0 | 24.8 | 27.9 | 27.6 | 23.8 |
| **Sn** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **SO4** | (mg/L) | 1 | 8 | 3 | 3 | 5 |
| **Sr** | (mg/L) | 0.108 | 0.158 | 0.126 | 0.137 | 0.178 |
| **Th** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Tl** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **U** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Zn** | (mg/L) | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |

[3] Concentrations represent the measured concentration in leachates without subtraction of the corresponding concentration in the groundwater.

*Table B2: Leachate analysis results for the Coarse Reject/Fine Tailings cemented paste backfill sample[2].*

| | | | | | | |
|---|---|---|---|---|---|---|
| **Total Time** | (day) | 0.08 | 2.0 | 4.0 | 7.0 | 14.0 |
| **Interval Time** | (day) | 0.08 | 1.9 | 2.0 | 3.0 | 7.0 |
| **Leachate Volume** | (mL) | 1995.62 | 1998.60 | 1998.00 | 1998.50 | 1998.50 |
| **Temp.** | (oC) | 20.7 | 20.8 | 20.5 | 20.2 | 19.7 |
| **pH** | | 7.0 | 10.1 | 9.6 | 9.5 | 9.7 |
| **ORP** | (mV) | 189 | 109 | 116 | 113 | 98 |
| **Eh** | (mV SHE) | 397 | 317 | 324 | 321 | 306 |
| **EC** | (µS/cm) | 156 | 281 | 169 | 161 | 178 |
| **TDS** | (mg/L) | 90 | 150 | 90 | 90 | 100 |
| **Alkalinity** | (mg CaCO3/L) | 108 | 160 | 99 | 99 | 102 |
| **Ag** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Al** | (mg/L) | 0.24 | 0.08 | 0.04 | 0.03 | 0.04 |
| **As** | (mg/L) | 0.007 | 0.005 | 0.005 | 0.006 | 0.008 |
| **B** | (mg/L) | <0.05 | 0.06 | 0.05 | 0.06 | 0.06 |
| **Ba** | (mg/L) | 0.053 | 0.48 | 0.512 | 0.585 | 0.536 |
| **Be** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Ca** | (mg/L) | 9 | 15 | 8 | 7 | 10 |
| **Cd** | (mg/L) | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **Cl** | (mg/L) | 8 | 13 | 10 | 10 | 11 |
| **Co** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Cr** | (mg/L) | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Cu** | (mg/L) | 0.003 | <0.001 | <0.001 | <0.001 | <0.001 |
| **F** | (mg/L) | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| **Fe** | (mg/L) | 0.96 | <0.05 | <0.05 | <0.05 | <0.05 |
| **Hg** | (mg/L) | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **K** | (mg/L) | 9 | 26 | 13 | 12 | 12 |
| **Li** | (mg/L) | 0.102 | 0.431 | 0.238 | 0.233 | 0.287 |
| **Mg** | (mg/L) | 4 | 1 | 2 | 2 | 2 |
| **Mn** | (mg/L) | 0.016 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Mo** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Na** | (mg/L) | 25 | 40 | 32 | 31 | 32 |
| **Ni** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **P** | (mg/L) | <1 | <1 | <1 | <1 | <1 |
| **Pb** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Sb** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 |
| **Se** | (mg/L) | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **Si** | (mg/L) | 33.2 | 23.2 | 24.4 | 24.6 | 22.1 |
| **Sn** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **SO4** | (mg/L) | 2 | 12 | 5 | 4 | 6 |
| **Sr** | (mg/L) | 0.121 | 0.199 | 0.119 | 0.108 | 0.137 |
| **Th** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Tl** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **U** | (mg/L) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Zn** | (mg/L) | 0.261 | <0.005 | <0.005 | <0.005 | <0.005 |

[2] Concentrations represent the measured concentration in leachates without subtraction of the corresponding concentration in the groundwater.

Table B3: Cumulative mass (mg/m$^2$) leached from the Milled Tailings cemented cylinder. Results highlighted in red represent elements for which there has been dissolution and those highlighted in green represent precipitating elements.

| Total Time (days) | 0.08 | 2.0 | 4.0 | 7.0 | 14.0 |
|---|---|---|---|---|---|
| Ag | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Al | 5.9 | 9.8 | 9.8 | 8.8 | 8.8 |
| As | 0.1 | 0.4 | 0.6 | 0.8 | 1.0 |
| B | -3 | -3 | -3 | -3 | -3 |
| Ba | -52 | -64 | -73 | -80 | -95 |
| Be | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Ca | 0 | 196 | 98 | 98 | 391 |
| Cd | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Cl | -98 | 98 | 98 | 98 | 196 |
| Co | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Cr | <0.1 | 0.05 | 0.05 | 0.05 | 0.05 |
| Cu | 0.39 | 0.39 | 0.24 | 0.10 | 0.00 |
| F | -10 | -20 | -29 | -39 | -49 |
| Fe | 16 | 16 | 16 | 16 | 16 |
| Hg | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| K | 587 | 3621 | 4993 | 6070 | 7146 |
| Li | 6 | 56 | 82 | 106 | 137 |
| Mg | 0 | -294 | -490 | -685 | -979 |
| Mn | 0.6 | 0.6 | 0.6 | 0.8 | 0.8 |
| Mo | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Na | 0 | 2056 | 2839 | 3525 | 4210 |
| Ni | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| P | <98 | <98 | <98 | <98 | <98 |
| Pb | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Sb | 0.00 | -0.05 | -0.05 | -0.05 | -0.10 |
| Se | <1 | <1 | <1 | <1 | <1 |
| Si | -68 | -940 | -1508 | -2105 | -3074 |
| Sn | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| SO4 | 0 | 685 | 881 | 1077 | 1469 |
| Sr | 0 | 6 | 8 | 11 | 18 |
| Th | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Tl | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| U | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Zn | -9 | -18 | -27 | -36 | -45 |

Table B4: Cumulative mass (mg/m$^2$) leached from the Coarse Rejects/Fine Tailings cemented cylinder. Results highlighted in red represent elements for which there has been dissolution and those highlighted in green represent precipitating elements.

| Total Time (days) | 0.08 | 2.0 | 4.0 | 7.0 | 14.0 |
|---|---|---|---|---|---|
| Ag | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Al | 20.5 | 25.4 | 26.4 | 26.4 | 27.4 |
| As | 0.3 | 0.4 | 0.5 | 0.7 | 1.1 |
| B | -3 | -3 | -4 | -4 | -4 |
| Ba | -52 | -61 | -68 | -68 | -72 |
| Be | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Ca | 98 | 783 | 783 | 685 | 881 |
| Cd | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Cl | 0 | 489 | 685 | 881 | 1174 |
| Co | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Cr | 0 | 0.05 | 0.05 | 0.05 | 0.05 |
| Cu | 0.10 | -0.05 | -0.20 | -0.34 | -0.49 |
| F | -10 | -20 | -29 | -39 | -49 |
| Fe | 91 | 91 | 91 | 91 | 91 |
| Hg | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| K | 489 | 2642 | 3522 | 4305 | 5088 |
| Li | 5 | 43 | 62 | 80 | 104 |
| Mg | 0 | -294 | -489 | -685 | -881 |
| Mn | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| Mo | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Na | 0 | 1468 | 2153 | 2740 | 3425 |
| Ni | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| P | <98 | <98 | <98 | <98 | <98 |
| Pb | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Sb | -0.05 | -0.10 | -0.15 | -0.20 | -0.20 |
| Se | <1 | <1 | <1 | <1 | <1 |
| Si | -49 | -1077 | -1986 | -2877 | -4012 |
| Sn | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| SO4 | 98 | 1174 | 1566 | 1859 | 2349 |
| Sr | 2 | 11 | 12 | 13 | 16 |
| Th | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Tl | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| U | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Zn | 16 | 7 | -2 | -11 | -19 |

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# Appendix C Surface Water

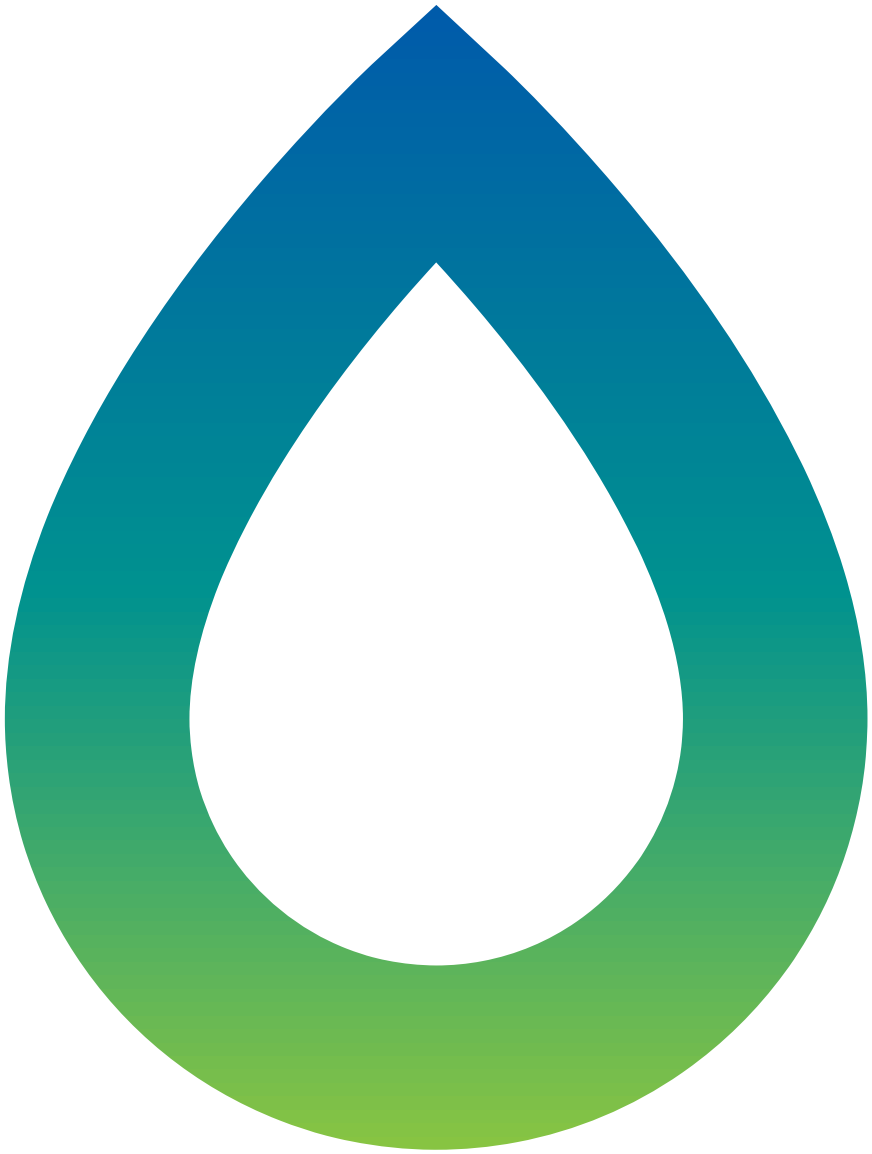
# BP33 UNDERGROUND MINE

## Flood study assessment

Lithium Developments (Grants NT) Pty Ltd

30 November 2023

1727-22-B



## DETAILS

| | |
|---|---|
| **Report Title** | BP33 Underground mine, Flood study |
| **Client** | Lithium Developments (Grants NT) Pty Ltd |

## THIS REVISION

| | |
|---|---|
| **Report Number** | 1727-22-B |
| **Date** | 30 November 2023 |
| **Author** | KO/AR |
| **Reviewer** | JO |

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# 1 INTRODUCTION

## 1.1 BACKGROUND

The BP33 Resource Project (BP33) forms a part of the greater Finniss Lithium Project (the Project), which currently encompasses both BP33 underground mine operation and the adjacent Grants operation. The Project is managed by Lithium Developments (Grants NT) Pty Ltd (LD) with construction currently ongoing. This flood study focuses on the site and the tributaries in the vicinity of the site.

The BP33 project is located approximately 6 km south of the Grants operations in the Northern Territory, approximately 20 km southwest of Darwin and 20 km west of Berry Springs. A locality plan of the Project area is shown in Figure 1.1.

## 1.2 PURPOSE AND SCOPE

The purpose of the BP33 flood study is to:

- Understand the pre-mining and developed conditions flooding characteristics in the vicinity of BP33 and the receiving tributaries (Drainage Line BP1).
- Understand the impacts of proposed infrastructure on the receiving waterways and other key site infrastructure.

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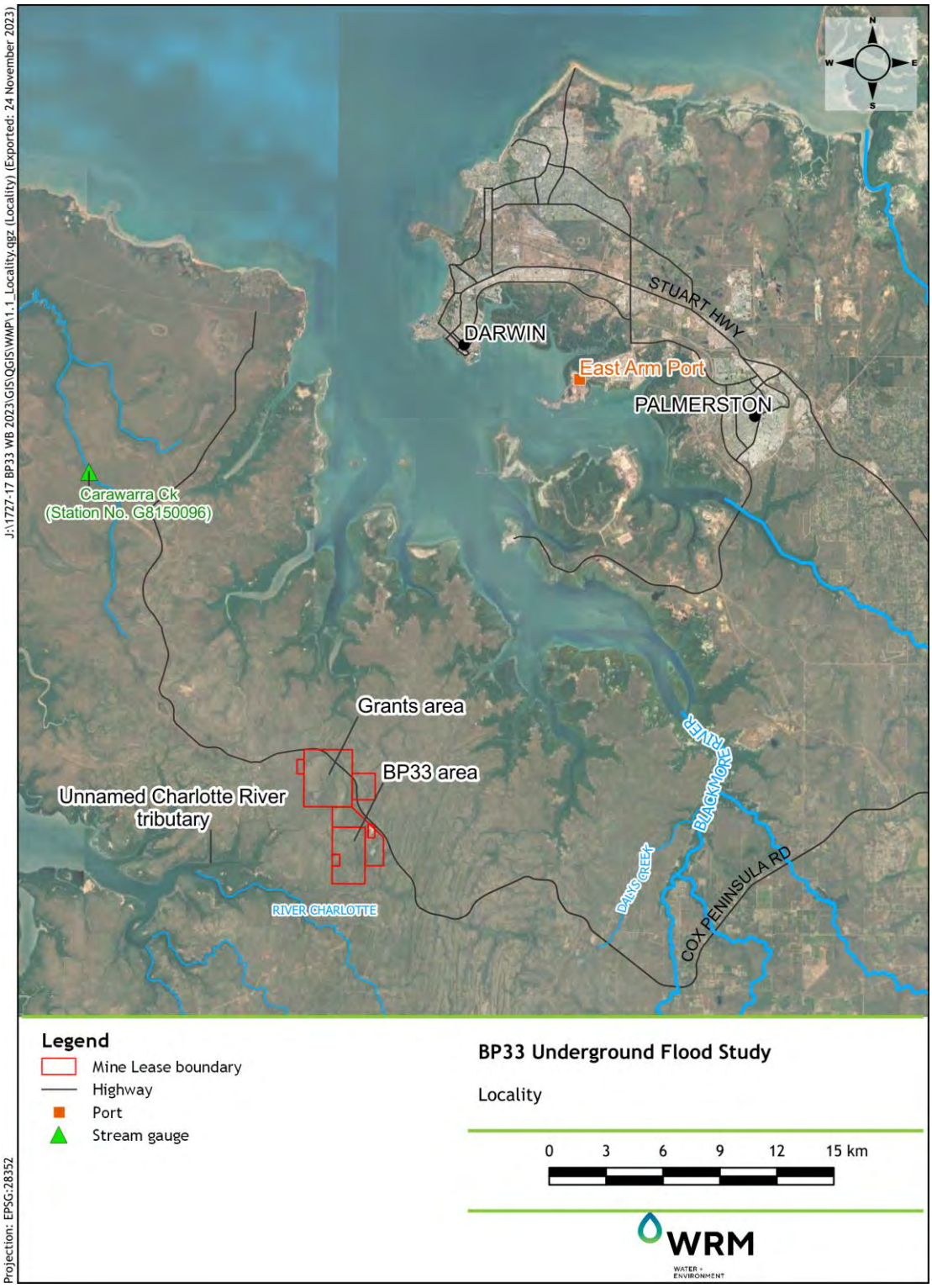


**Figure 1.1 Project locality**

# 2 DRAINAGE CHARACTERISTICS

## 2.1 GENERAL

Figure 2.1 shows the local catchments and drainage features in the vicinity of the BP33 area. There are two unnamed tributaries that drain through the vicinity of the BP33 area, Drainage Line BP1 and the overland flowpath. The unnamed tributaries are located within the Charlotte River catchment, which discharges into Bynoe Harbour. The Charlotte River is located approximately 3 km to the southwest of BP33.

### 2.1.1 Drainage Line BP1

Drainage Line BP1 has a catchment area of approximately 359 ha to the downstream Mine Lease boundary. Of this catchment area, approximately 94 ha is upstream of OHD. The catchment is mostly natural with some grassed areas that were cleared by preliminary exploration activities. The channel is poorly defined, particularly in the upper section of the reach. The channel banks are vegetated with grasses, shrubs and small trees. There are three arms of Drainage Line BP1:

- The central drainage line which is named as Drainage Line BP1;
- The waterway to the east where overflows from the Observation Hill Dam (OHD) discharge into Drainage Line BP1; and
- A local north-western overland flow path which crosses the BP33 site area before discharging into Drainage Line BP1.

### 2.1.2 Western overland flow path

In addition to Drainage Line BP1, there is an overland flow path to the southwest of the site has a catchment area of approximately 29.8 ha to the southern side of the Mining Lease boundary extent.

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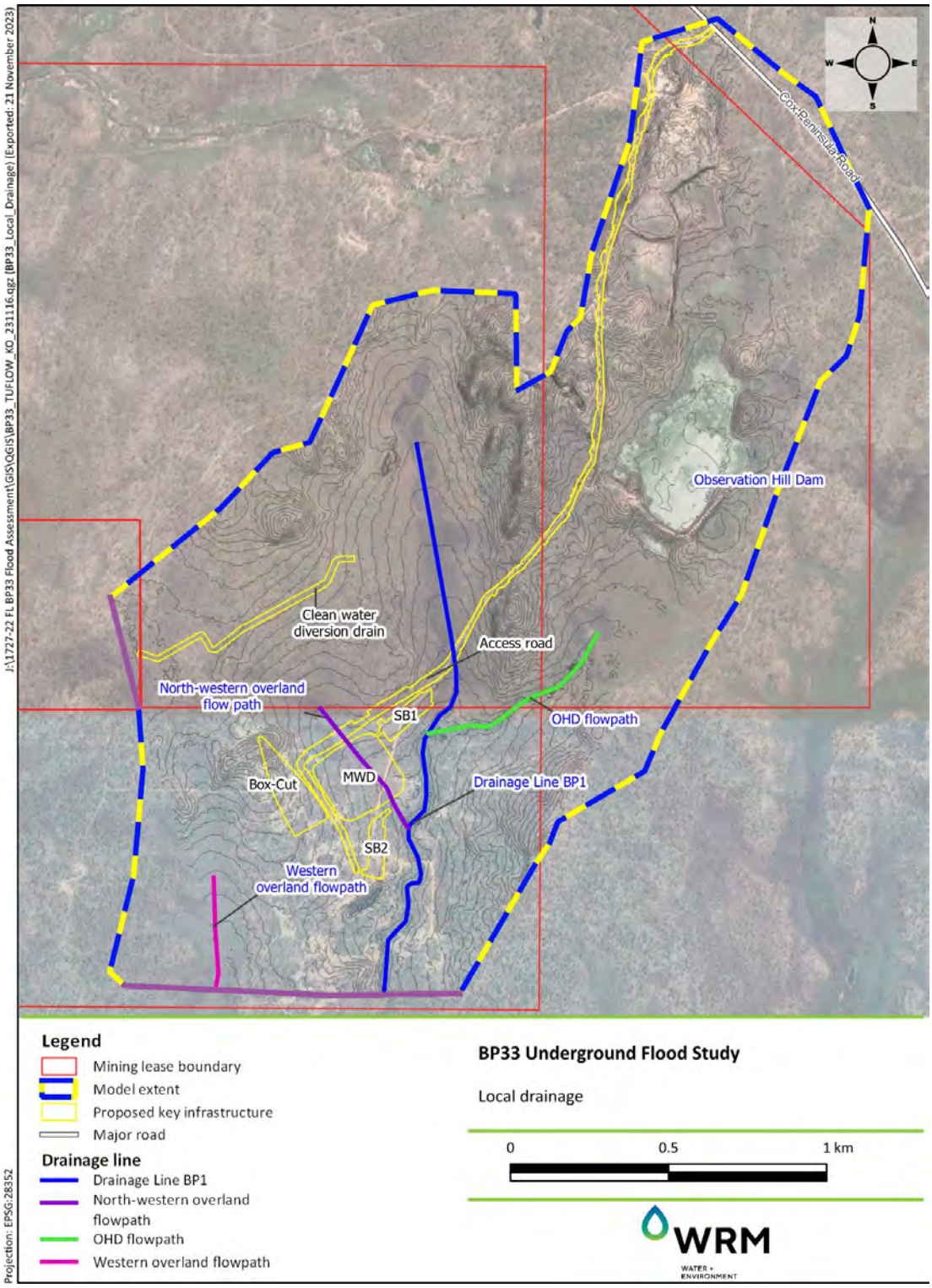


**Figure 2.1 Local drainage network**

# 3 HYDROLOGICAL MODELLING

## 3.1 OVERVIEW

The URBS hydrologic model (Caroll, 2021) was used to estimate design flood discharges for the catchment. URBS is a runoff-routing computer model that uses a network of conceptual storages to represent the routing of rainfall excess through a catchment. URBS has been extensively used throughout Australia by many, including by the Bureau of Meteorology (BoM) for flood forecasting on major river systems.

The URBS model was used in the "split mode" which enables the separate simulation of catchment and channel routing. Adopted rainfall losses are subtracted from the total rainfall hyetograph to obtain rainfall excess. The rainfall excess is then routed through conceptual catchment storage to determine the local runoff hydrograph for each sub-catchment. Full details of the URBS model and its features are given in the URBS v6.60 User Manual (Carroll, 2021).

Further details of the modelling methodology and model configuration are provided below.

## 3.2 METHODOLOGY

A hydrologic model was developed for the pre-mining conditions and developed conditions using the URBS runoff-routing software package. The 2021 version of URBS, which includes an implementation of the ARR 2019 guidelines, was used.

There was no publicly available recorded streamflow data in the drainage lines that cross the proposed Project area to calibrate the model. As a result, the URBS design discharges estimated for the Project were validated against the 10% AEP and 1% AEP design flood events.

Design discharges were determined using the ensemble methodology defined in Australian Rainfall & Runoff (Ball et al., 2019). An ensemble of 10 temporal patterns is modelled for each storm duration to derive a range of estimated peak discharges for the 10% AEP and 1% AEP events. The storm duration with the highest median peak discharge of the ensemble is selected and the temporal pattern that produces the peak discharge just above the ensemble median is used for design event modelling. Design flood hydrographs were then estimated using the validated URBS model were adopted as inflows in the hydraulic model.

## 3.3 DESIGN RAINFALL INTENSITIES

Design rainfall intensities for the Project URBS model for all design events and durations from 15 minutes to 12 hours were obtained from the Commonwealth Bureau of Meteorology (BOM) Design Rainfall Data System (http://www.bom.gov.au/water/designRainfalls/revised-ifd/). Table 3.1 shows the adopted design rainfall depths.

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**Table 3.1 Adopted design rainfall intensities, AEPs for 10% and 1%, durations from 15 minutes to 12 hours**

| Duration | Design rainfall intensities (mm/hr) by AEP | |
|---|---|---|
| | 10% | 1% |
| 15 min | 151 | 198 |
| 20 min | 135 | 175 |
| 25 min | 122 | 158 |
| 30 min | 112 | 144 |
| 45 min | 90.0 | 116 |
| 1 hour | 76.0 | 98.0 |
| 1.5 hour | 58.8 | 76.6 |
| 2 hours | 48.4 | 64.0 |
| 3 hours | 36.5 | 49.6 |
| 4.5 hours | 27.3 | 38.7 |
| 6 hours | 22.3 | 32.5 |
| 9 hours | 16.8 | 25.7 |
| 12 hours | 13.8 | 21.9 |

## 3.4 MODEL CONFIGURATION

### 3.4.1 Spatial configuration

Figure 3.1 shows the URBS model configuration for pre-mining and developed conditions. The model covers a area of 4.0 $km^2$ and consists of 19 sub-catchments, ranging in size from 0.05 $km^2$ to 0.43 $km^2$. Data based on the latest available topography was provided by the client with approximately 1 m grid resolution were used to delineate the sub-catchment draining to the study area.

### 3.4.2 Sub-catchment parameters

Table 3.2 shows the URBS modelling parameters used. Characteristics for each sub-catchment are shown in Table 3.3 which includes catchment slope, catchment area, imperviousness and urbanisation. Catchment slopes and area were determined based on available topographic data.

**Table 3.2 URBS parameters**

| URBS Parameter | Adopted Value |
|---|---|
| Model type | Split |
| Alpha (Channel Lag Parameter) | 0.2 |
| Beta (Catchment Lag Parameter) | 3.5 |
| m (Catchment non-linearity) | 0.6 |
| n (Channel routing exponent 1/(km/h)) | 1.0 |
| USES | L, U, I, CS |

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Table 3.3 URBS sub-catchment parameters

| Sub-catchment ID | Area (km²) | Catchment Slope (%) | Impervious (%) | Urbanisation |
|---|---|---|---|---|
| **Pre-mining conditions** | | | | |
| GL_01 | 0.07 | 7% | 0.0 | 0.0 |
| GL_03 | 0.34 | 3% | 0.0 | 0.0 |
| GL_06 | 0.18 | 5% | 0.0 | 0.0 |
| GL_07 | 0.19 | 3% | 0.0 | 0.0 |
| GL_10 | 0.19 | 9% | 0.0 | 0.0 |
| GL_11 | 0.32 | 6% | 0.0 | 0.0 |
| GL_13 | 0.36 | 3% | 0.0 | 0.0 |
| GL_17 | 0.19 | 3% | 0.0 | 0.0 |
| GL_36 | 0.21 | 5% | 0.0 | 0.0 |
| GL_37 | 0.26 | 4% | 0.0 | 0.0 |
| GL_42 | 0.09 | 9% | 0.0 | 0.0 |
| GL_43 | 0.45 | 5% | 0.0 | 0.0 |
| GL_44 | 0.41 | 5% | 0.0 | 0.0 |
| GL_67 | 0.10 | 3% | 0.0 | 0.0 |
| GL_68 | 0.23 | 2% | 0.0 | 0.0 |
| GL_69 | 0.15 | 4% | 0.0 | 0.0 |
| GL_70 | 0.05 | 2% | 0.0 | 0.0 |
| GL_71 | 0.07 | 2% | 0.0 | 0.0 |
| **Developed conditions** | | | | |
| GL_68 | 0.23 | 2% | 53.9 | 1 |
| GL_69 | 0.15 | 4% | 19.2 | 0.38 |
| GL_70 | 0.05 | 2% | 75.7 | 1 |
| GL_71 | 0.07 | 2% | 20.7 | 0.51 |

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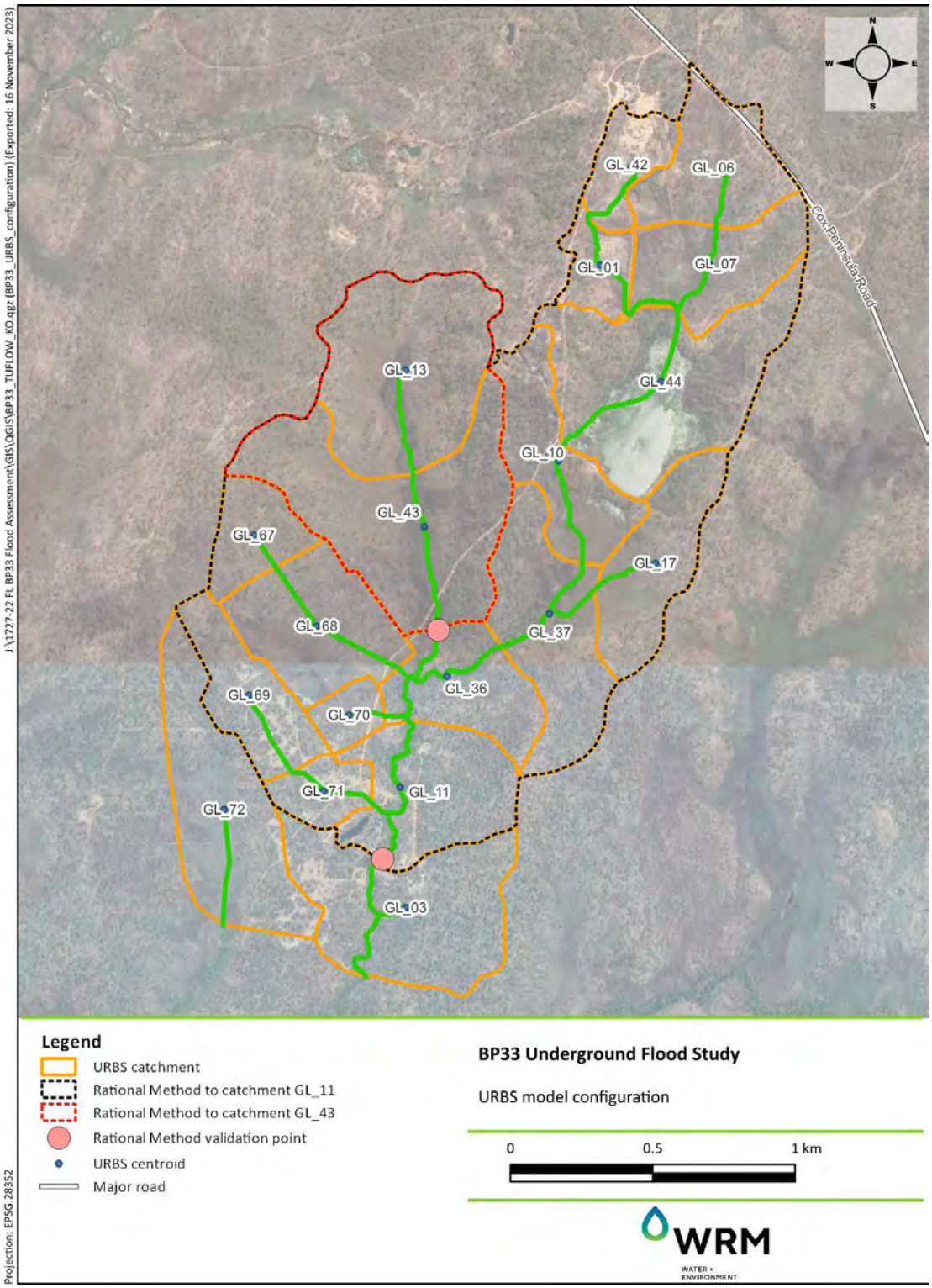


**Figure 3.1 URBS configuration**

### 3.4.3 Temporal patterns

Temporal patterns were obtained from the ARR data hub based on a point location at the centroid of the catchment. As per ARR guidelines, 10 temporal patterns which result in 10 design storms for each duration for each AEP were used. The URBs model was run for all 10 temporal patterns for various storm durations for the 10% and 1% AEP events. The critical storm duration was identified as the duration which produce the highest median peak discharge from the 10 design storms for each storm duration.

### 3.4.4 Design rainfall losses

URBS Initial Loss (IL) and Continuing Loss (CL) values were varied to each design event to find the values of losses necessary to reconcile URBS estimates of peak flood discharges at GL_43 and GL_11 for all design events. The adopted IL and CL for the two events are shown in Table 3.4.

**Table 3.4 Adopted IL and CL rates**

| Design Event (AEP %) | Initial Loss (mm) | Continuing Loss (mm/hr) |
|---|---|---|
| 10 | 10.0 | 2.0 |
| 5 | 8.0 | 2.0 |
| 1 | 2.0 | 2.0 |

## 3.5 MODEL VALIDATION

The BP33 URBS model was validated against the Rational Method (RM) peak discharge estimates. The RM estimates of peak flood discharges for all design events were obtained at sub-catchment GL_43 and GL_11, located at the upstream of BP33 URBS model or upstream of the proposed infrastructure area of BP33 Mine Lease. A total area of 79.23 ha and 337.54 ha drains to GL_43 and GL_11 respectively.

Table 3.5 shows the percentage difference between URBS and Rational Method peak discharges in GL_43 and GL_11 for all design events. The URBS model results in catchment GL_43 and GL_11 shows are within 10% and 3% of the Rational Method results which shows a good agreement across the two methodologies.

**Table 3.5 URBS model validation results**

| AEP (%) | URBS peak discharge ($m^3/s$) | RM peak discharge ($m^3/s$) | Difference to RM |
|---|---|---|---|
| **Catchment to GL_43** | | | |
| 10 | 8.7 | 8.0 | 9.4% |
| 1 | 13.2 | 13.0 | 1.6% |
| **Catchment to GL_11** | | | |
| 10 | 34.7 | 34.9 | -0.5% |
| 1 | 56.3 | 57.6 | -2.2% |

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## 3.6 REPRESENTATIVE TEMPORAL PATTERNS

The validated URBS model was used to estimate design discharges for the BP33 Mine Lease area and Observation Hill Dam based on the ARR 2019 guidelines (Ball et al, 2019). Design discharge hydrographs were produced for the 10% AEP and 1% AEP design events, for a range of storm durations from 15 minutes to 12 hours. An ensemble of 10 temporal patterns was applied for each duration. At the reporting locations (sub-catchment GL_43 and GL_11), the critical duration design storm that had been validated was identified.

At the reporting location (sub-catchment GL_11 and GL_43), the critical duration design storm that had been validated was identified. Table 3.5 shows the pre-mining and operational conditions critical storm durations at GL_11 and GL_43 for all modelled design events.

Table 3.6 shows the representative temporal pattern hydrographs which were selected for use in the TUFLOW hydraulic model. The representative design temporal patterns were adopted based on the GL_11 and GL_43.

**Table 3.6 URBS critical durations**

| AEP (%) | Critical duration | |
|---|---|---|
| | GL_11 | GL_43 |
| 10 | 1 hour | 1 hour |
| 1 | 2 hours | 4.5 hours |

**Table 3.7 Representative design temporal patterns**

| Duration | Representative temporal pattern | |
|---|---|---|
| | 10% AEP | 1% AEP |
| 15 min | 6 | 8 |
| 30 min | 7 | 9 |
| 1 hour | 4 | 9 |
| 1.5 hour | 9 | 3 |
| 2 hour | 9 | 7 |
| 3 hour | 8 | 7 |
| 4.5 hour | 10 | 10 |
| 6 hour | 1 | 8 |
| 9 hour | 5 | 1 |
| 12 hour | 5 | 2 |

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# 4 HYDRAULIC MODELLING

## 4.1 OVERVIEW

The two-dimensional TUFLOW hydrodynamic model (BMT, 2023) was used to simulate the flow behaviour of the unnamed tributaries (Drainage Line BP1) in the vicinity of the Project including flood extents, depths and velocities.

Hydraulic models were prepared for the following scenarios:

- **Pre-mining conditions**: The site has not been developed and the pre-mining terrain is similar to dense vegetation, as observed by the surrounding area.
- **Developed conditions:** The site has been developed which includes a clean water diversion drain, several sediment basins and an access road to the east of the BP33 which connects to Cox Pennisula Road. The three developed conditions scenarios are:
    - **Option 1 (DEV1):** A culvert crossing (1 x 1.5 m diameter corrugated steel pipes) incorporated in the access road at Drainage Line BP1.
    - **Option 2 (DEV2):** A floodway incorporated in the access road at Drainage Line BP1.
    - **Option 3 (DEV2a):** A revised floodway incorporated in the access road at Drainage Line BP1. A flow diversion bund is also proposed to divert the floodwaters away from Sediment Basin 1 (SB1).

The results of the above hydraulic models will be used to determine the catchment flow behaviour and to determine the impacts of the proposed infrastructure on the receiving waterways. Further details of the modelling methodology and model configuration are provided below.

## 4.2 METHODOLOGY

A TUFLOW two-dimensional hydrodynamic model was used to estimate the flooding characteristics (depths, levels and velocities) for the study area. TUFLOW represents hydraulic behaviour on a fixed grid by solving the full two-dimensional depth-averaged momentum and continuity equations for free surface flow. The model automatically calculates breakout points and flow directions within the study area. An adaptive time step is used by the computational engine to maintain simulation stability. All hydraulic modelling was undertaken using the TUFLOW Build 2023-03-AB HPC-GPU Solver.

The hydraulic model was run for the 10% AEP and 1% AEP design flood events for pre-mining conditions and three developed condition scenarios. The model results were used to assess the potential impacts on flood extents, depths, velocities and levels at the BP33 area.

The discharges estimated using the URBS hydrologic model were adopted as inflows to the TUFLOW hydraulic model. All URBS hydrograph inputs are a combination of local and total sub-catchment flows. The representative temporal pattern for each model duration was calculated using the URBS flows and was then simulated in the TUFLOW model. The analysis for the selection of representative temporal patterns for each duration is shown in Section 3.4.3.

## 4.3 PRE-MINING MODEL CONFIGURATION

### 4.3.1 Topographic data

The 2023 base model topography was configured using the terrain survey data provided by JBU. The 2023 LiDAR was acquired on 20 September 2023 and covers the terrain in June 2023. Areas not covered by the 2023 terrain survey data was supplemented.

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Areas where there was a significant elevation difference between the 2023 and 2021 datasets were adjusted vertically (using the TUFLOW model) to ensure a smooth transition between the two surfaces. Figure 4.1 shows the topographic data used in the hydraulic model.

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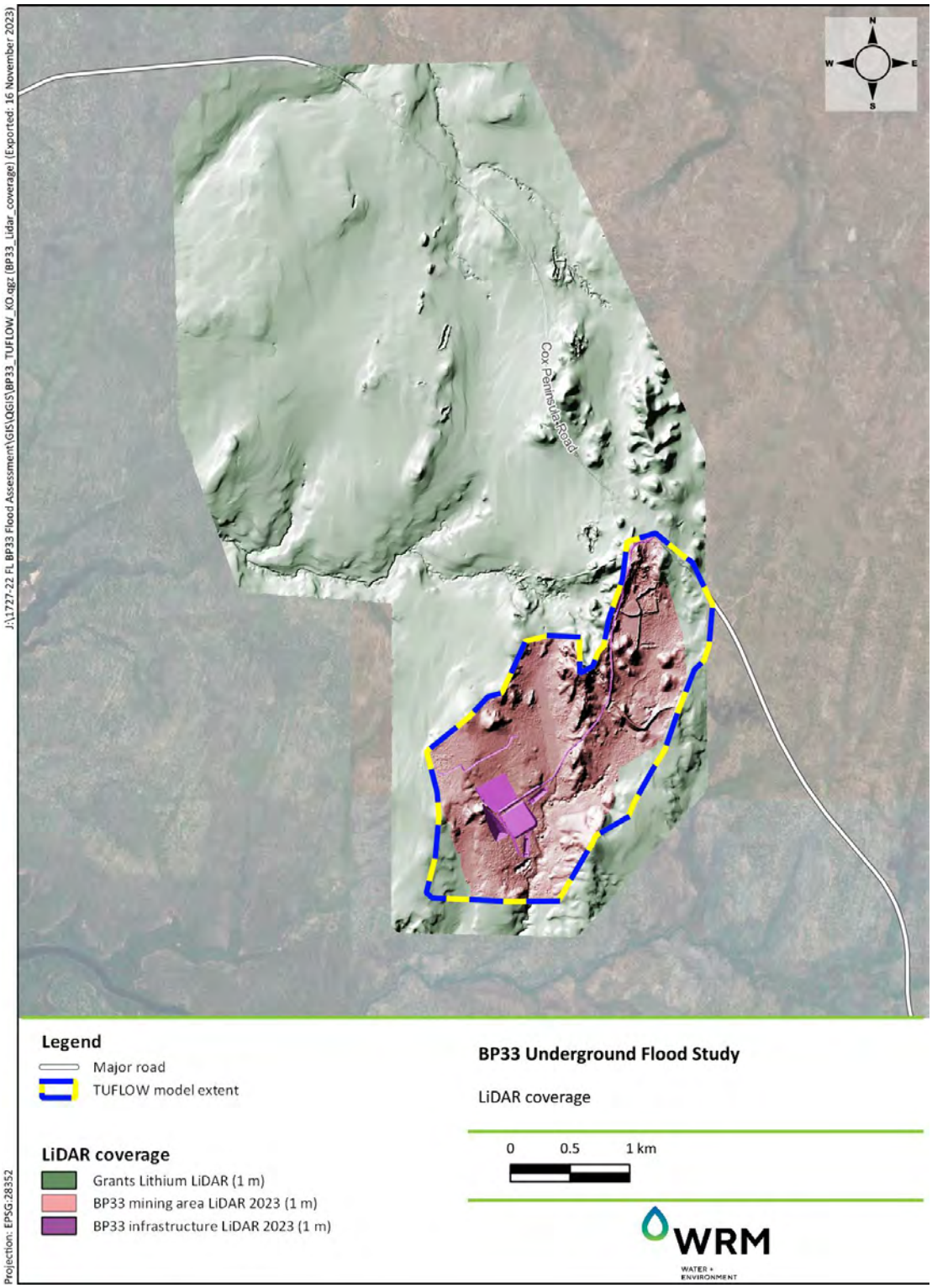


**Figure 4.1 Topographic data extents**

### 4.3.2 Model extent and spatial configuration

The TUFLOW model extent covers an area of about 398.65 ha and includes the infrastructure area as well as the external catchments that will drain through Drainage Line BP1. From the most upstream area, the model extends approximately 3.1 km to the south as shown in Figure 4.2.

The model uses a 2 m cell size (i.e. 2 m x 2 m cells). The 2 m cell size was adopted as it ensured a good representation of major drainage features, road embankments and unnamed channels or gullies.

### 4.3.3 Inflow and outflow boundaries

Design discharge hydrographs produced by the URBS model were applied to the TUFLOW model as inflow hydrographs as shown in Figure 4.1, using the 'Surface Area' (SA) inflow approach. The SA inflow approach was used to apply local catchment inflows along a flow path that were produced by a validated URBS model for pre-mining conditions.

The adopted downstream model boundaries are located far enough downstream to ensure results at the BP33 Mine Lease area are not impacted by boundary effects. There were three downstream outflows boundaries in this model. All downstream boundaries were described as non-tidally affected (clear of the Timor Sea). Hence, a 'normal flow' type boundary condition for each downstream model boundary was adopted based on the downstream channel slope. Figure 4.2 shows the location of the inflow and outflow boundaries for pre-mining conditions.

### 4.3.4 Adopted Mannings 'n' roughness

The TUFLOW model uses Manning's 'n' values to represent hydraulic resistance across the TUFLOW model area. The adopted Manning's 'n' values corresponding to each land use type are shown in Table 4.1. The classification of land use areas for hydraulic modelling was based on aerial imagery. The adopted pre-mining conditions of land use mapping is shown in Figure 4.3.

**Table 4.1 Adopted Manning's 'n' values**

| Land use description | Manning's 'n' coefficient |
|---|---|
| Floodplain | 0.090 |
| Road Reserve | 0.025 |
| Hardstand | 0.025 |
| ROM Pad | 0.025 |
| Sediment basin | 0.025 |
| Settling ponds | 0.025 |
| Dam | 0.090 |
| Waste rock area | 0.050 |
| Box-cut stockpile area | 0.050 |
| Cleared | 0.030 |
| Spillway | 0.022 |

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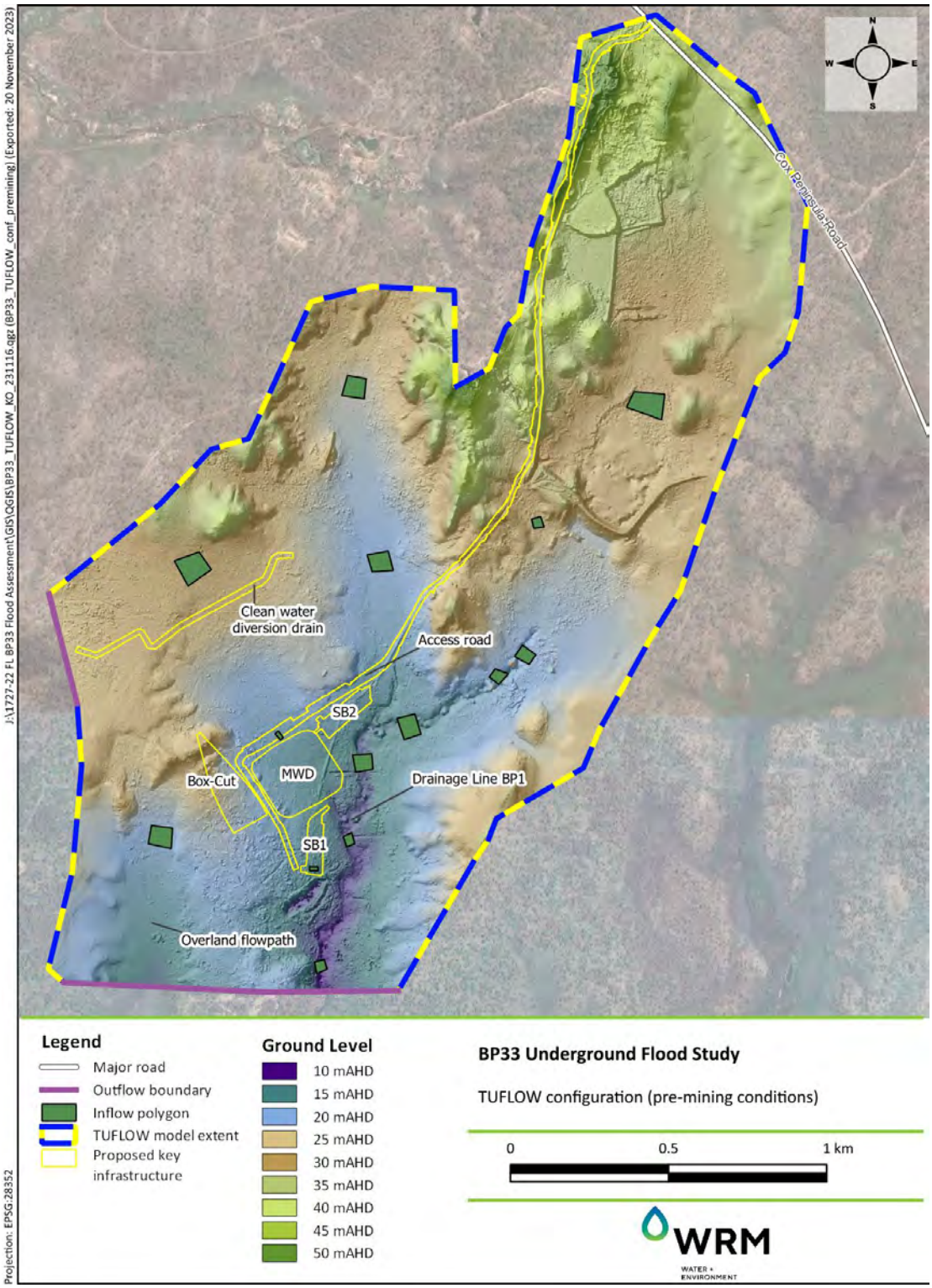


**Figure 4.2 TUFLOW configuration, pre-mining conditions**

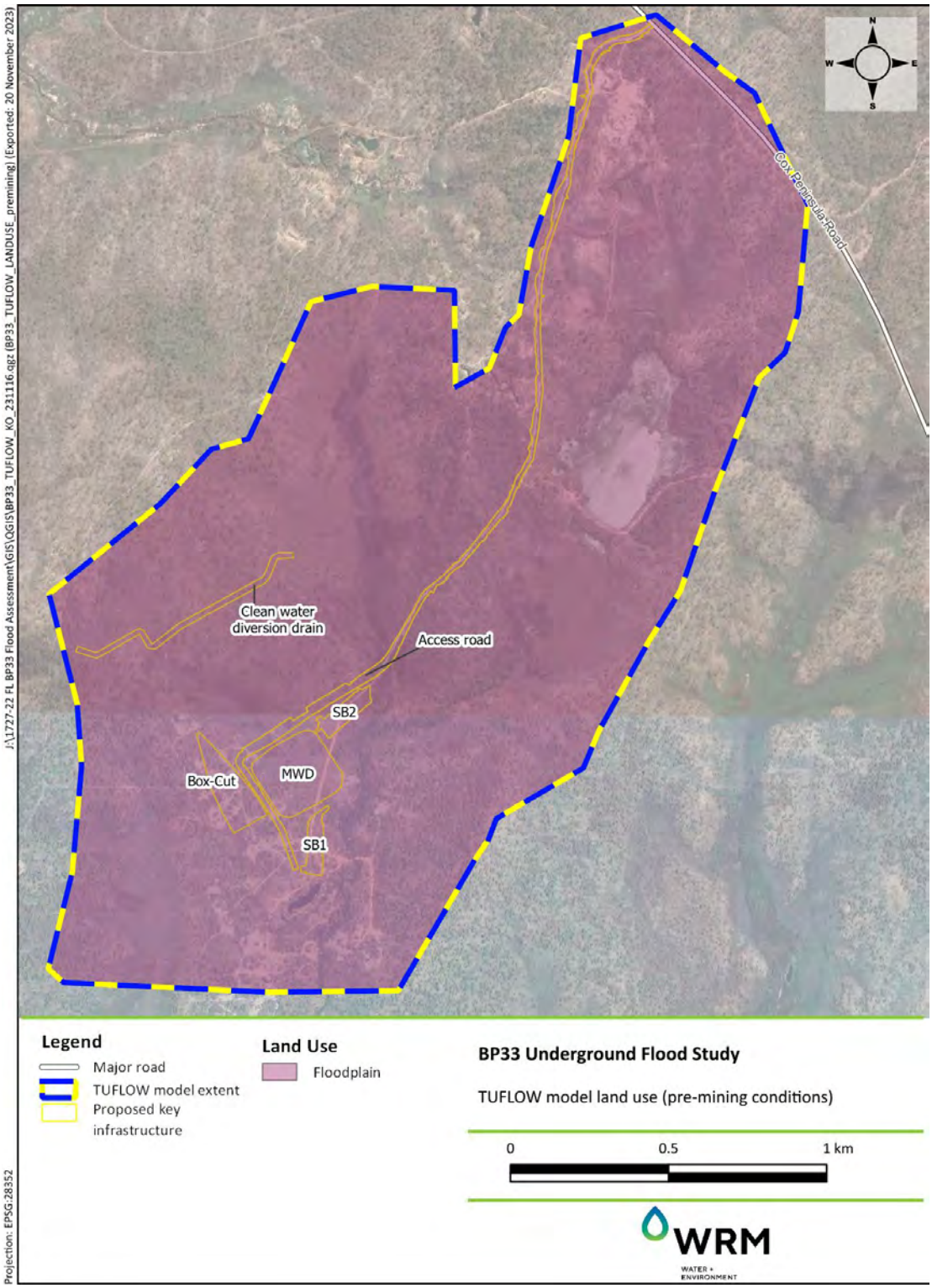


**Figure 4.3 TUFLOW model land use mapping, pre-mining conditions**

## 4.4 DEVELOPED MODEL CONFIGURATION

The pre-mining conditions TUFLOW model was adopted and revised to include the proposed development in the infrastructure area, including the proposed access road into the BP33 site. The model changes were based on the provided topographic information and design drawings provided in October 2023 from the client. Three options were modelled for developed conditions:

- **Option 1 – Culvert design (DEV1):**
  - Includes 5 x 1.5 m Corrugated Steel Pipes (CSP) across the proposed access road crossing Drainage Line BP1.
- **Option 2 – Floodway design (DEV2):**
  - A floodway is proposed at the access road crossing Drainage Line BP1.
- **Option 3 – Floodway design with flow diversion bund (DEV2A):**
  - An alternative floodway design is proposed at the access road crossing Drainage Line BP1.
  - A flow diversion bund/access road bund is proposed to divert floodwaters from the floodway away from SB1.

### 4.4.1 General developed conditions model changes

The following changes were made to the pre-mining conditions model configuration:

- The proposed infrastructure design surfaces were incorporated into the pre-mining topography. The proposed key infrastructure includes:
  - An access road to the east of BP33. The access road crosses an unnamed tributary (named Drainage Line BP1);
  - A clean water diversion drain north of the box-cut stockpile which would divert clean catchment into Drainage Line BP1, upstream of the access road;
  - Two sediment basins (SB1 and SB2) located on the southern side of the site. The sediment basins would capture site-runoff and discharge into Drainage Line BP1;
- The land use mapping was adapted and revised to represent the proposed developments in DEV1 conditions (See Figure 4.3). The relevant roughness coefficients are shown in Table 4.1;
- Initial water levels were set based on the spillway levels for the sediment basins. This would simulate the worst-case scenario where there is no available storage in the sediment basins to store site runoff and would run directly off-site and into Drainage Line BP1.
- One SA inflow polygon were relocated into the sediment basins within the site infrastructure area. The inflow hydrographs were based on the developed conditions URBS hydrologic model.

### 4.4.2 Option 1 – Culvert design (DEV1) model changes

Based on the latest topographical data and latest design drawings for DEV1, the following changes were made to the pre-mining conditions model configuration (see Figure 4.2):

- The access road culverts (BP001) were modelled in the DEV1 conditions as to the proposed design specifications. The invert levels of BP001 were estimated using the existing ground elevations. Table 4.2. The culverts were modelled with 0% blockage due to the nature of the surrounding catchment (mainly sparse bushland);

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**Table 4.2 Access road culvert details, DEV1**

| ID | Type | Dimension (no. of barrels @ dia. Of CSP) | Upstream Invert Level (mAHD) | Downstream Invert Level (mAHD) |
|---|---|---|---|---|
| BP001 | CSP | 5 x 1.5 m | 17.4 | 17.3 |

### 4.4.3 Option 2 – Floodway design (DEV2)

Based on the latest topographical data and latest design drawings for DEV2, the following changes were made to the pre-mining conditions model configuration (see Figure 4.2):

- The proposed infrastructure design surfaces were incorporated into the pre-mining topography which includes a floodway at the access road.

### 4.4.4 Option 3 – Floodway design with flood diversion bund (DEV2A)

Based on the latest topographical data and latest design drawings for DEV2A, the following changes were made to the pre-mining conditions model configuration (see Figure 4.2):

- The proposed infrastructure design surfaces were incorporated into the pre-mining topography which includes:
  - A revised floodway design at the access road compared to DEV2;
  - A flood diversion bund to the west, downstream of the floodway to divert floodwaters away from SB1.

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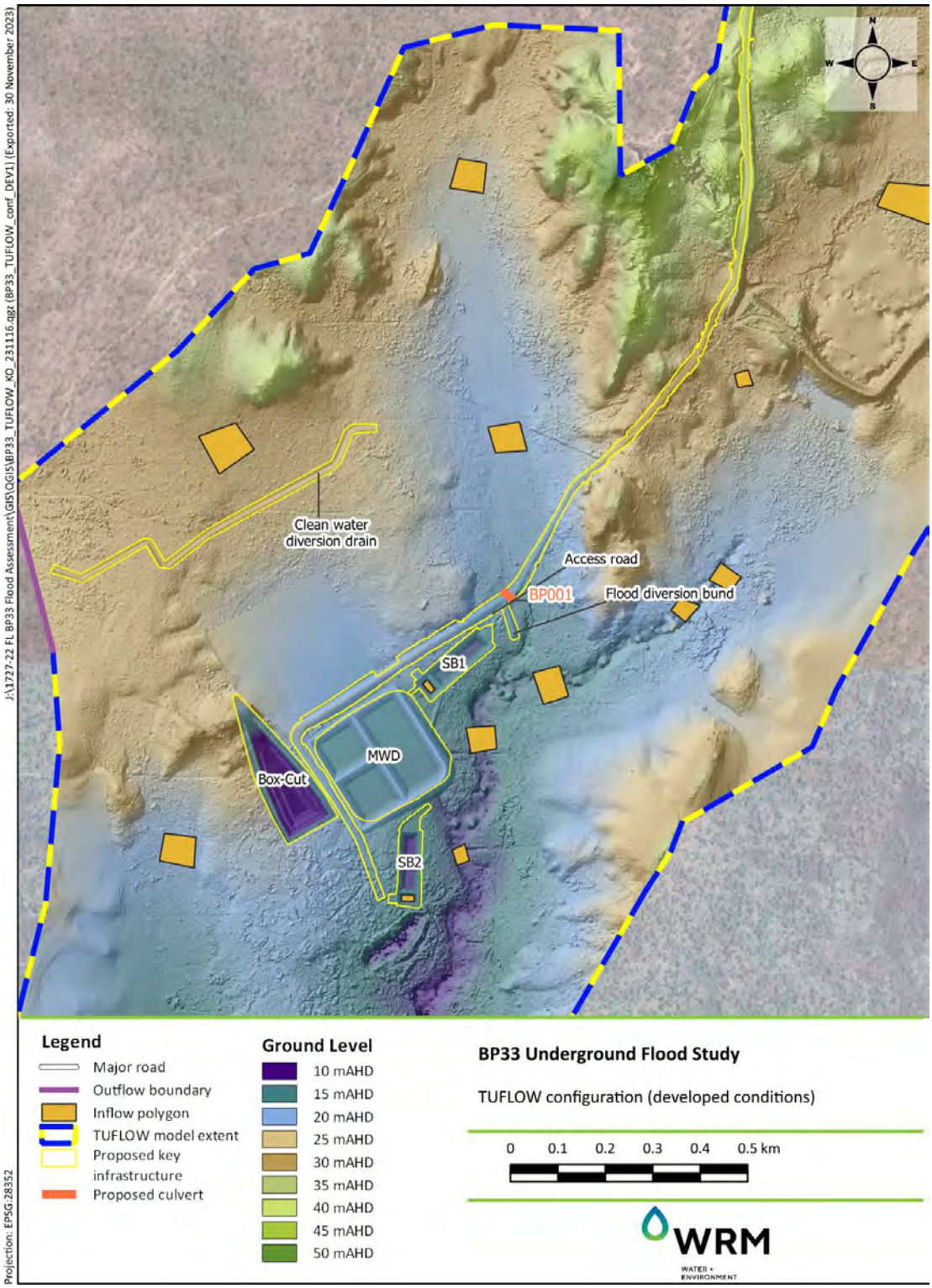


**Figure 4.4 TUFLOW configuration, developed conditions**

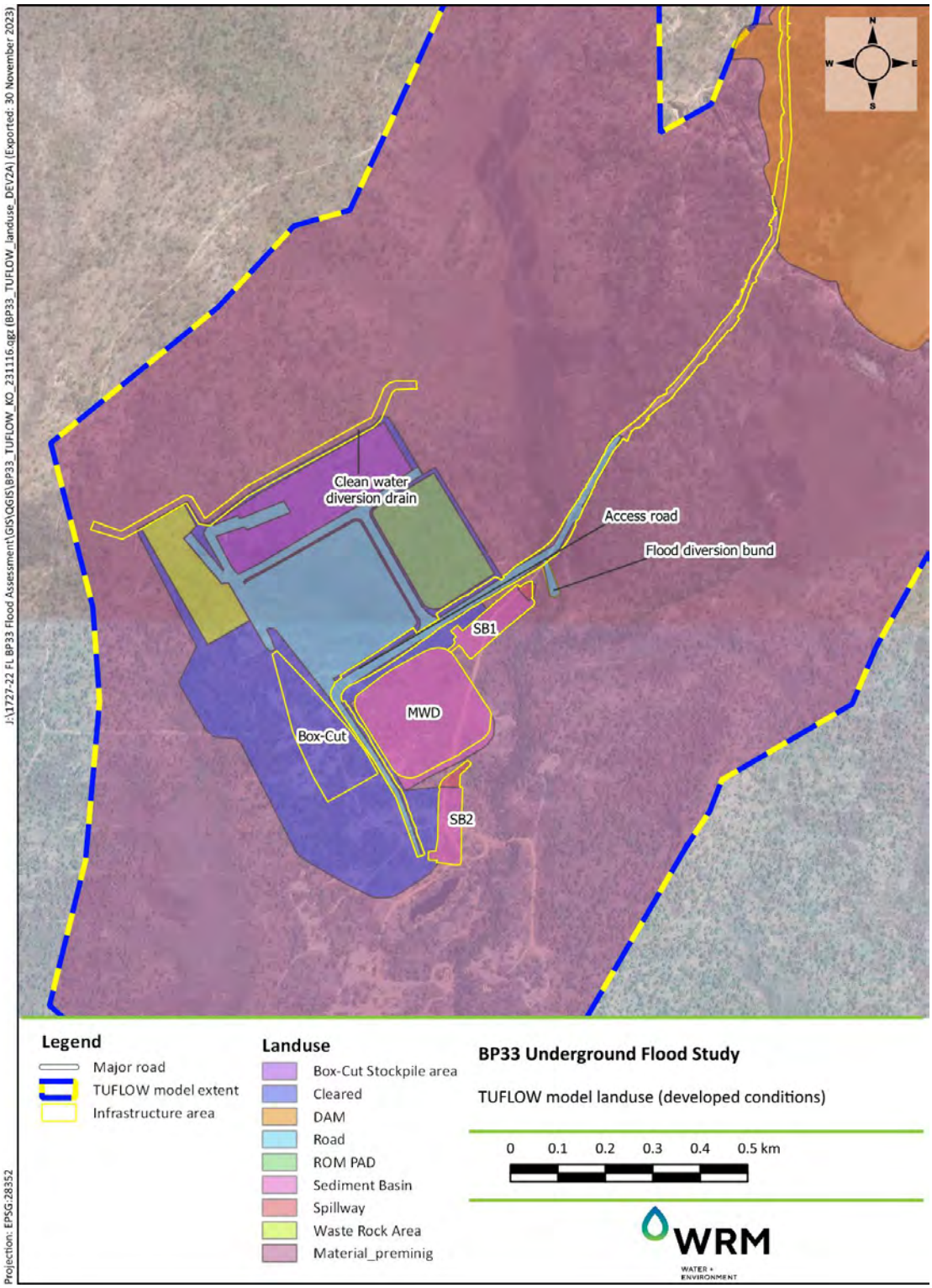


**Figure 4.5 TUFLOW land use mapping, developed conditions**

# 5 FLOOD MODELLING ASSESSMENT

## 5.1 OVERVIEW

The existing drainage features and the proposed infrastructure in the BP33 area have been assessed using hydrologic (URBS) and hydraulic (TUFLOW) models to determine the potential impact of the Project on flood behaviour including:

- The potential to increase the extent of flooding at the internal catchment (ML boundary); and
- The potential to impact on proposed key infrastructure areas (in terms of identifying locations where key erosion protection measures are required.

The TUFLOW model was used to estimate predicted peak flood extents, levels and depths for the 1% (1 in 100) and 10% (1 in 10) AEP design flood events. The result figures highlight key location points of interest, which covers the levels in the sediment basins, levels upstream and downstream the access road, levels in the downstream section of Drainage Line BP1 and the toe of MWD.

## 5.2 PRE-MINING CONDITIONS RESULTS

### 5.2.1 Overview

The TUFLOW model was used to determine the pre-mining conditions 10% and 1% AEP design peak flood extents, levels, depths and velocities in the vicinity of the BP33 area under pre-mining conditions. Figure 4.2 shows the adopted TUFLOW configuration under pre-mining conditions.

Figure A.1 to Figure A.2 in Appendix A show the predicted peak flood extents, levels and depths under pre-mining conditions for the 10% and 1% AEP events respectively.

Figure A.9 to Figure A.10 in Appendix A show the predicted peak flood velocities under pre-mining conditions for the 10% and 1% AEP events respectively.

### 5.2.2 Pre-mining conditions modelling results

Key findings on flooding within the BP33 catchment and its tributaries are summarised below:

- The BP33 access road remains flood free for events up to and including the 1% AEP event.
- It is predicted that flows within the culvert will reach approximately 13.7 $m^3/s$ in the 1% AEP event.
- Water levels upstream of the BP33 access road is 18.9 mAHD during the 1% AEP event, which is an increase of up to 1.0 m compared to pre-mining conditions;
- There is generally an increase in flood levels in Drainage Line BP1 from SB1 to SB2 of up to 0.05 m.
- Flood levels at the model boundary extent would be less than or equal to pre-mining conditions.
- In terms of erosion risks:
    - There is risk of floodwaters from Drainage Line BP1 and SB2 sediment water eroding the toe of MWD.
    - There is a risk of sediment water from SB1 eroding the inner corner of SB1.
    - It is recommended to apply erosion protection measures to prevent erosion and scour risks to SB1 and MWD.
- For the 10% AEP event:
    - The tributaries in the mine lease are potential areas to flooding. Particularly from the upstream clean water catchment to the north of the site.

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- There are areas of minor ponding behind the existing dirt track road which extends from Cox Pennisula Road to the historical BP33 pit. The results show:
  - Up to approximately 0.4 m would pond behind the dirt track road located within the north-eastern catchment overland flow path.
  - Up to approximately 0.5 m would pond behind the dirt track road located within Drainage Line BP1.
- Predicted peak velocities in Drainage Line BP1 are typically below 1 m/s. There is a general increase in flood velocities downstream of the dirt track road.
- The overland flow path to the west of the site does not interact with any of the proposed infrastructure locations.
- The overland flow paths indicate that there would be very shallow (between 0.1 m to 0.3 m). The flood levels and depths are more defined in the downstream section of Drainage Line BP1. Depths in the downstream section of Drainage Line BP1 reach up to 2.0 m in the 10% AEP event.

- For the 1% AEP event:
  - There are areas of minor ponding behind the existing dirt track road which extends from Cox Pennisula Road to the historical BP33 pit. The results show:
    - Up to approximately 0.5 m would pond behind the dirt track road located within the north-eastern catchment overland flow path.
    - Up to approximately 0.6 m would pond behind the dirt track road located within Drainage Line BP1.
  - Similar to the 10% AEP design events, predicted peak velocities in Drainage Line BP1 are typically below 1 m/s. There is a general increase in flood velocities downstream of the dirt track road.
  - The overland flow path to the west of the site does not interact with any of the proposed infrastructure locations.
  - The overland flow paths indicate that there would be very shallow (between 0.1 m to 0.4 m). The flood levels and depths are more defined in the downstream section of Drainage Line BP1. Depths in the downstream section of Drainage Line BP1 reach up to 2.5 m in the 1% AEP event.

## 5.3 DEVELOPED CONDITIONS

### 5.3.1 Overview

Figure 4.4 shows the proposed developed condition scenarios configuration adopted in the TUFLOW model. The TUFLOW model results for developed conditions were used to assess the changes in the 10% AEP and 1% AEP peak water level in the external catchment areas. Flood impacts may be caused by the proposed development at the infrastructure site and external catchments, particularly the access road located at the crossing of Drainage Line BP1.

Figure A.3 to Figure A.8 in Appendix A show the predicted peak flood extents, levels and depths under operational conditions for the 10% and 1% AEP events respectively.

Figure A.11 to Figure A.16 in Appendix A show the predicted peak flood velocities under DEV1 conditions for the 10% and 1% AEP events respectively.

Figure A.17 to Figure A.22 in Appendix A show the changes in peak flood levels under DEV1 conditions for the 10% and 1% AEP events respectively.

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Table B.1 and Table B.2 in Appendix B shows the predicted flood levels and afflux at key locations at BP33.

### 5.3.2 Option 1 – Culvert design (DEV1) modelling results

Key findings on flooding within the BP33 catchment and Drainage Line BP1 are summarised below:

- The BP33 access road remains flood free for events up to and including the 1% AEP event.
- It is predicted that flows within the culvert will reach approximately 9.1 $m^3/s$ in the 10% AEP event and 13.7 $m^3/s$ in the 1% AEP event.
- Water levels upstream of the BP33 access road is 18.9 mAHD during the 1% AEP event, which is an increase of up to 1.0 m compared to pre-mining conditions;
- There is generally an increase in flood levels in Drainage Line BP1 from SB1 to SB2 of up to 0.05 m.
- Flood levels at the model boundary extent would be less than or equal to pre-mining conditions.
- Flood velocities downstream of the culvert ranges between 0.8 m/s to 1.4 m/s during the 1% AEP event.
- In terms of erosion risks:
    - There is risk of floodwaters from Drainage Line BP1 and SB2 sediment water eroding the toe of MWD.
    - There is a risk of sediment water from SB1 eroding the inner corner of SB1.
    - It is recommended to apply erosion protection measures to prevent erosion and scour risks to SB1 and MWD.

### 5.3.3 Option 2 – Floodway design (DEV2) modelling results

Key findings on flooding within the BP33 catchment and Drainage Line BP1 are summarised below:

- The BP33 access road would divert the upstream catchment flow across the floodway and into the Drainage Line BP1.
- It is predicted that flows across the floodway would reach approximately 9.2 $m^3/s$ in the 10% AEP event and 15.4 $m^3/s$ in the 1% AEP event.
- Water levels upstream of the BP33 access road is approximately 18.6 mAHD during the 1% AEP event, which is an increase of up to 0.8 m compared to pre-mining conditions;
- There is generally an increase in flood levels in Drainage Line BP1 from SB1 to SB2 of up to 0.09 m.
- Flood levels at the model boundary extent would increase up to 0.05 m.
- Flood depths across the access road floodway are up to 0.12 m in the 10% AEP event and 0.17 m in the 1% AEP event.
- The predicted peak velocities across the BP33 access road ranges between 1.0 m/s to 2.5 m/s for the 1% AEP event.
- In terms of erosion risk:
    - There is a risk of floodwaters from Drainage Line BP1 and SB2 sediment water eroding the toe of MWD.
    - There is a risk of sediment water from SB1 eroding the inner corner of SB1.

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- There is a risk of floodwater from the access road floodway to spill into SB1. Water over the floodway would spill into SB1 for the 10% AEP (17.37 mAHD) and 1% AEP events (17.40 mAHD).
- It is recommended to apply erosion protection measures to prevent erosion and scour risk to SB1 and MWD.

### 5.3.4 Option 3 – Floodway design with diversion bund (DEV2A) modelling results

Key findings on flooding within the BP33 catchment and Drainage Line BP1 are summarised below:

- The BP33 access road would divert the upstream catchment flow across the floodway and into Drainage Line BP1.
- The flood diversion bund would divert the upstream catchment flows away from SB1.
- It is predicted that flows across the floodway would reach approximately 14.6 $m^3/s$ in the 1% AEP event.
- Water levels upstream of the BP33 access road is approximately 18.3 mAHD in the 1% AEP event, which is an increase of up to 0.6 m compared to pre-mining conditions;
- There is generally an increase in flood levels in Drainage Line BP1 from SB1 to SB2 of up to 0.05 m.
- Flood levels at the model boundary extent would increase up to 0.03 m.
- Flood depths across the access road floodway are up to 0.12 m in the 10% AEP event and 0.17 m in the 1% AEP event.
- The predicted peak velocities across the BP33 access road ranges between 1.5 m/s to 2.0 m/s for the 1% AEP event.
- In terms of erosion risk:
  - There is a risk of floodwaters from Drainage Line BP1 and SB2 sediment water eroding the toe of MWD.
  - There is a risk of sediment water from SB1 eroding the inner corner of SB1.
  - It is recommended to apply erosion protection measures to prevent erosion and scour risk to SB1 and MWD.

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# 6 CONCLUSION

WRM undertook a Drainage Line BP1 flood assessment to assess the BP33 flood risk for proposed infrastructure and mining areas. The developed conditions hydraulic model results showed the following for the three access road design scenarios:

- **Option 1: Culvert design (DEV1)**
  - The BP33 access road remains flood free for events up to and including the 1% AEP event.
  - It is predicted that flows within the culvert will reach approximately 13.7 $m^3/s$ in the 1% AEP event.
  - Water levels upstream of the BP33 access road is 18.9 mAHD during the 1% AEP event, which is an increase of up to 1.0 m compared to pre-mining conditions;
  - There is generally an increase in flood levels in Drainage Line BP1 from SB1 to SB2 of up to 0.05 m.
  - Flood levels at the model boundary extent would be less than or equal to pre-mining conditions.
  - Flood velocities downstream of the culvert ranges between 0.8 m/s to 1.4 m/s during the 1% AEP event.
  - In terms of erosion risks:
    - There is risk of floodwaters from Drainage Line BP1 and SB2 sediment water eroding the toe of MWD.
    - There is a risk of sediment water from SB1 eroding the inner corner of SB1.
    - It is recommended to apply erosion protection measures to prevent erosion and scour risks to SB1 and MWD.
- **Option 2: Floodway design (DEV2)**
  - The BP33 access road would divert the upstream catchment flow across the floodway and into the Drainage Line BP1.
  - It is predicted that flows across the floodway would reach approximately 15.4 $m^3/s$ in the 1% AEP event.
  - Water levels upstream of the BP33 access road is approximately 18.6 mAHD during the 1% AEP event, which is an increase of up to 0.8 m compared to pre-mining conditions;
  - There is generally an increase in flood levels in Drainage Line BP1 from SB1 to SB2 of up to 0.09 m.
  - Flood levels at the model boundary extent would increase up to 0.05 m.
  - The predicted peak velocities across the BP33 access road ranges between 1.0 m/s to 2.5 m/s for the 1% AEP event.
  - In terms of erosion risk:
    - There is a risk of floodwaters from Drainage Line BP1 and SB2 sediment water eroding the toe of MWD.
    - There is a risk of sediment water from SB1 eroding the inner corner of SB1.
    - There is a risk of floodwater from the access road floodway to spill into SB1. Water over the floodway would spill into SB1 for the 10% AEP and 1% AEP events.

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- It is recommended to apply erosion protection measures to prevent erosion and scour risk to SB1 and MWD.

- **Option 3: Revised floodway design with flood diversion bund (DEV2A)**
  - The BP33 access road would divert the upstream catchment flow across the floodway and into Drainage Line BP1.
  - The flood diversion bund would divert the upstream catchment flows away from SB1.
  - It is predicted that flows across the floodway would reach approximately 14.6 $m^3/s$ in the 1% AEP event.
  - Water levels upstream of the BP33 access road is approximately 18.3 mAHD in the 1% AEP event, which is an increase of up to 0.6 m compared to pre-mining conditions;
  - There is generally an increase in flood levels in Drainage Line BP1 from SB1 to SB2 of up to 0.05 m.
  - Flood levels at the model boundary extent would increase up to 0.03 m.
  - Flood depths across the access road floodway are up to 0.12 m in the 10% AEP event and 0.17 m in the 1% AEP event.
  - The predicted peak velocities across the BP33 access road ranges between 1.5 m/s to 2.0 m/s for the 1% AEP event.
  - In terms of erosion risk:
    - There is a risk of floodwaters from Drainage Line BP1 and SB2 sediment water eroding the toe of MWD.
    - There is a risk of sediment water from SB1 eroding the inner corner of SB1.
    - It is recommended to apply erosion protection measures to prevent erosion and scour risk to SB1 and MWD.

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# 7 REFERENCES


| | |
|---|---|
| Ball et al, 2019 | 'Australian Rainfall and Runoff: A Guide to Flood Estimation', Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), © Commonwealth of Australia (Geoscience Australia), 2019. |
| BMT, 2023 | *TUFLOW (software), BMT, version 2023-03-AB, 2023.* |
| Carroll, 2021 | URBS (Unified River Basin Simulator): A Rainfall Runoff Routing Model for Flood Forecasting & Design (Version 6.6) D.G. Carroll, 2021 |


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# APPENDIX A DESIGN FLOOD MAPS

## A.1 PEAK FLOOD EXTENTS, DEPTHS AND LEVELS

Figure A.1 to Figure A.2 show the predicted peak flood extents, depths and levels for 10% AEP and 1% AEP for pre-mining conditions.

Figure A.3 to Figure A.4 show the predicted peak flood extents, depths and levels for 10% AEP and 1% AEP for DEV1 conditions.

Figure A.5 to Figure A.6 show the predicted peak flood extents, depths and levels for 10% AEP and 1% AEP for DEV2 conditions.

Figure A.7 to Figure A.8 show the predicted peak flood extents, depths and levels for 10% AEP and 1% AEP for DEV2A conditions.

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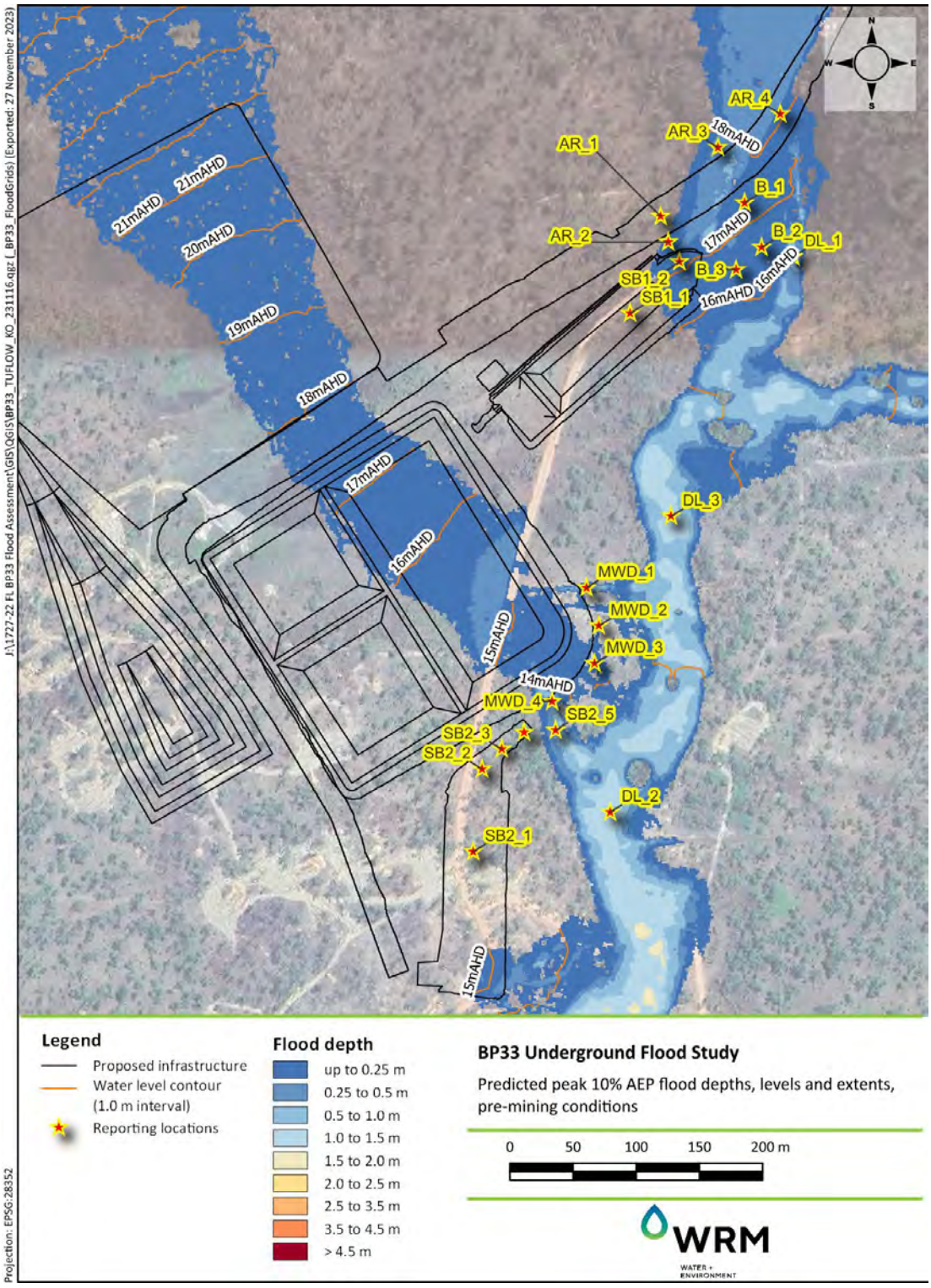


**Figure A.1 Peak flood extents, levels & depths, 10% AEP, pre-mining conditions**

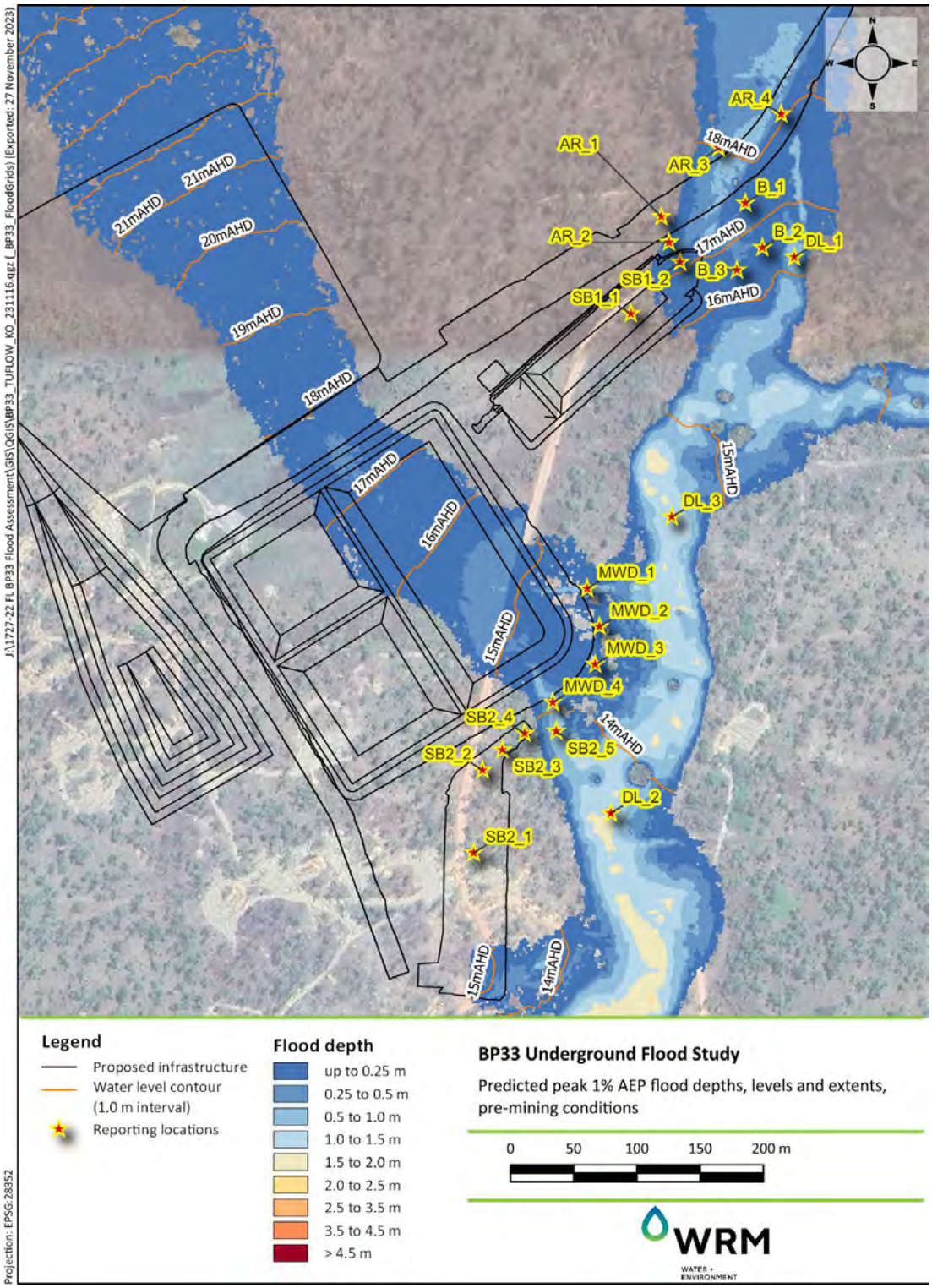


**Figure A.2 Peak flood extents, levels & depths, 1% AEP, pre-mining conditions**

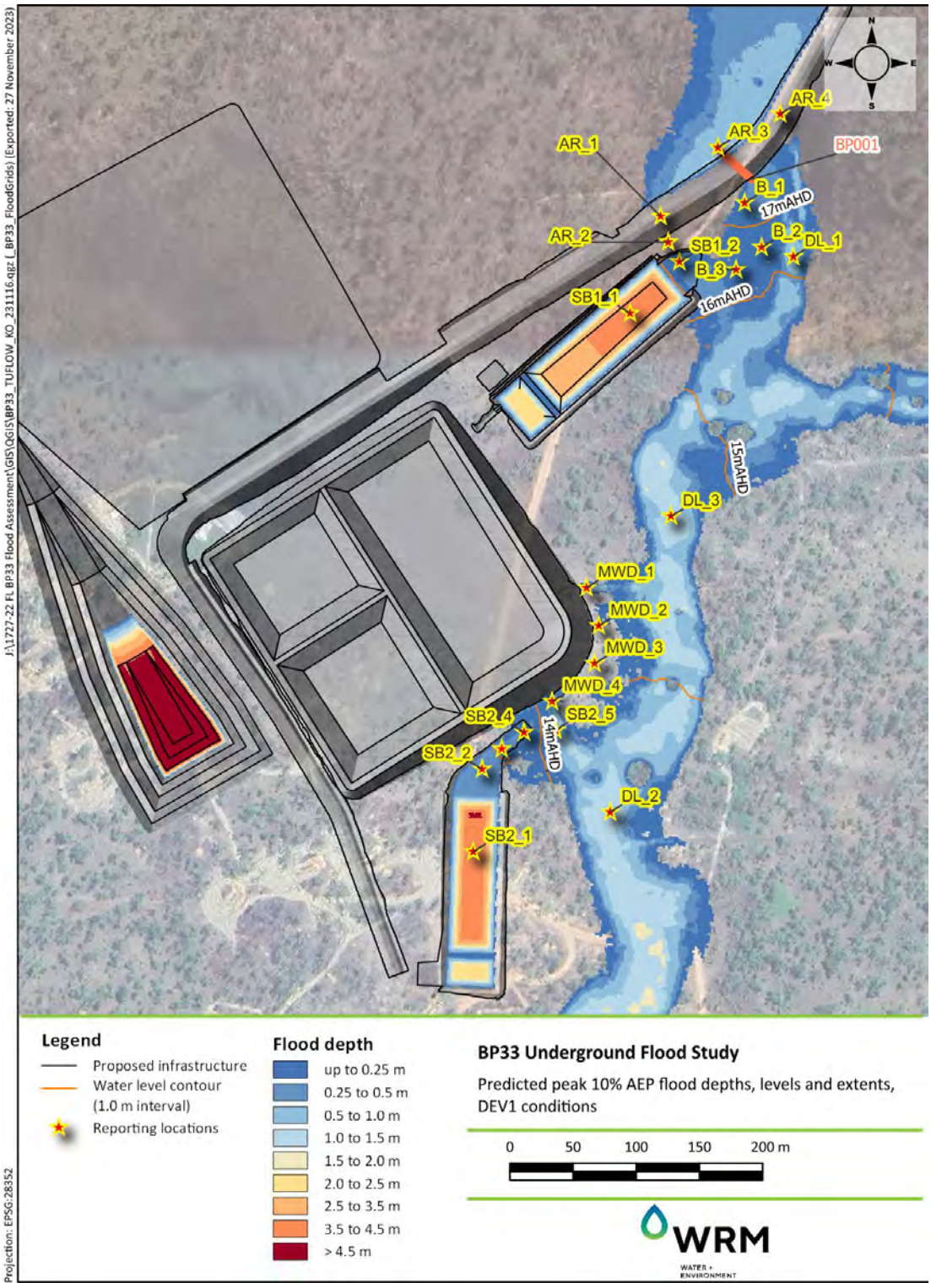


**Figure A.3 Peak flood extents, levels & depths, 10% AEP, DEV1 conditions**

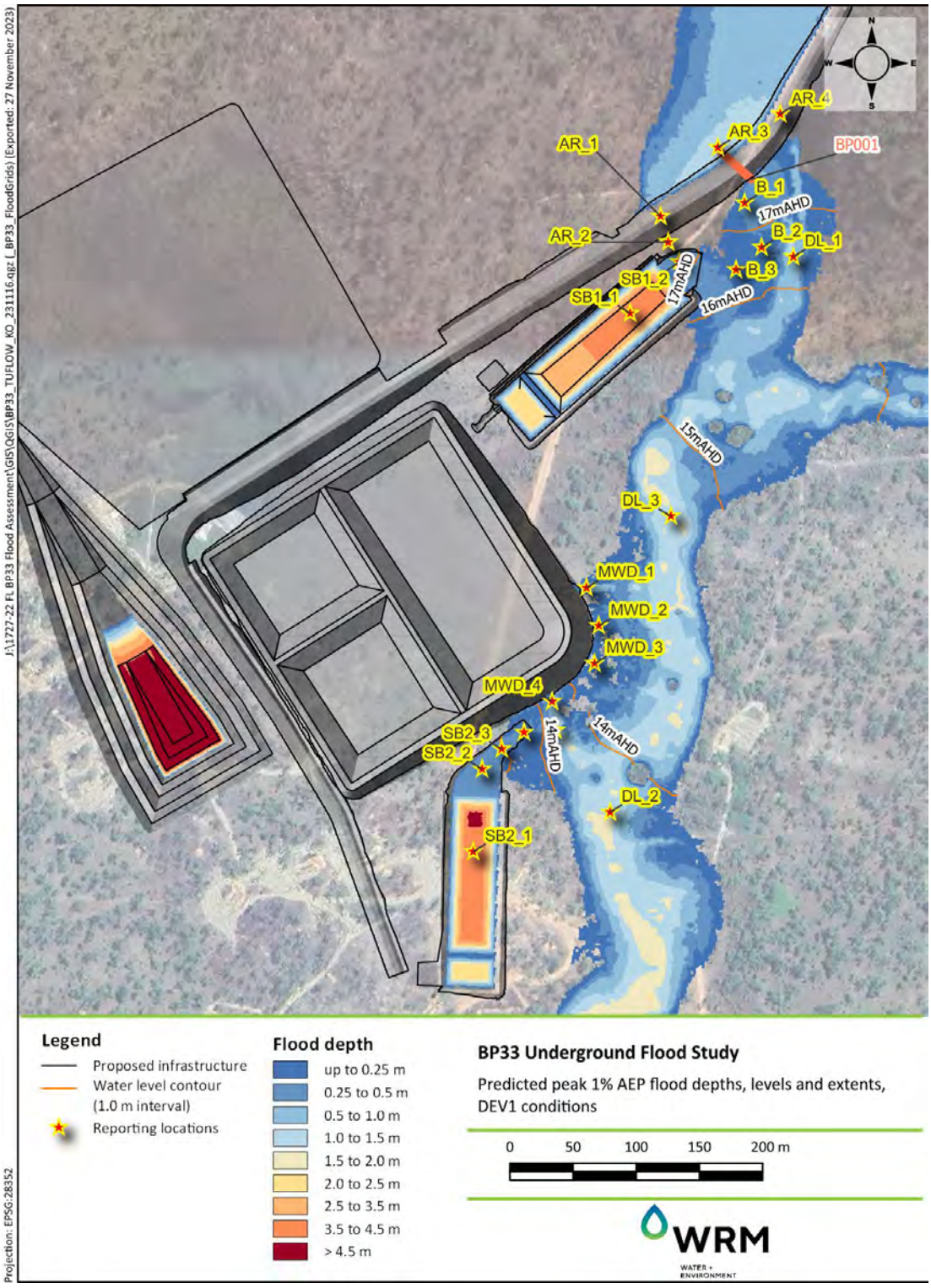


**Figure A.4 Peak flood extents, levels & depths, 1% AEP, DEV1 conditions**

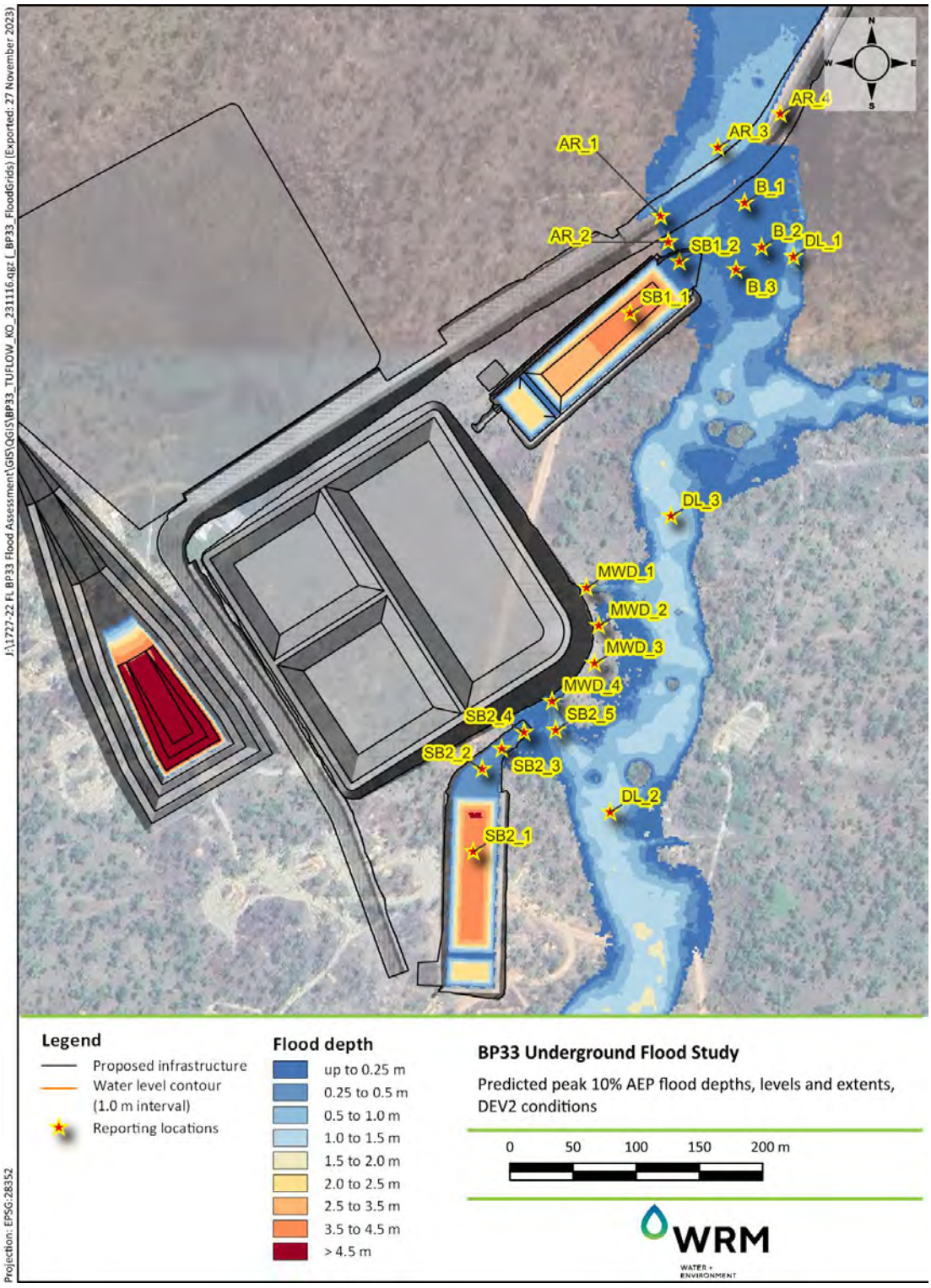


**Figure A.5 Peak flood extents, levels & depths, 10% AEP, DEV2 conditions**

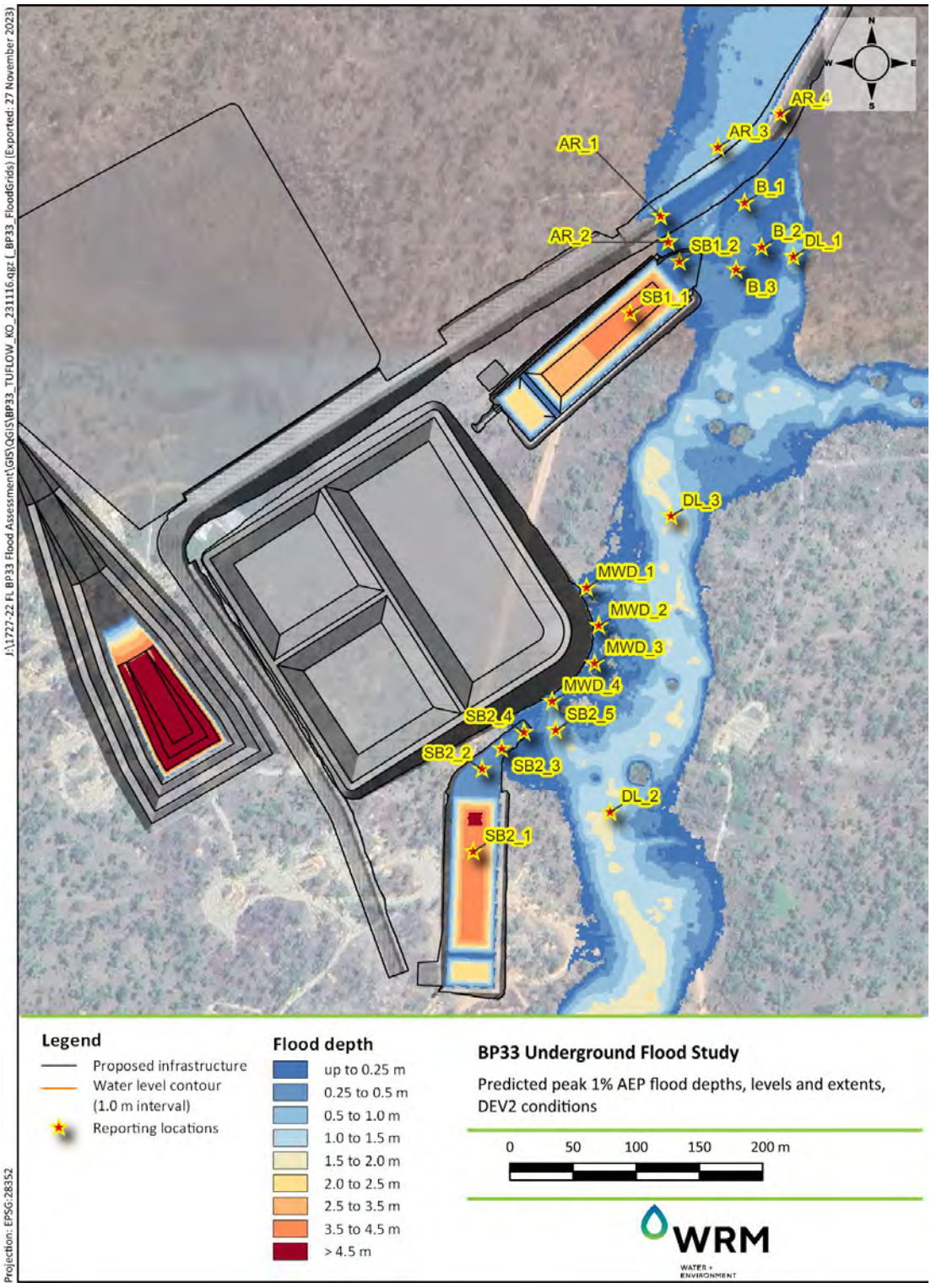


**Figure A.6 Peak flood extents, levels & depths, 1% AEP, DEV2 conditions**

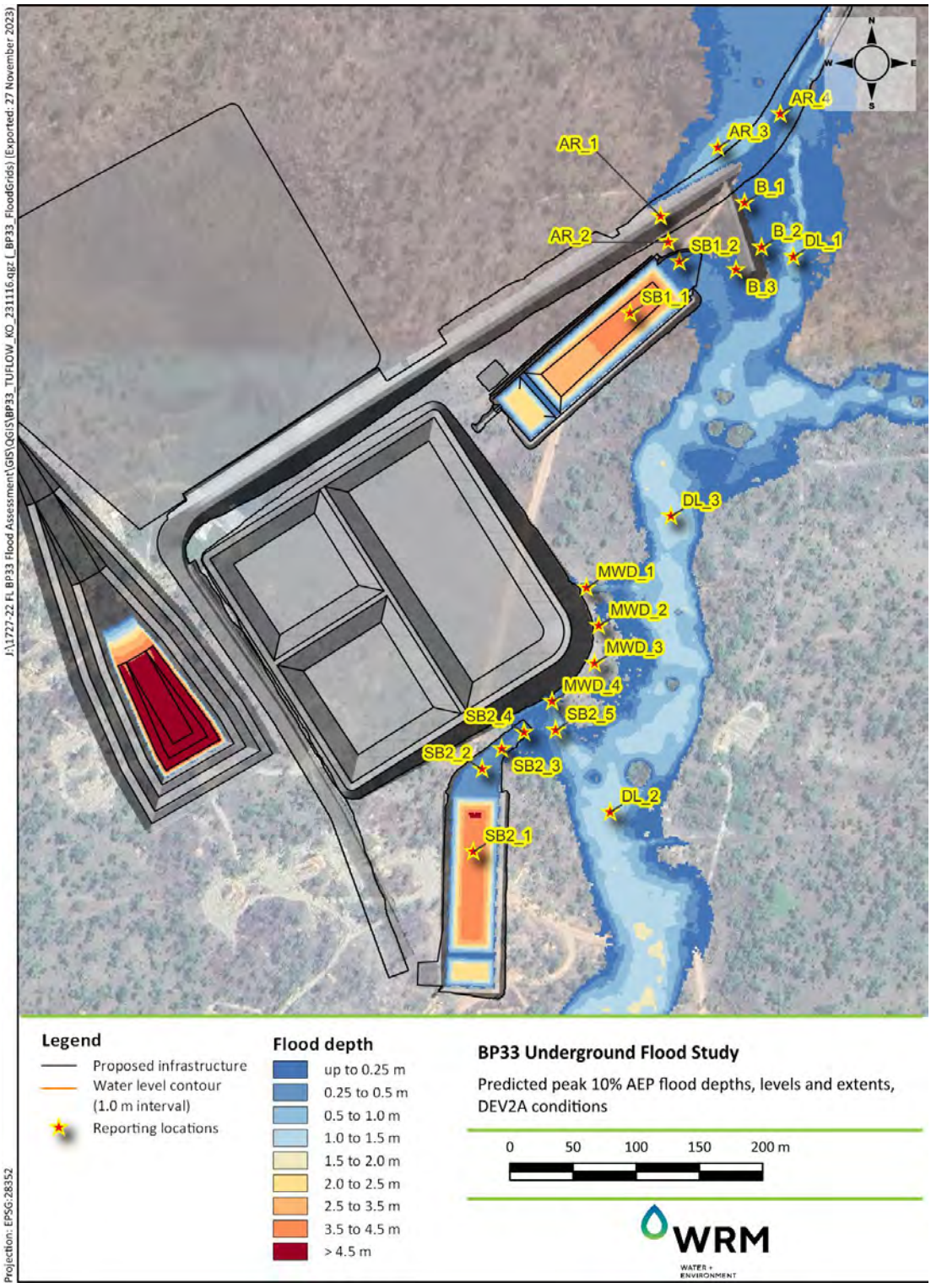


**Figure A.7 Peak flood extents, levels & depths, 10% AEP, DEV2A conditions**

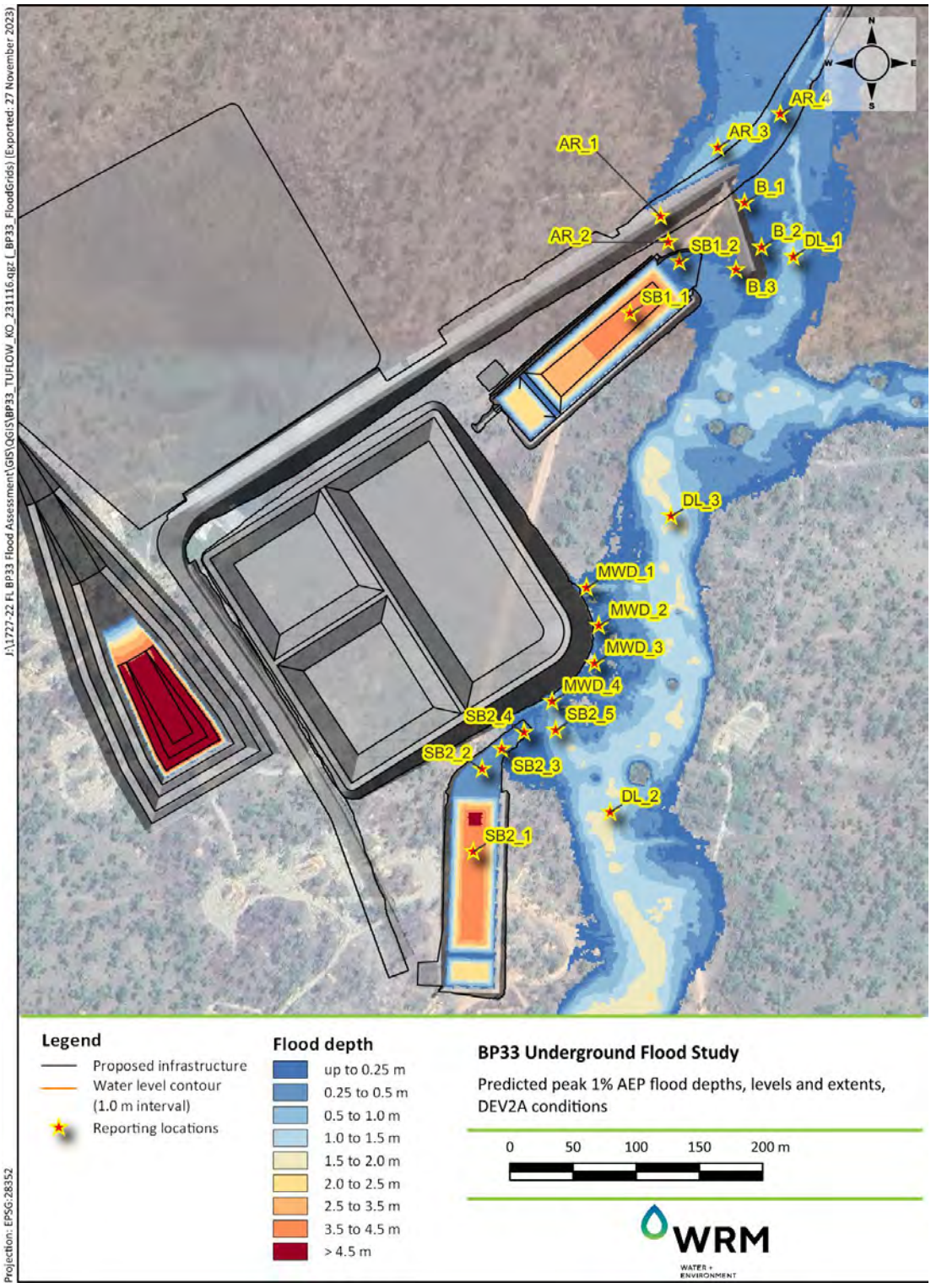


**Figure A.8 Peak flood extents, levels & depths, 1% AEP, DEV2A conditions**

## A.2 PEAK FLOOD VELOCITIES

Figure A.9 to Figure A.10 show the predicted peak flood velocities for 10% AEP and 1% AEP for pre-mining conditions.

Figure A.11 to Figure A.12 show the predicted peak flood velocities for 10% AEP and 1% AEP for DEV1 conditions.

Figure A.13 to Figure A.14 show the predicted peak flood velocities for 10% AEP and 1% AEP for DEV2 conditions.

Figure A.15 to Figure A.16 show the predicted peak flood velocities for 10% AEP and 1% AEP for DEV2A conditions.

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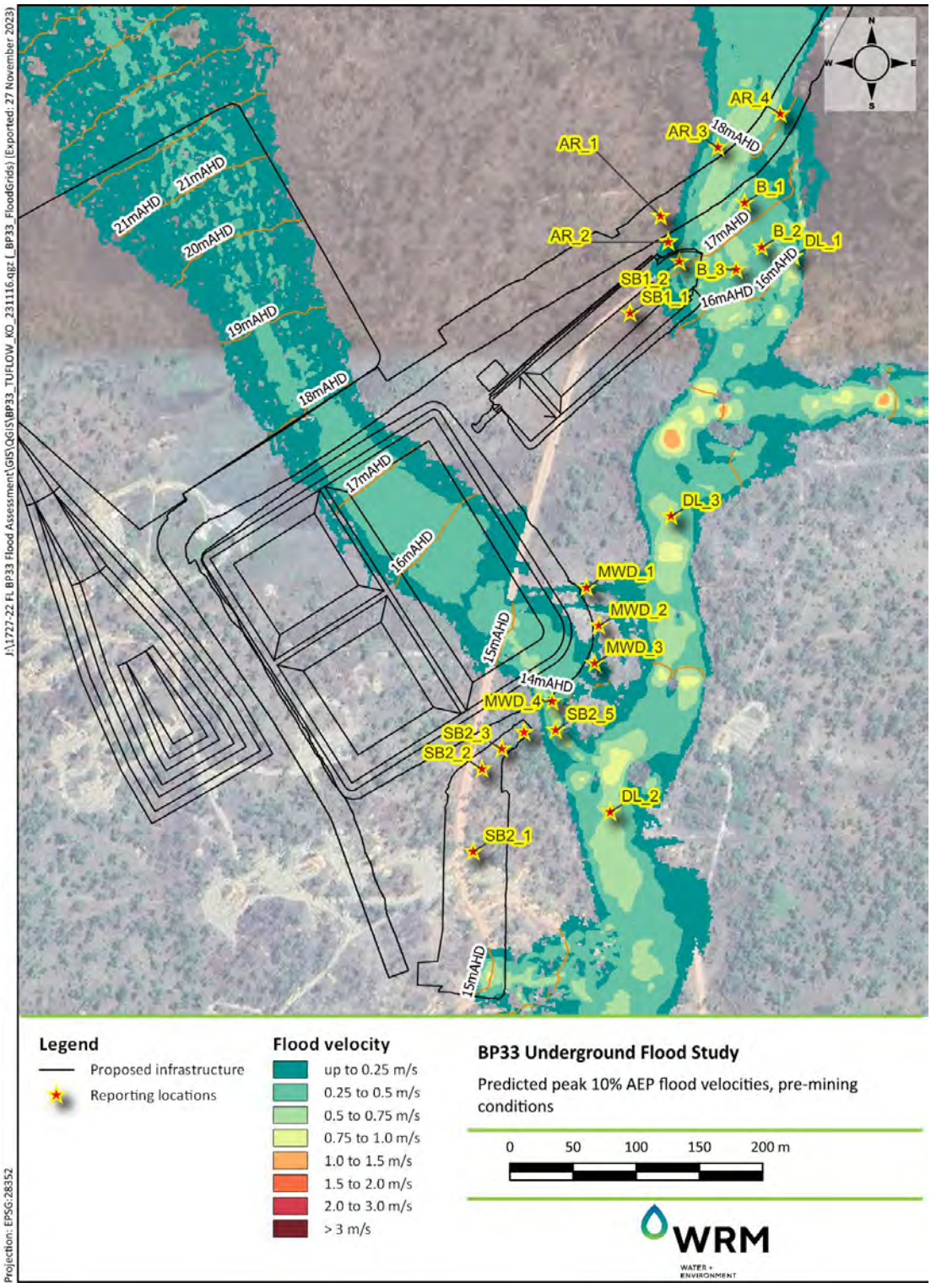


**Figure A.9 Peak flood velocities, 10% AEP, pre-mining conditions**

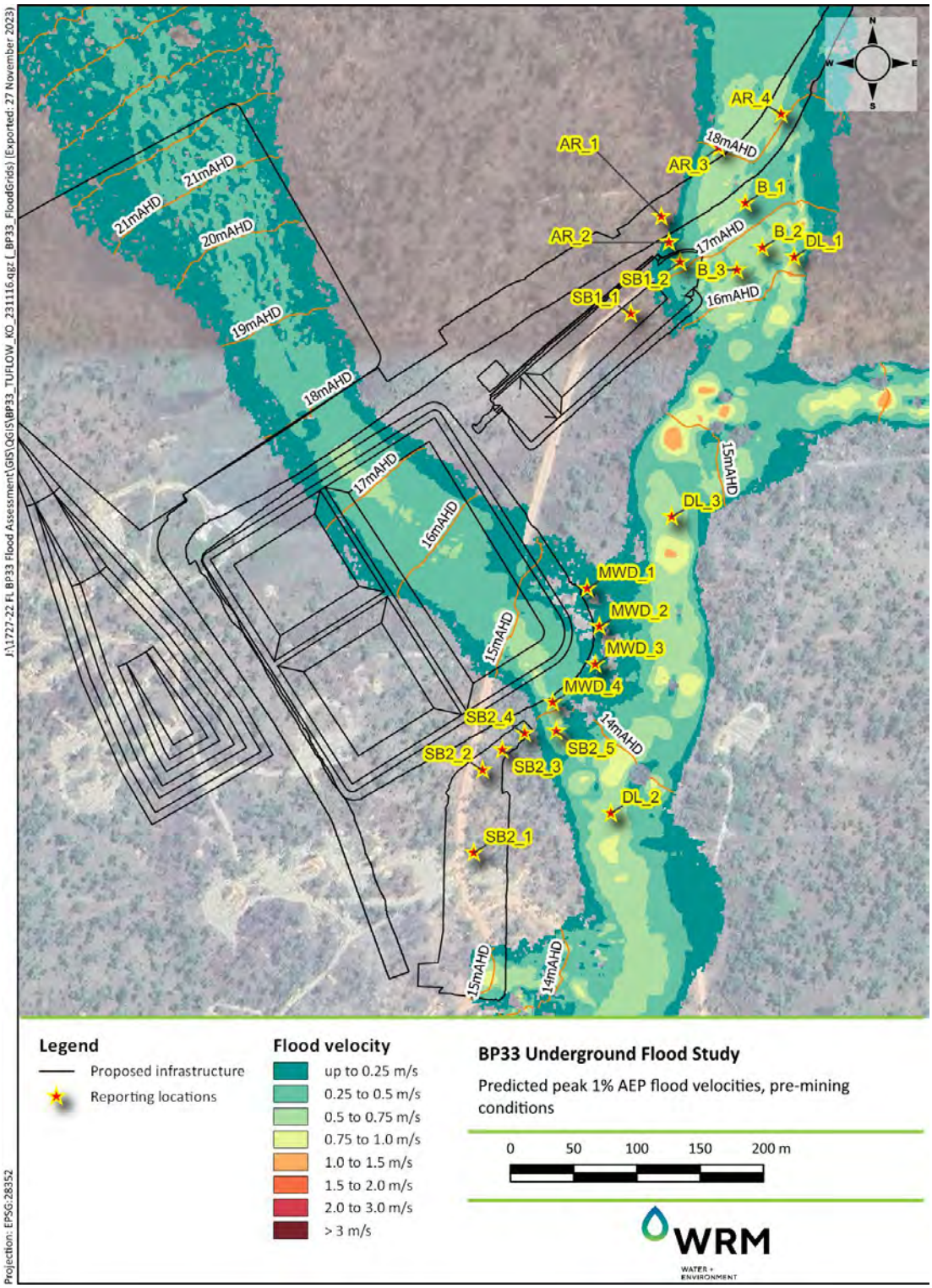


**Figure A.10** **Peak flood velocities, 1% AEP, pre-mining conditions**

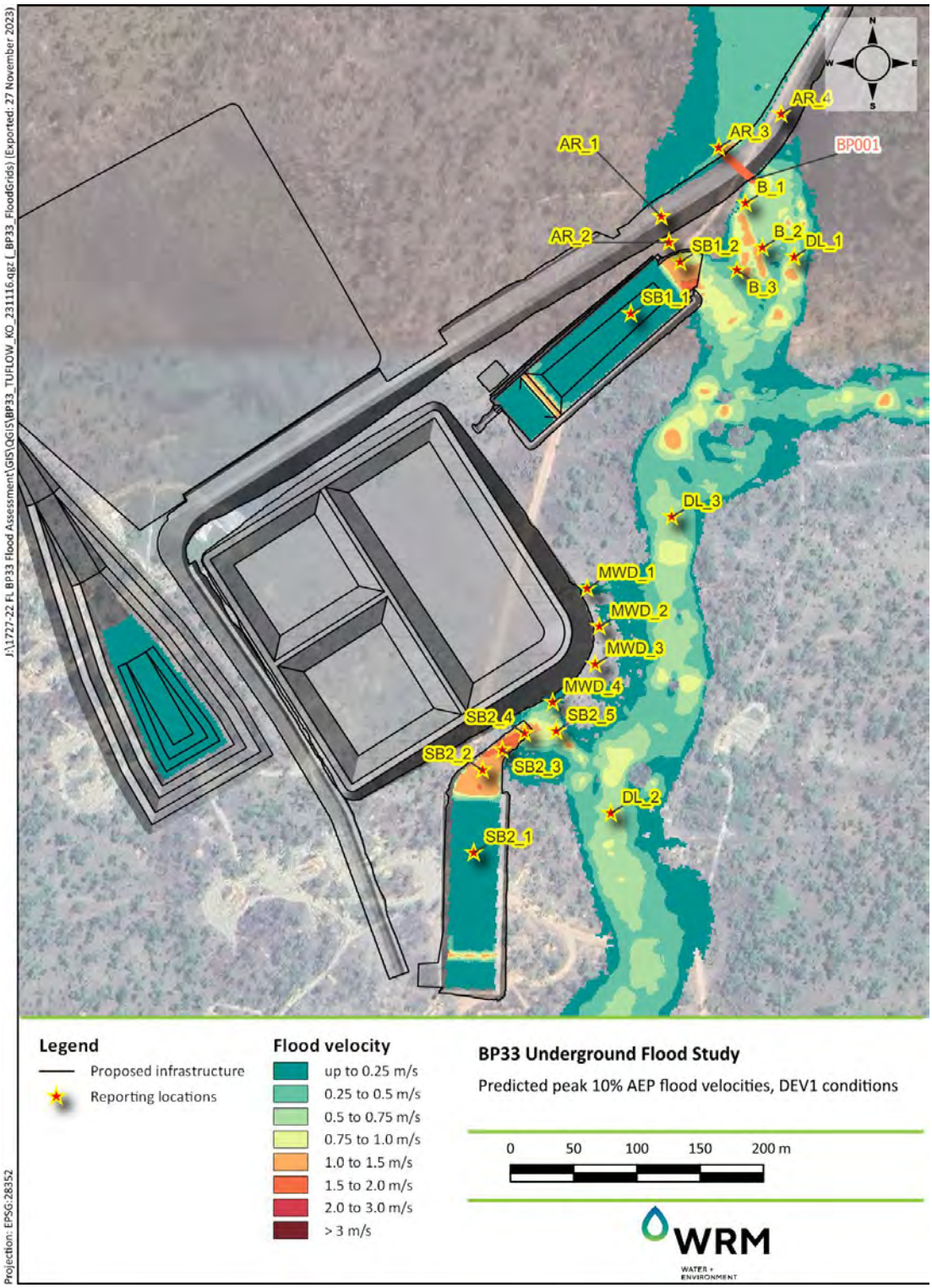


**Figure A.11** **Peak flood velocities, 10% AEP, DEV1 conditions**

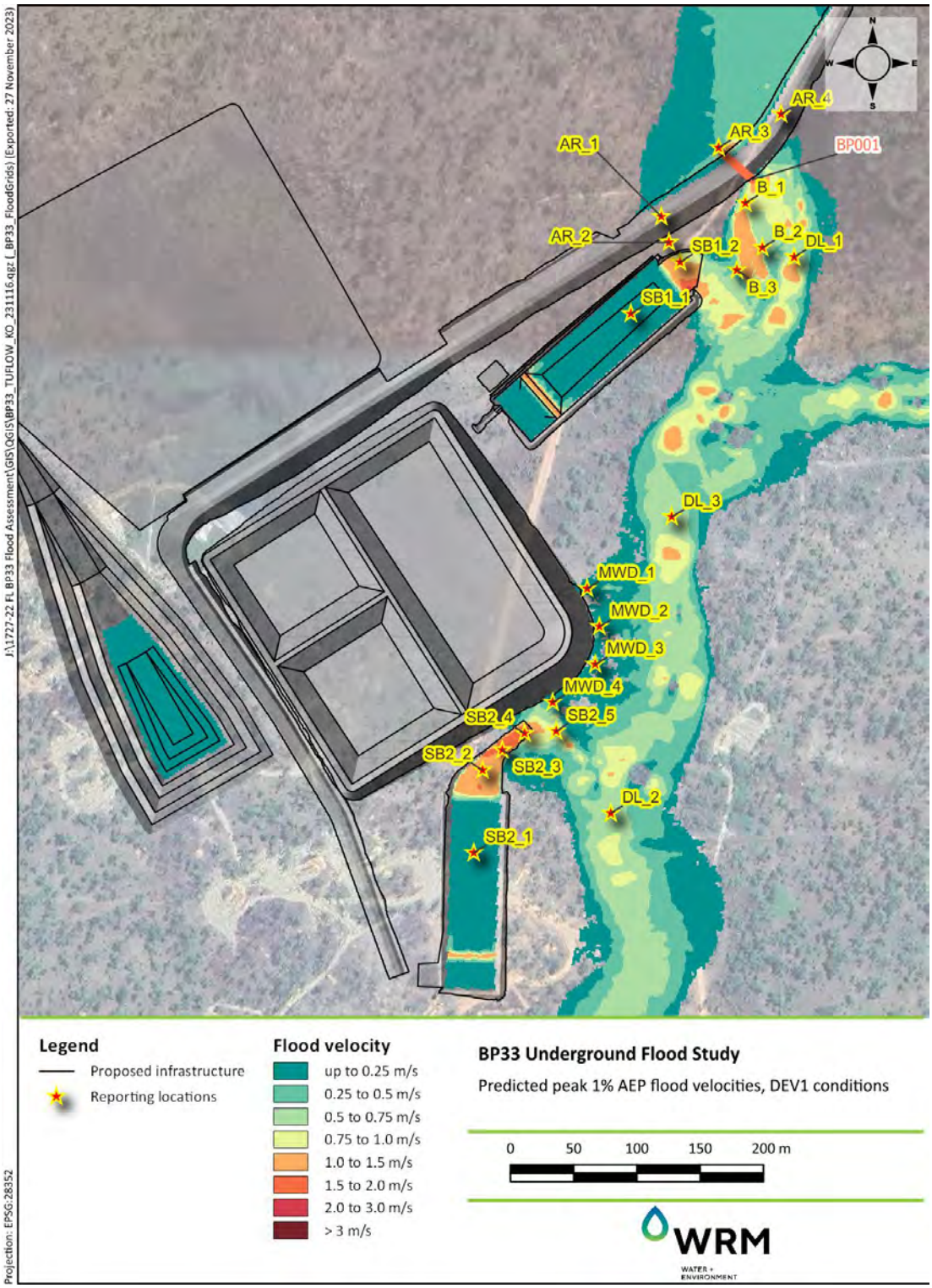


**Figure A.12** **Peak flood velocities, 1% AEP, DEV1 conditions**

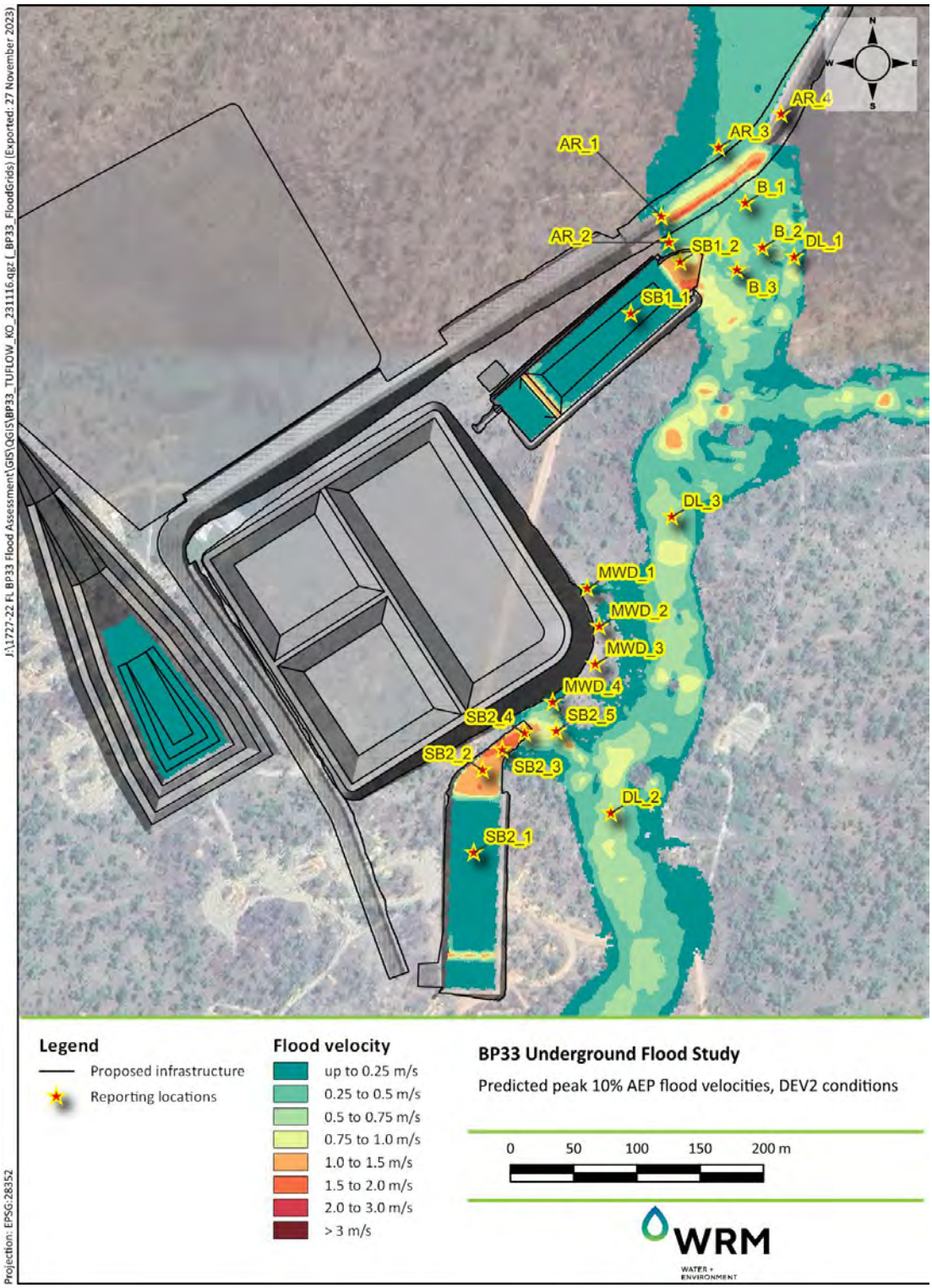


**Figure A.13** **Peak flood velocities, 10% AEP, DEV2 conditions**

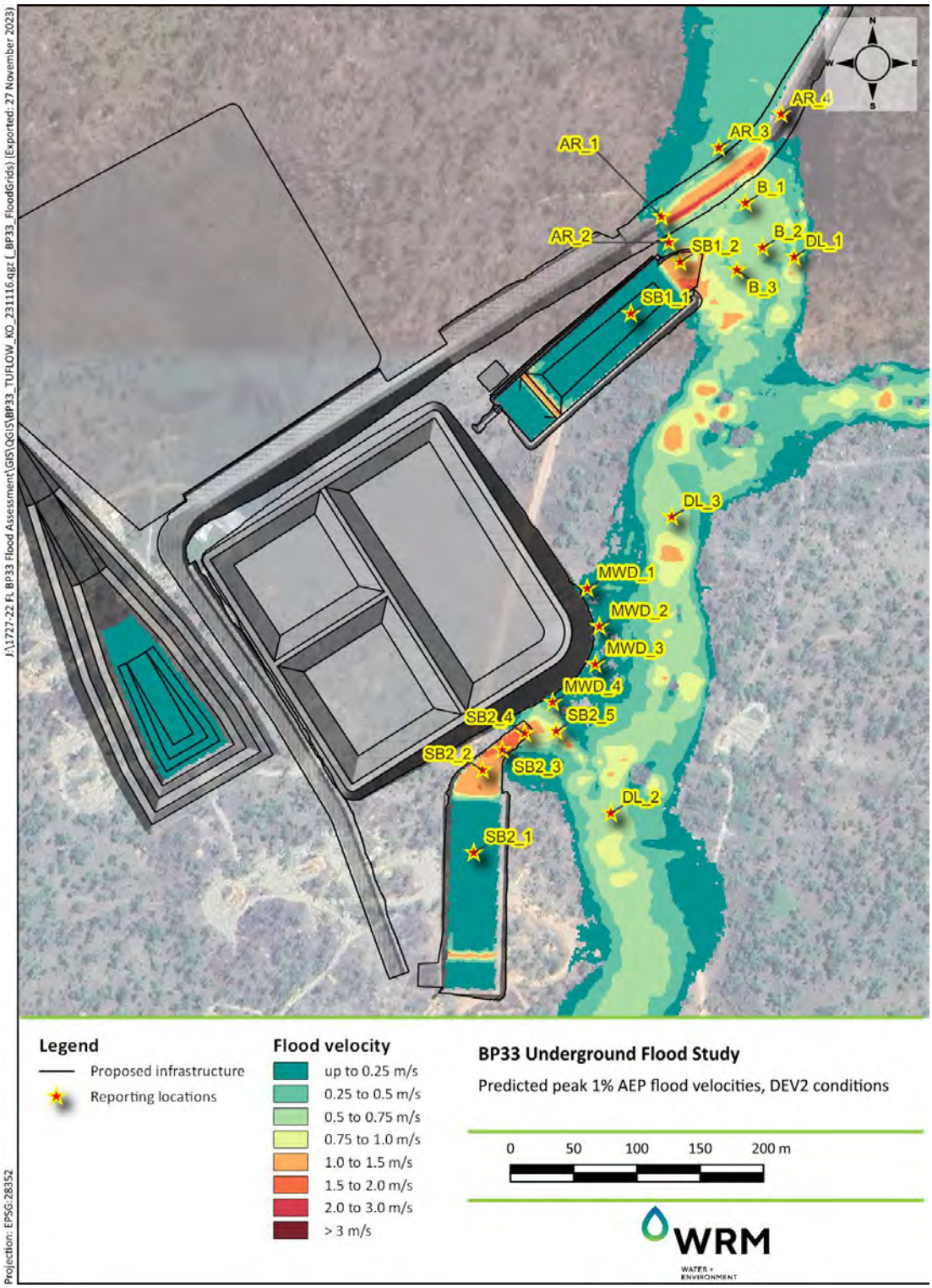


**Figure A.14** **Peak flood velocities, 1% AEP, DEV2 conditions**

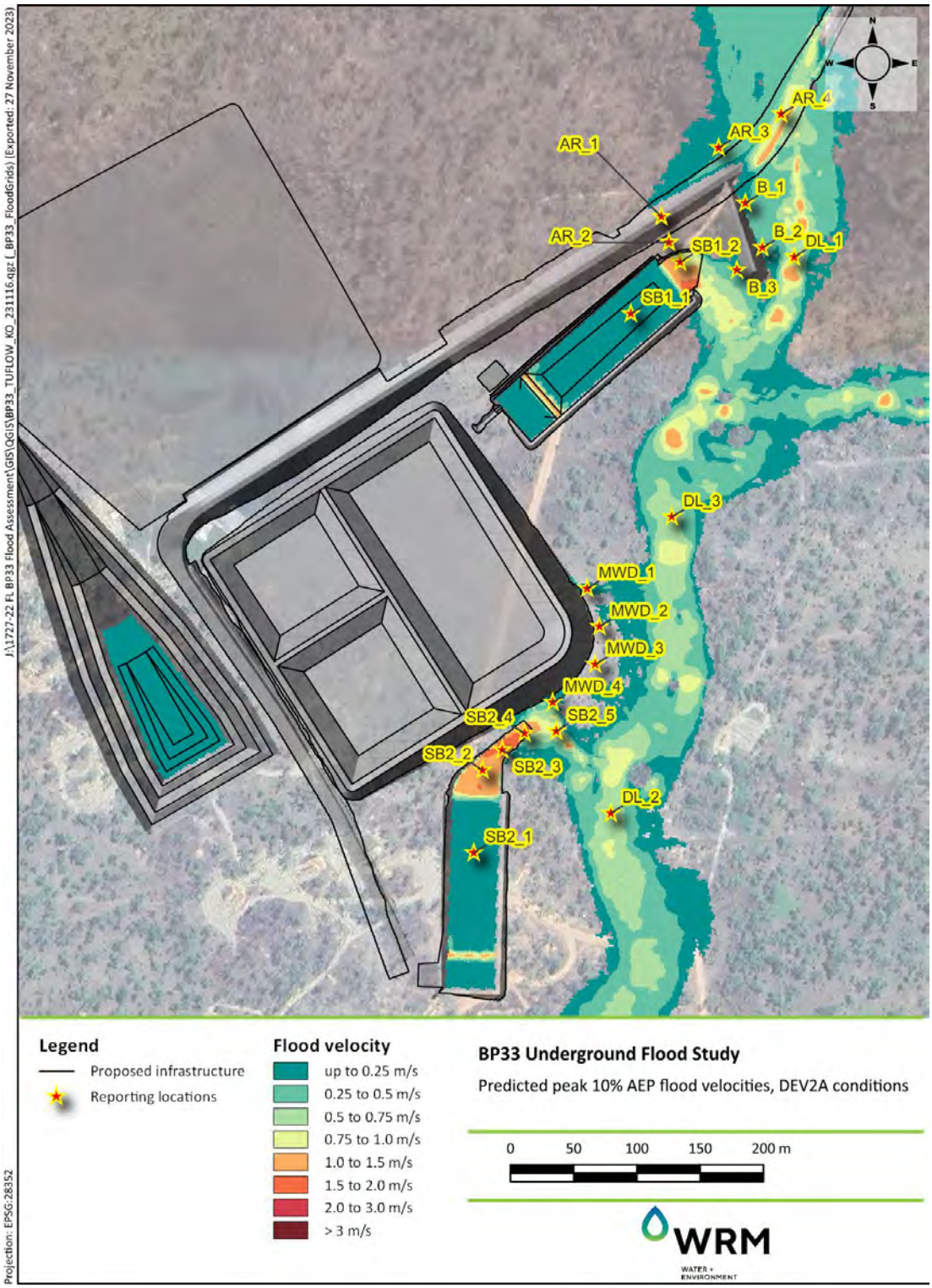


**Figure A.15** **Peak flood velocities, 10% AEP, DEV2A conditions**

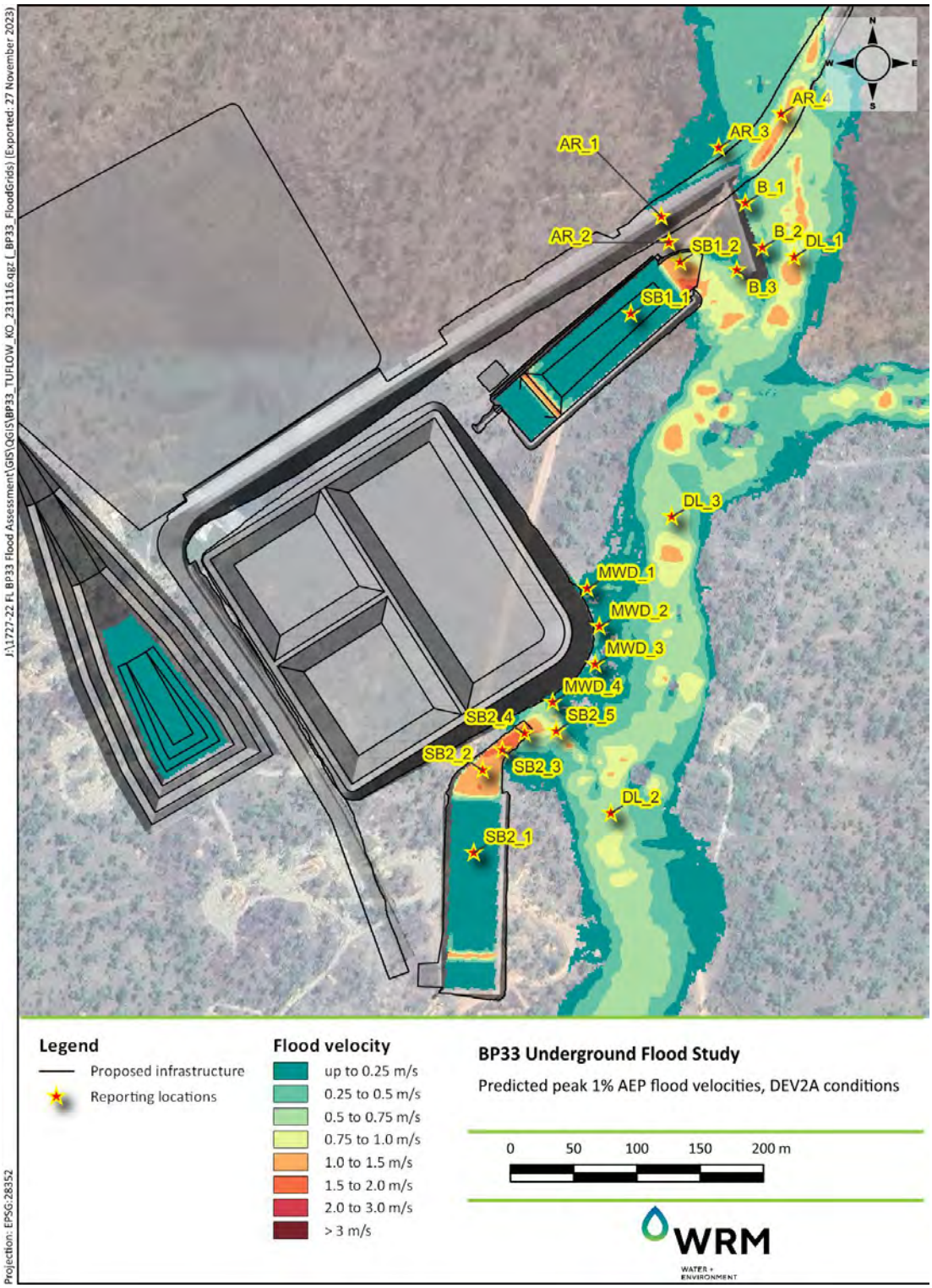


**Figure A.16** **Peak flood velocities, 1% AEP, DEV2A conditions**

## A.3 PEAK FLOOD LEVEL IMPACT

Figure A.17 to Figure A.18 show the change in predicted peak flood levels for 10% AEP and 1% AEP for DEV1 conditions.

Figure A.19 to Figure A.20 show the change in predicted peak flood levels for 10% AEP and 1% AEP for DEV2 conditions.

Figure A.21 to Figure A.22 show the change in predicted peak flood levels for 10% AEP and 1% AEP for DEV2A conditions.

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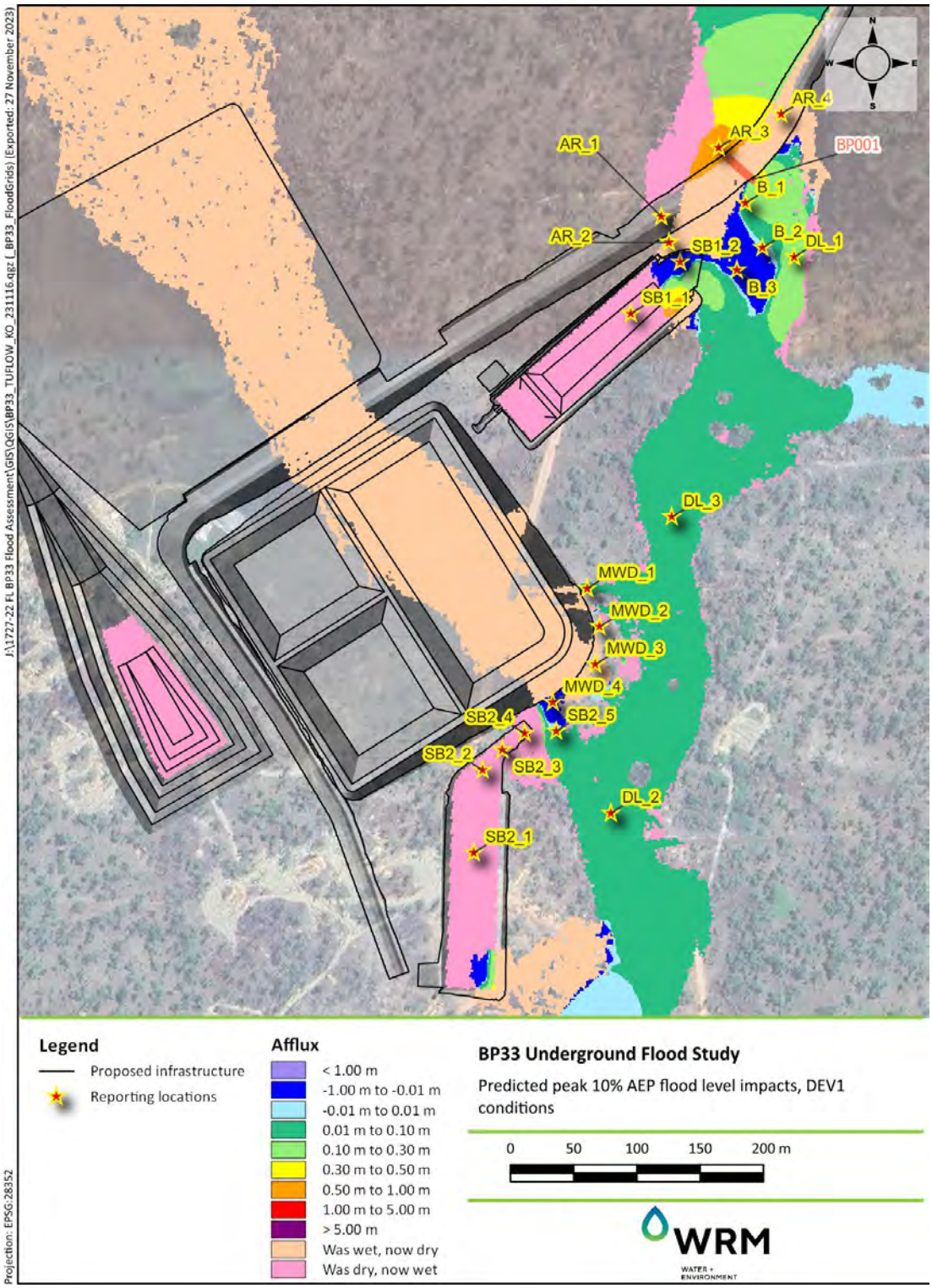


**Figure A.17** **Change in peak flood levels, 10% AEP, DEV1 conditions**

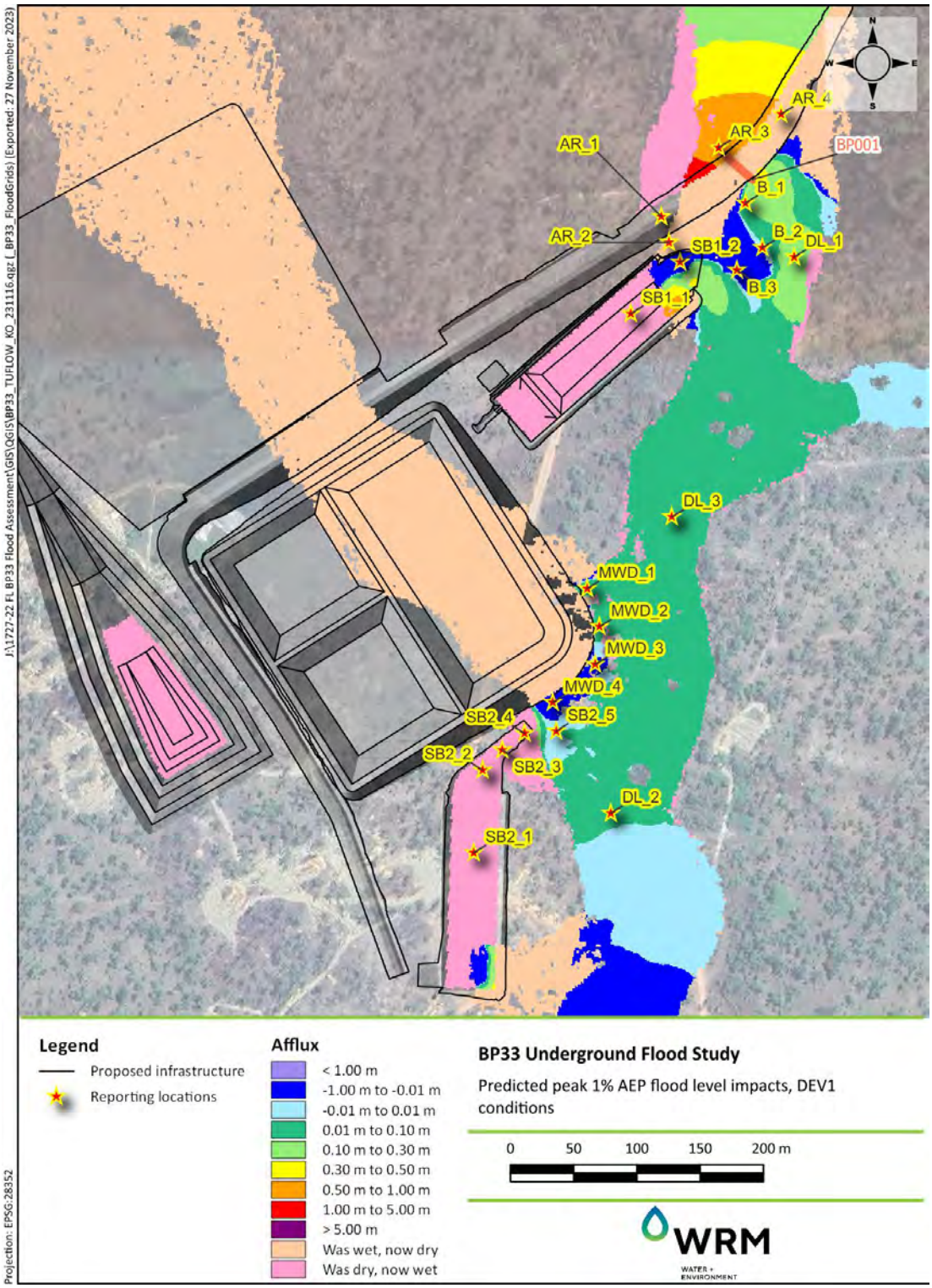


**Figure A.18** **Change in peak flood levels, 1% AEP, DEV1 conditions**

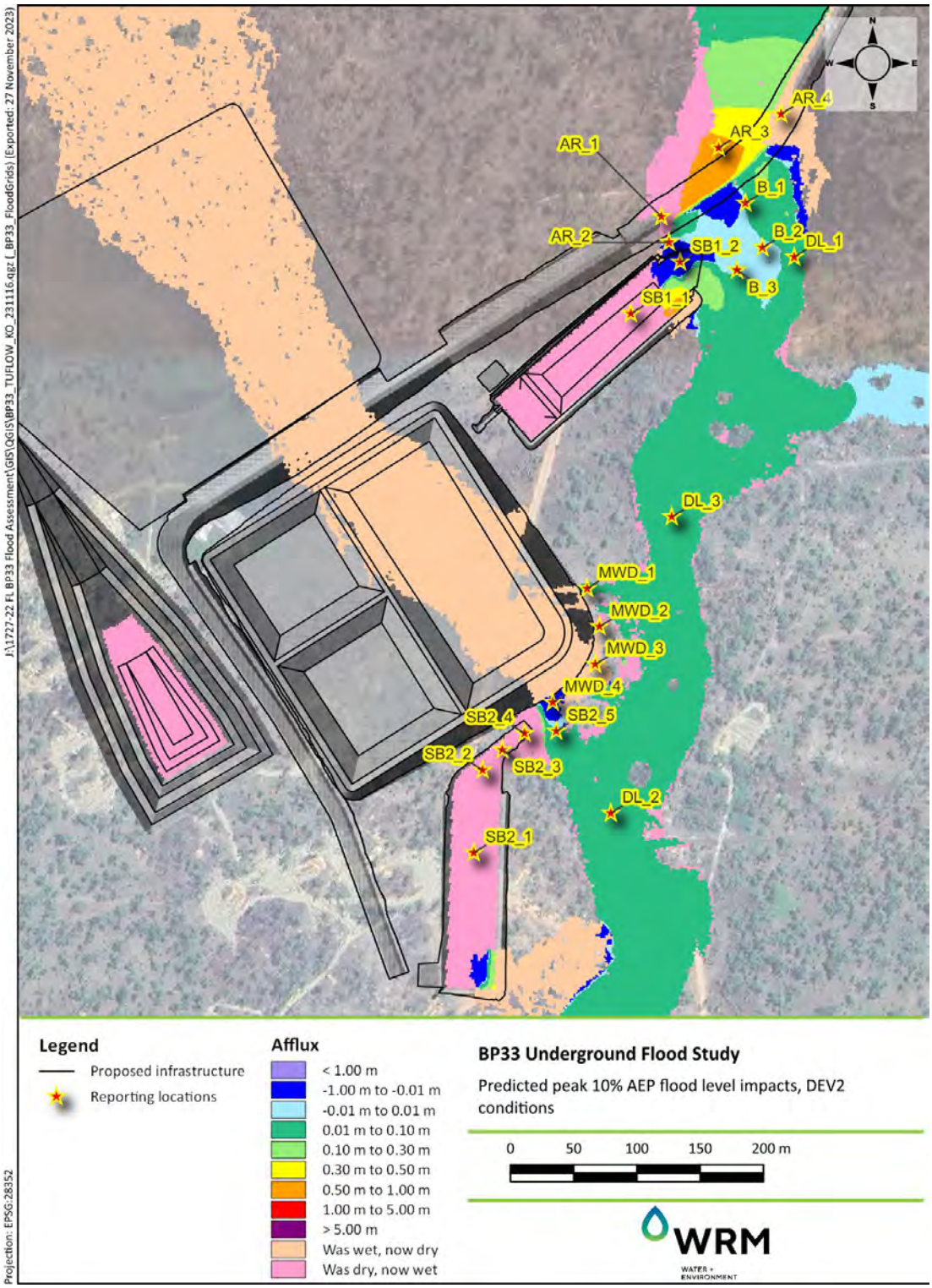


**Figure A.19** **Change in peak flood levels, 10% AEP, DEV2 conditions**

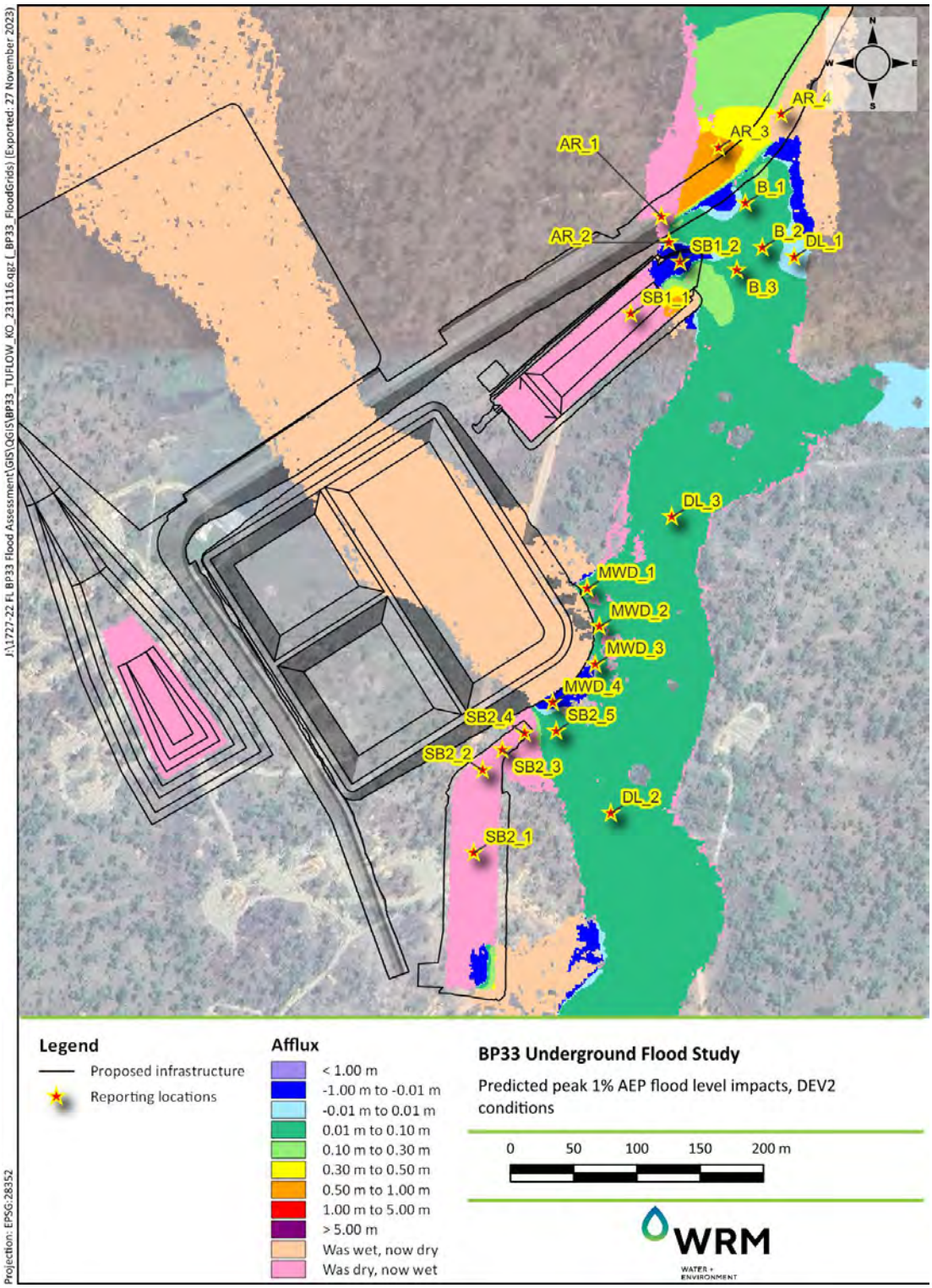


**Figure A.20** **Change in peak flood levels, 1% AEP, DEV2 conditions**

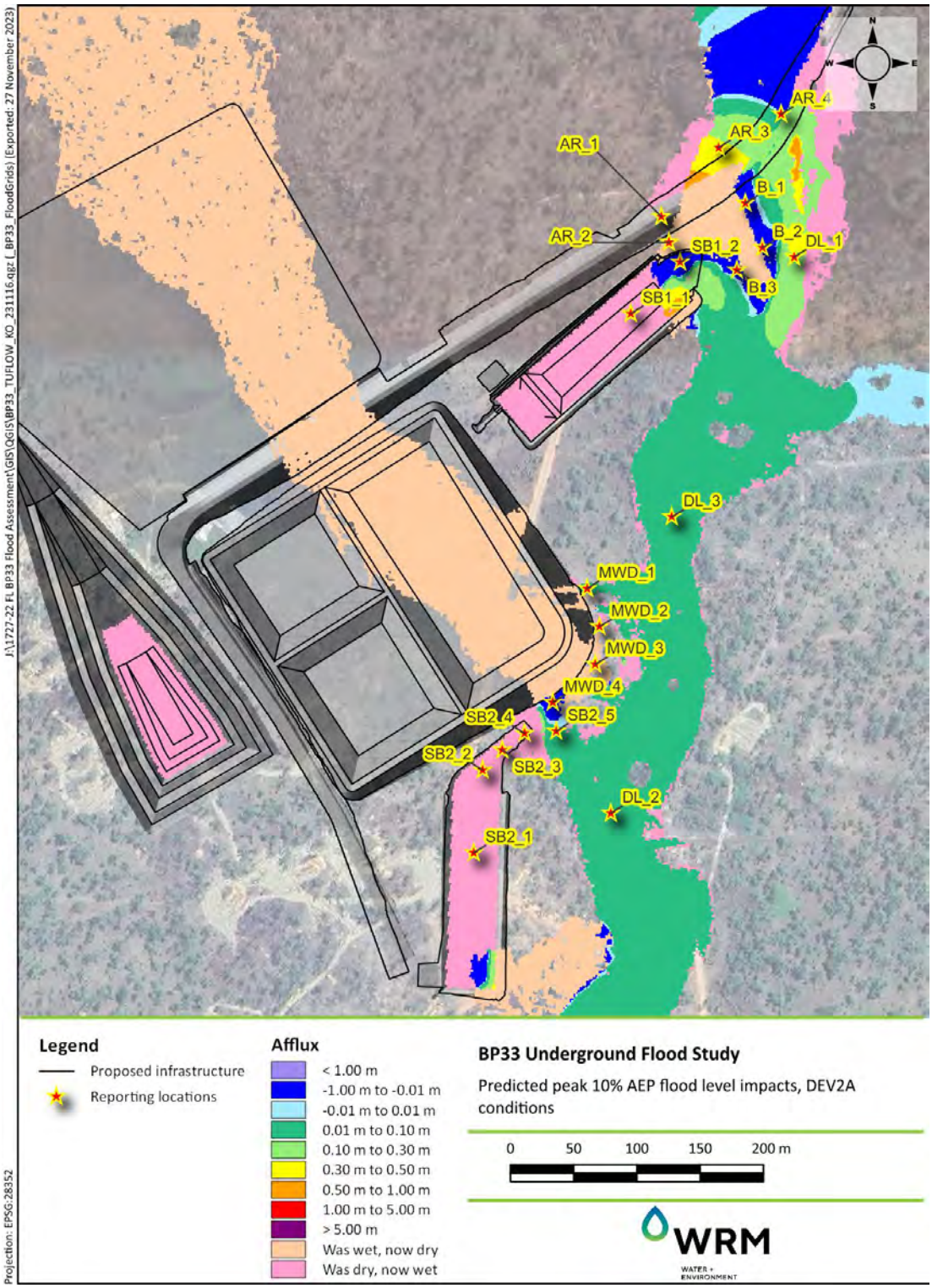


**Figure A.21** **Change in peak flood levels, 10% AEP, DEV2A conditions**

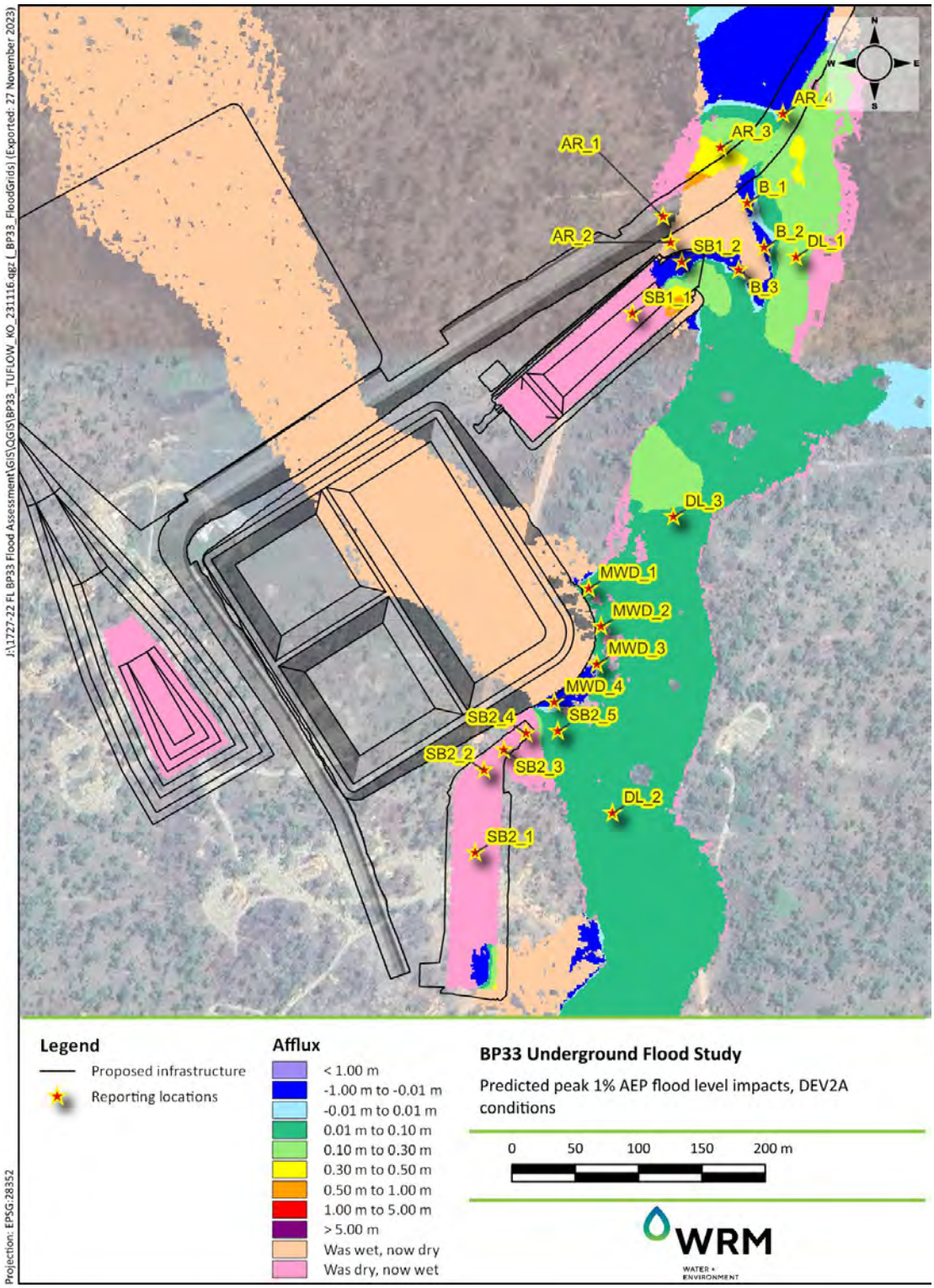


**Figure A.22** **Change in peak flood levels, 1% AEP, DEV2A conditions**

# APPENDIX B PREDICTED FLOOD LEVELS AND AFFLUX

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**Table B.1 10% AEP design event levels and afflux**

| Reporting locations | Pre-mining ground level (mAHD) | Design level (mAHD) | 10% AEP design event | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Predicted DEV1 flood level (mAHD) | Predicted DEV2 flood level (mAHD) | Predicted DEV2A flood level (mAHD) | DEV1 WSL afflux (m) | DEV2 WSL afflux (m) | DEV2A WSL afflux (m) |
| ***Access Road*** | | | | | | | | |
| AR_1 | 17.75 | DEV1: 20.27<br>DEV2/A: 18.45 | -[c] | 18.52 | -[c] | -[c] | -[b] | -[c] |
| AR_2 | 17.30 | - | -[a] | 17.37 | -[c] | -[a] | -[a] | -0.07[a] |
| AR_3 | 17.60 | - | 18.55 | 18.57 | 18.28 | 0.6 | 0.63 | 0.33 |
| AR_4 | 18.17 | 18.10 | -[a] | -[a] | 18.22 | -[a] | -[a] | -0.02 |
| ***Sediment Basin 1*** | | | | | | | | |
| SB1_1 | 17.20 | 16.75 | 16.98 | 16.98 | 17.03 | -0.35 | -0.35 | -[b] |
| SB1_2 | 17.20 | 16.74 | 16.96 | 16.96 | 16.94 | -0.3 | -0.3 | -0.33 |
| ***Sediment Basin 2*** | | | | | | | | |
| SB2_1 | 15.54 | 14.78 | 15.09 | 15.09 | 15.10 | -[b] | -[b] | -[b] |
| SB2_2 | 15.30 | 14.76 | 15.07 | 15.07 | 15.05 | -[b] | -[b] | -[b] |
| SB2_3 | 15.02 | 14.65 | 14.96 | 14.96 | 14.94 | -[b] | -[b] | -[b] |
| SB2_4 | 14.45 | 14.42 | 14.68 | 14.68 | 14.75 | -[b] | -[b] | -[b] |

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| Reporting locations | Pre-mining ground level (mAHD) | Design level (mAHD) | 10% AEP design event | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Predicted DEV1 flood level (mAHD) | Predicted DEV2 flood level (mAHD) | Predicted DEV2A flood level (mAHD) | DEV1 WSL afflux (m) | DEV2 WSL afflux (m) | DEV2A WSL afflux (m) |
| SB2_5 | 13.08 | - | 13.76 | 13.77 | 13.77 | 0.02 | 0.02 | 0.03 |
| ***MWD*** | | | | | | | | |
| MWD_1 | 13.58 | - | 14.31 | 14.32 | 14.32 | 0.07 | 0.07 | 0.08 |
| MWD_2 | 14.21 | - | -[c] | -[c] | -[c] | -[c] | -[c] | -[c] |
| MWD_3 | 14.16 | - | -[c] | -[c] | -[c] | -[c] | -[c] | -0.06[a] |
| MWD_4 | 13.07 | - | 13.77 | 13.78 | 13.79 | -0.11 | -0.11 | -0.10 |
| ***Drainage Line BP1*** | | | | | | | | |
| DL_1 | 15.39 | - | 16.25 | 16.06 | 16.30 | 0.24 | 0.04 | 0.29 |
| DL_2 | 12.35 | - | 13.57 | 13.58 | 13.58 | 0.04 | 0.05 | 0.05 |
| DL_3 | 13.34 | - | 14.54 | 14.55 | 14.55 | 0.08 | 0.09 | 0.09 |
| **Bund (DEV2A only)** | | | | | | | | |
| B_1 | 15.39 | - | - | - | 17.15 | - | - | -0.06 |
| B_2 | 12.35 | - | - | - | 16.59 | - | - | -0.05 |
| B_3 | 13.34 | - | - | - | 16.47 | - | - | -0.07 |

Note:

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[a] – Was wet, now dry

[b] – Was dry, now wet

[c] – Not inundated

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**Table B.2 1% AEP design event levels and afflux**

| Reporting locations | Pre-mining ground level (mAHD) | Design level (mAHD) | 1% AEP design event | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Predicted DEV1 flood level (mAHD) | Predicted DEV2 flood level (mAHD) | Predicted DEV2A flood level (mAHD) | DEV1 WSL afflux (m) | DEV2 WSL afflux (m) | DEV2A WSL afflux (m) |
| ***Access Road*** | | | | | | | | |
| AR_1 | 17.75 | DEV1: 20.27<br>DEV2/A: 18.45 | -[c] | 18.57 | -[c] | -[c] | -[b] | -[c] |
| AR_2 | 17.30 | - | -[a] | 17.41 | - | -[a] | 0.02 | -0.09[a] |
| AR_3 | 17.60 | - | 18.81 | 18.64 | 18.33 | 0.79 | 0.63 | 0.32 |
| AR_4 | 17.97 | 18.13 | -[a] | -[a] | 18.27 | -[a] | -[a] | -0.01 |
| ***Sediment Basin 1*** | | | | | | | | |
| SB1_1 | 17.20 | 16.75 | 17.03 | 17.03 | 17.08 | -0.31 | -0.31 | -[b] |
| SB1_2 | 17.20 | 16.74 | 17.02 | 17.02 | 16.99 | -0.26 | -0.26 | -0.29 |
| ***Sediment Basin 2*** | | | | | | | | |
| SB2_1 | 15.54 | 14.78 | 15.16 | 15.16 | 15.16 | -[b] | -[b] | -[b] |
| SB2_2 | 15.30 | 14.76 | 15.14 | 15.14 | 15.12 | -[b] | -[b] | -[b] |
| SB2_3 | 15.02 | 14.65 | 15.01 | 15.01 | 14.99 | -[b] | -[b] | -[b] |
| SB2_4 | 14.45 | 14.42 | 14.71 | 14.71 | 14.78 | -[b] | -[b] | -[b] |
| SB2_5 | 13.08 | - | 13.97 | 13.99 | 14.01 | 0.01 | 0.03 | 0.05 |

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| Reporting locations | Pre-mining ground level (mAHD) | Design level (mAHD) | 1% AEP design event | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Predicted DEV1 flood level (mAHD) | Predicted DEV2 flood level (mAHD) | Predicted DEV2A flood level (mAHD) | DEV1 WSL afflux (m) | DEV2 WSL afflux (m) | DEV2A WSL afflux (m) |
| ***MWD*** | | | | | | | | |
| MWD_1 | 13.58 | - | 14.51 | 14.53 | 14.54 | 0.05 | 0.07 | 0.08 |
| MWD_2 | 14.21 | - | 14.47 | 14.49 | 14.50 | 0.04 | 0.06 | 0.08 |
| MWD_3 | 14.16 | - | 14.24 | 14.26 | 14.27 | -0.01 | 0.01 | 0.02 |
| MWD_4 | 13.07 | - | 13.98 | 14.00 | 14.03 | -0.07 | -0.05 | -0.02 |
| ***Drainage Line BP1*** | | | | | | | | |
| DL_1 | 15.39 | - | 16.38 | 16.19 | 16.47 | 0.20 | 0.01 | 0.28 |
| DL_2 | 12.35 | - | 13.81 | 13.84 | 13.85 | 0.02 | 0.04 | 0.05 |
| DL_3 | 13.34 | - | 14.76 | 14.78 | 14.80 | 0.07 | 0.09 | 0.11 |
| ***Bund (DEV2A only)*** | | | | | | | | |
| B_1 | 15.39 | - | - | - | 17.22 | - | - | -0.03 |
| B_2 | 12.35 | - | - | - | 16.64 | - | - | -0.03 |
| B_3 | 13.34 | - | - | - | 16.53 | - | - | -0.04 |

Note:

[a] – Was wet, now dry

[b] – Was dry, now wet

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[c] – Not inundated

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# APPENDIX C SURFACE HYDROLOGY AND FLOOD INUNDATION REPORT

# Core Lithium Ltd, Finniss Lithium Project

## BP33 Underground Mining Proposal: surface hydrology and flood inundation modelling

Final report

# Core Lithium Ltd, Finniss Lithium Project

## BP33 Underground Mining Proposal: surface hydrology and flood inundation modelling

### Final report

March 2020

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# Executive Summary

The report assesses the potential changes in stream flow and flood inundation associated with development of the proposed BP33 underground mine on ML(A) 32346. The proposed mine site is located on the Cox Peninsula, approximately 2.7 km southwest of the Cox Peninsula Road in the Charlotte River/Bynoe Harbour catchment. Catchments were delineated that affect the lease. These are referred to as Catchments A and B. Catchment A is a large right bank sub-catchment of the Charlotte River. The main channel in sub-catchment A is 6.5km in length, measured from the Observation Hill Dam (OHD) spillway to the confluence with the Charlotte River. The main channel in Catchment B is 4.5km to the confluence with the Charlotte River. The channels become incised before entering their mangrove lined tidal channels near their confluence with the Charlotte River. All streams on ML(A) 32346 are ephemeral.

Because of the steep terrain in the Bynoe Harbour catchments, it is unlikely storm surge will have an impact on the mine infrastructure. The outlet of mine affected catchments in Catchment A is at ≈5.4mAHD, and Catchment B is at ≈2.9mAHD. The HAT at Burge Point is 3.6mAHD. The lowest point in the proposed mine infrastructure is 23mAHD at the southwest corner of the boxcut bund.

Hydrologic modelling and flood inundation modelling showed a slight decrease in discharges for the mining scenario. The slight decrease is probably due to the modelling assumption that no rainfall on the mine infrastructure leaves the mine site. This assumption is based on the conceptual design which includes best practice procedures, such as sediment retention basins, to ensure that all water is retained on-site. Flood risk analysis showed that there is no increased danger to humans, livestock or native wildlife due to the mine site. Flood inundation modelling indicated that there is little difference to the natural flow regime caused by the mine site. Catchment discharges for the 1%AEP event are 237 $m^3s^{-1}$ for the pre-mining and 236.3 $m^3s^{-1}$ for the mining scenario and Engineers Australia Regional Flood Frequency Estimated discharge is 298 $m^3s^{-1}$.

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# 1 Introduction

The Core Lithium Ltd Lithium resource is located at 694081m East, 8594222m North, GDA94/MGA52, near Berry Springs, Northern Territory. This report focuses on ML(A)32346 (*Figure 1*) but the wider catchment includes the Observation Hill Dam (OHD) catchment (*Figure 2*).

EcOz Environmental Consultants commissioned Surface Water & Erosion Solutions to undertake a hydrological and flood inundation assessment of the proposed mine site, both before mining and with proposed mine infrastructure in place. The assessment comprises:

1. Catchment hydrologic modelling; and
2. Inundation risk modelling of a 1%Annual Exceedance Probability (AEP) design rainfall event.

# 2 Site Description

Desktop analysis of aerial imagery provided an understanding of the stream catchments in the area and the general channel network. A field inspection was not conducted for this study but was previously conducted and reported (EnviroConsult Australia Pty Ltd, 2018a).

## 2.1 Stream Catchments

There are 2 sub-catchments of the Charlotte R. impacted by ML(A)32346 (*Figure 2*). These have been named catchment A and catchment B. These catchments have been further divided into sub-catchments for the pre-mine hydrologic model. Most of the natural drainage on the lease drains south towards a right-bank tributary of the Charlotte R. Details of the catchments are given in *Table 1*. All channels are ephemeral. The large catchment A upstream was included because high discharges in that stream may cause backflow into the catchment containing infrastructure.

Catchment thalwegs (*Figure 3*) have a gentle slope of ≈0.5% to their confluence with Charlotte River through tidal, mangrove-lined channels.

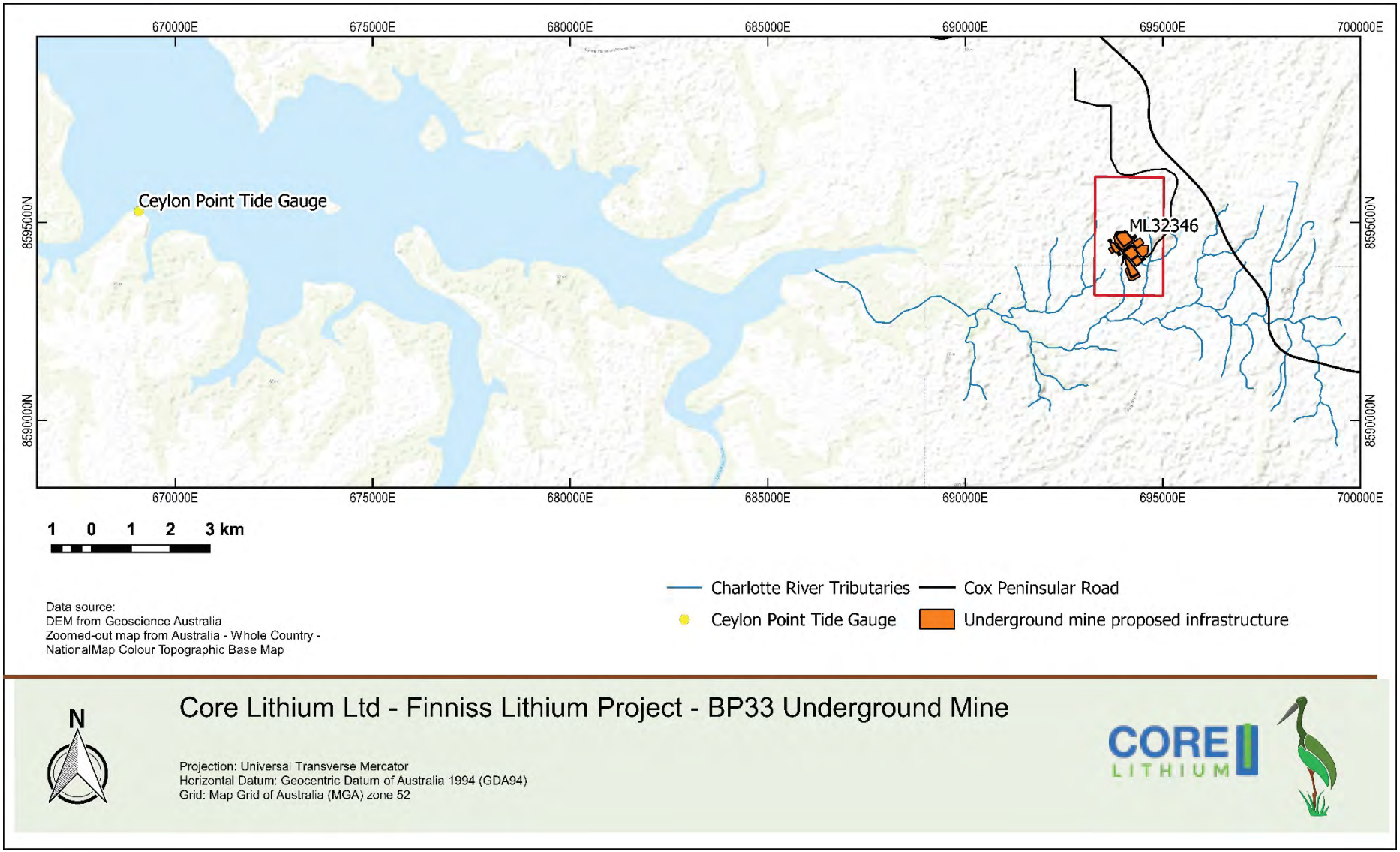



*Figure 1. Location of ML(A)32346 and Ceylon Point tide gauge.*

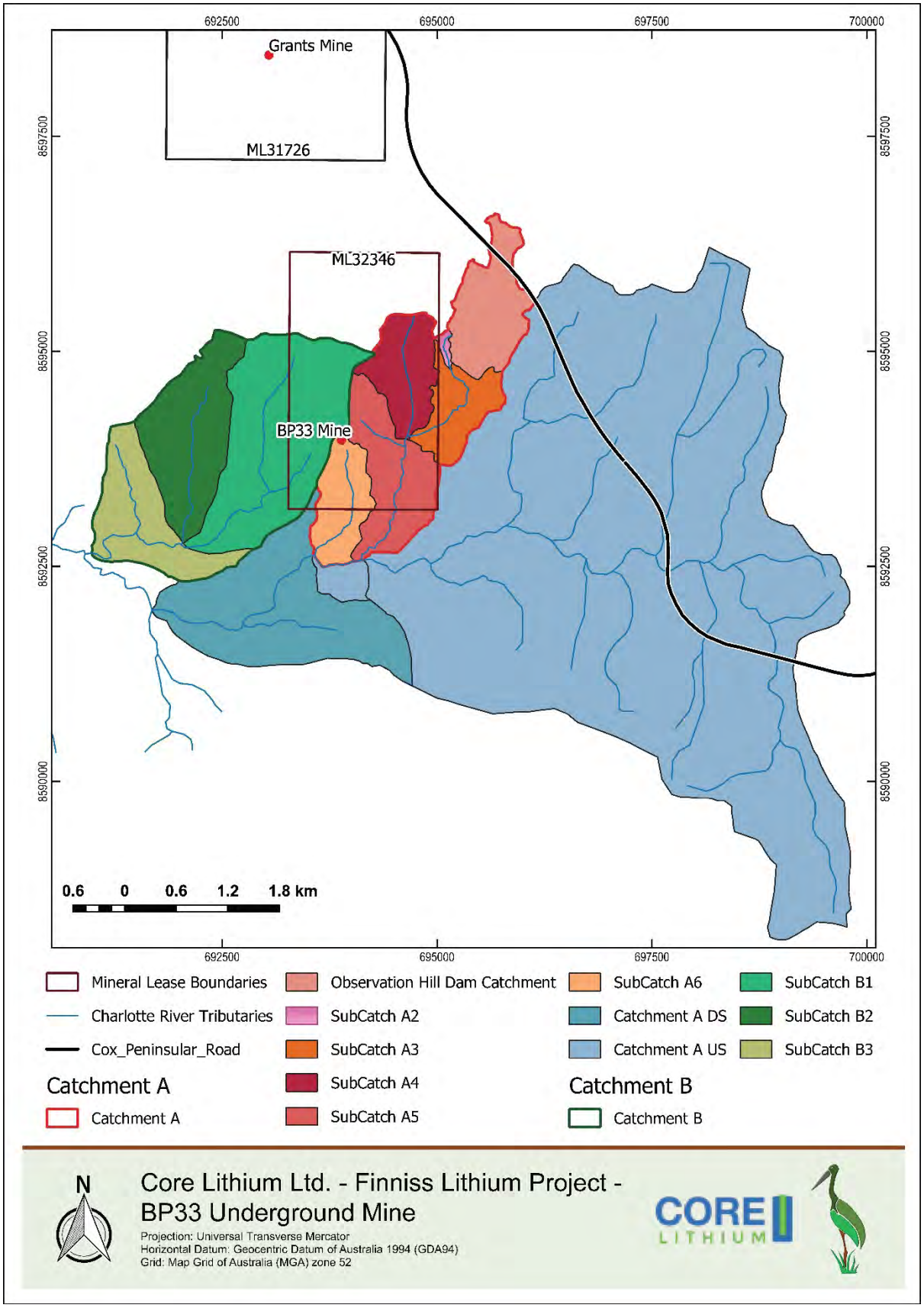



*Figure 2. Layout of the pre-mine catchments delineated for this study.*

*Table 1 Catchment areas and locations pre-mine (based on MGA Zone 52).*

| Catchment | Area (ha) | Catchment Outlet | |
|---|---|---|---|
| | | Easting (m) | Northing (m) |
| A2 | 4.7 | 695162 | 8594791 |
| A3 | 74.7 | 694634 | 8593975 |
| A4 | 69.4 | 694683 | 8593970 |
| A5 | 111.7 | 694084 | 8595229 |
| A6 | 78.6 | 693579 | 8592637 |
| A upstream | 2382.6 | 693573 | 8592615 |
| A downstream | 291.5 | 691686 | 8591979 |
| B1 | 303.0 | 692050 | 8592746 |
| B2 | 169.8 | 692050 | 8592746 |
| B3 | 134.0 | 690989 | 8592637 |

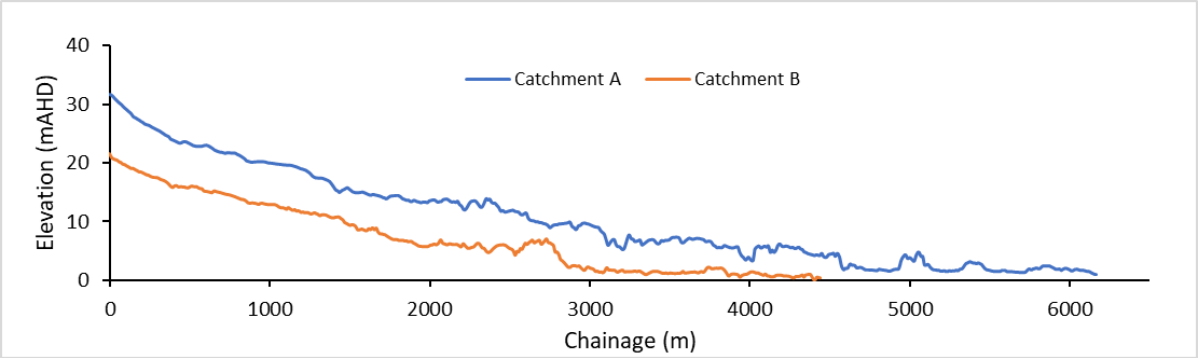



*Figure 3. Long-section of the thalwegs of the catchments intersected by ML 32346.*

# 3 Existing Site Hydrology

Information available for this project is listed below:

- GIS-based topographic information, which provided information on waterways and waterbodies, the location of proposed infrastructure and ML(A)32346,
- A 10m digital elevation model was purchased from the Northern Territory Government (NTG) and this allowed delineation of catchments and streamlines,
- A 0.5m pre-mining and infrastructure DEM provided by Core,
- ESRI Satellite (ArcGIS/World Imagery) aerial photography accessed through Quantum GIS,
- Silo rainfall data, and
- Online storm tide inundations maps for Darwin Harbour and Bynoe Harbour.

## 3.1 Regional Rainfall and Evaporation

SILO data from 1971 to 2018 were used for surface water modelling to maintain consistency with previous surface water modelling (EnviroConsult Australia Pty Ltd, 2018a). Only 24-hour rainfall from SILO were available. SILO products provide national coverage, mostly based on BOM data, with interpolated infills for missing data and the rainfall data. At the location coordinates, 694081m East, 8594222m North, GDA94/MGA52, used in this study, data are interpolated.

The average monthly rainfalls and evaporation based on SILO data at the Core site are shown in *Figure 4*.

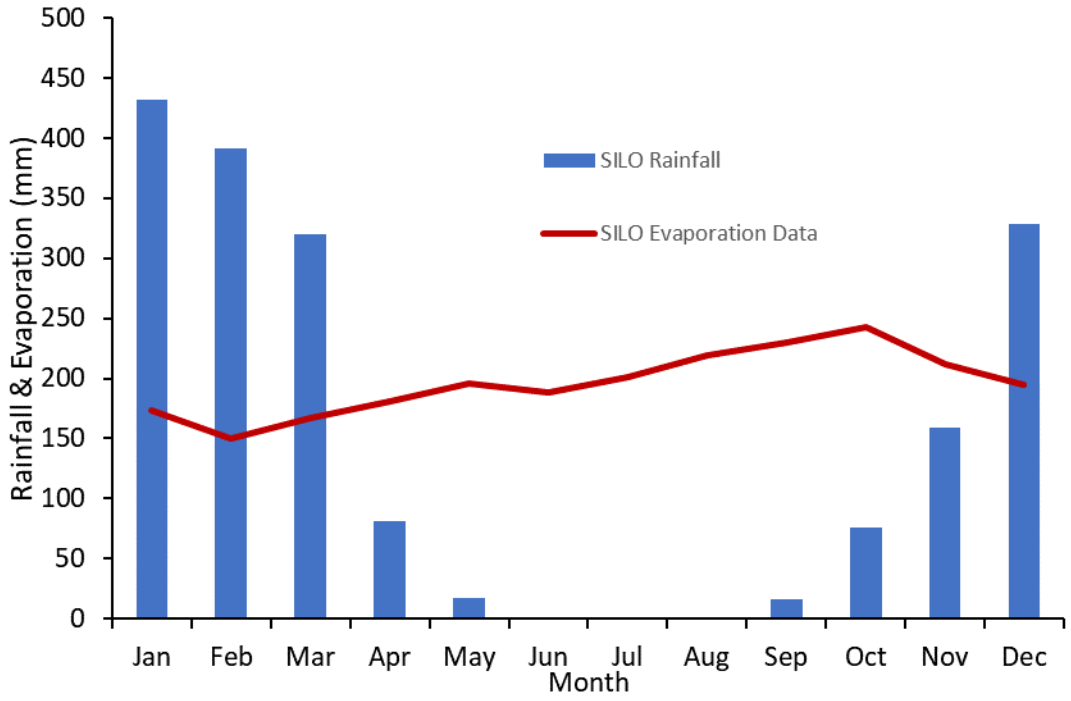



*Figure 4 Average monthly rainfall and evaporation for SILO data from 1971 to 2018 for the Core site.*

## 3.2 Design Rainfall Events

Inundation risk modelling for a 1%AEP[1] rainfall event will be used for the flood inundation modelling. The 2019 Intensity–Frequency–Duration (IFD) design rainfalls for the site are provided by the BOM for use in conjunction with the 2019 edition of Australian Rainfall and Runoff (ARR2019, http://arr.ga.gov.au/arr-guidelines) to derive the probable rainfall runoff characteristics of such events required for the inundation risk modelling. The derivation of the design event was completed using the hydrologic model, RORB.

*Figure 5* shows the more frequent event IFD curves used for derivation of the design event.

[1] This is the current terminology recommend by Engineers Australia for the return interval of rainfall events. 1%AEP is 1 in 100 or Q100 and 0.1%AEP is 1 in 1000 or Q1000.

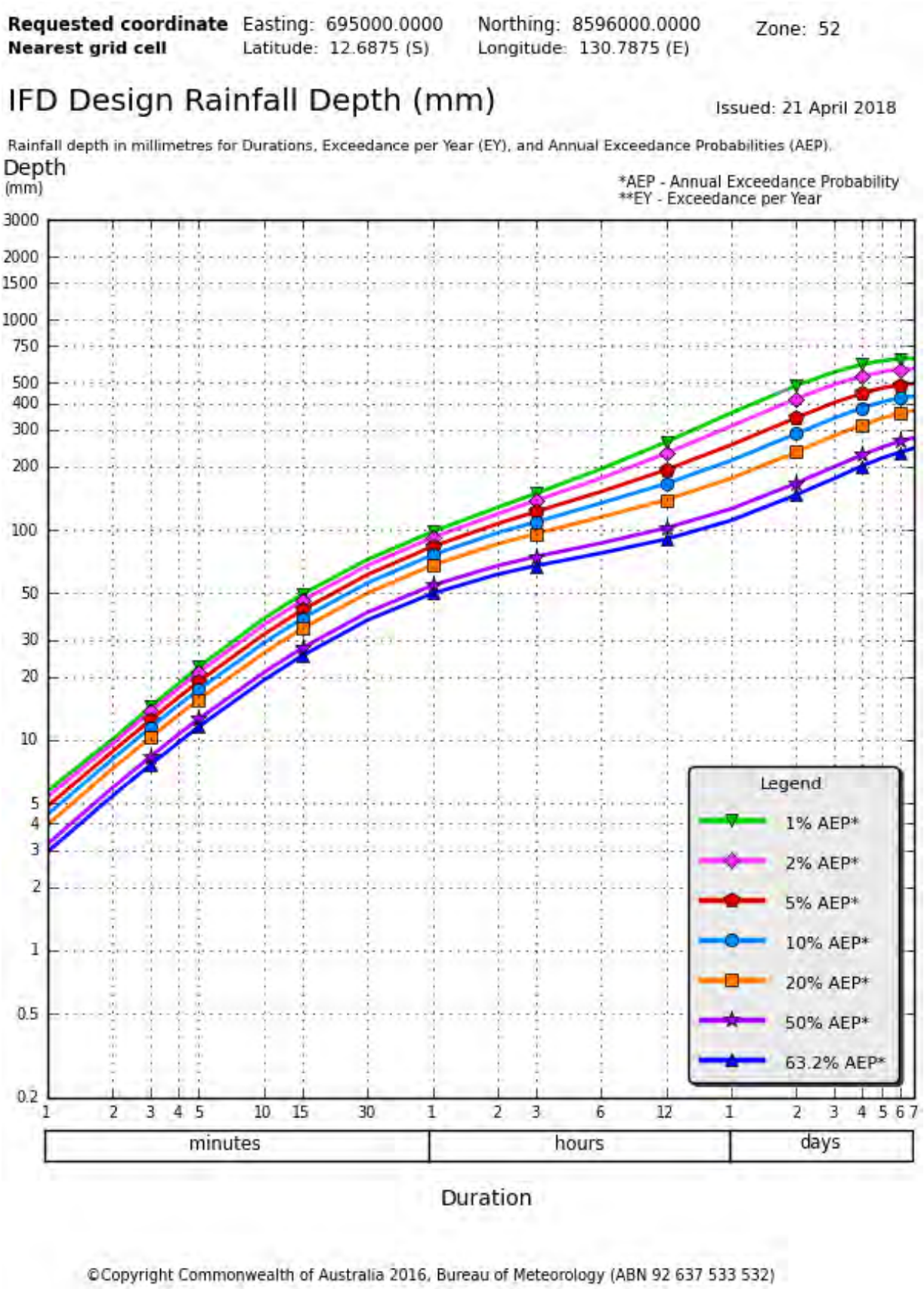



*Figure 5. BOM intensity, frequency, duration curves for design rainfall up to a 1%AEP event at ML 32346.*

## 3.3 The Observation Hill Dam

The Observation Hill Dam (OHD) is in the upper reaches of Catchment A draining towards Bynoe Harbour (*Figure 2*). This dam has been previously described (EnviroConsult Australia Pty Ltd, 2018c).

## 3.4 Storm Surge

Storm surge data are available from the NTG for Darwin Harbour and parts of Bynoe Harbour. The Bynoe Harbour data were reported by $CO_2$ Australia and Seafarms, in their environmental assessment report to the NTEPA for commercial development (https://ntepa.nt.gov.au/__data/assets/pdf_file/0020/382403/draft_eis_seadragon_core_breeding_centre_appendix_17_water_tech_reports.pdf). Storm tide heights for the primary surge 1%AEP and secondary surge 0.1%AEP events are shown in *Table 2*. Storm surge extents for the 2010 and 2100 primary storm surge are shown in *Figure 6.*

*Table 2. Storm surge levels in Bynoe Harbour.*

| Year | Bynoe Harbour | |
|---|---|---|
| | Primary storm tide (mAHD) | Secondary storm tide (mAHD) |
| 2010 | 3.7 | 4.7 |
| 2050 | 4.1 | 5.6 |
| 2100 | 4.6 | 6.2 |

*Figure 6* shows that there is little penetration of the storm surge into mine affected catchments apart from a small amount in the lower tidal reaches. The level of the 2100 primary storm tide is 4.6mAHD. The outlet of mine affected catchments in Catchment A is at ≈5.4mAHD, and Catchment B is at ≈2.9mAHD. The highest astronomical tide (HAT) at Burge Point is 3.6mAHD. The lowest point in the proposed mine infrastructure in 23mAHD at the southwest corner of the boxcut bund and is ≈2km upstream from the storm tide level in Charlotte River. So, it is unlikely that storm surge will affect the proposed mine infrastructure and ML(A)32346.

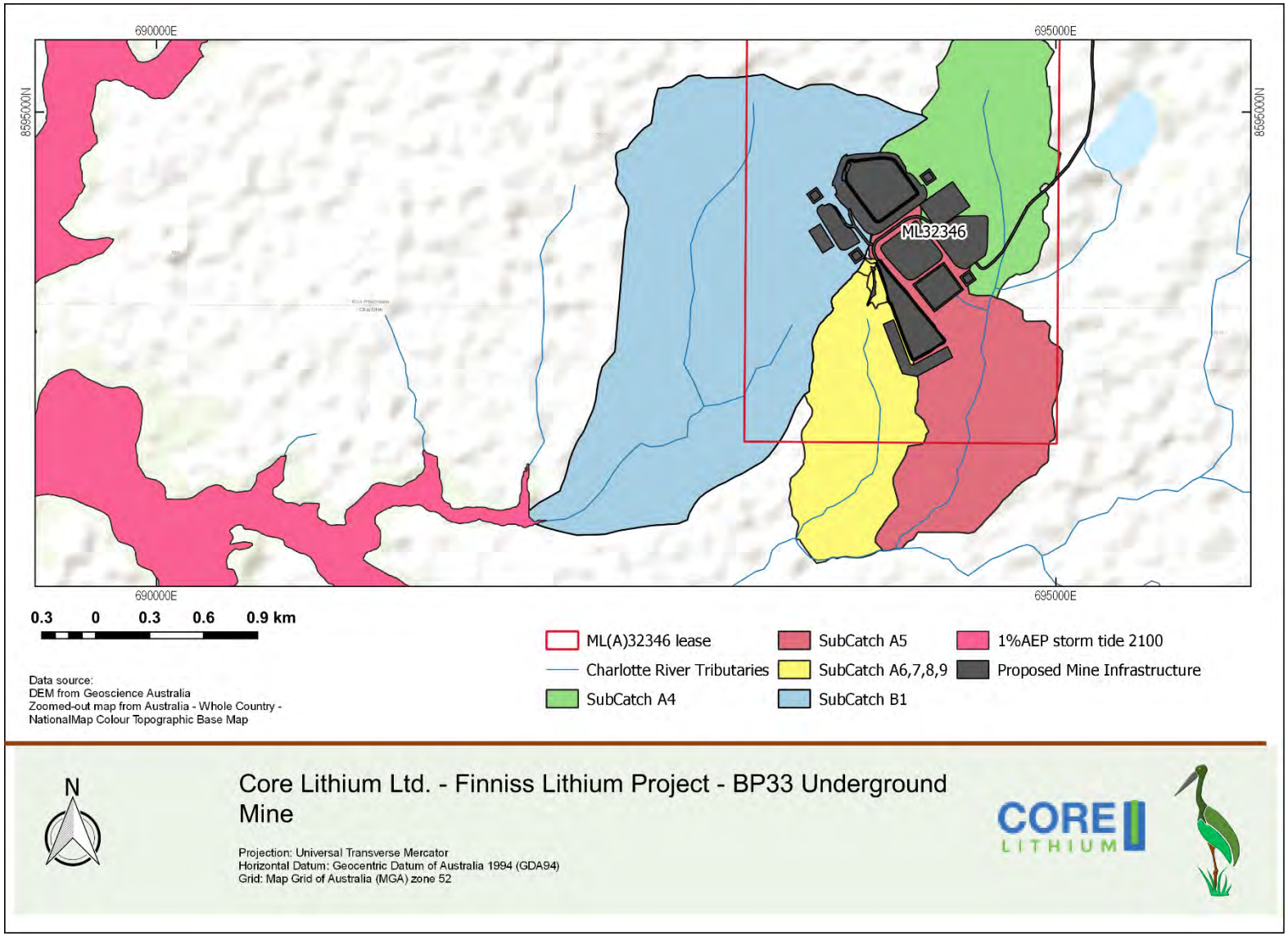



*Figure 6. Estimated 2100 1%AEP surge inundation extent near the outlets of Catchments A and B.*

# 4 Catchment hydrology

## 4.1 Introduction

This section assesses the effects of the mine site infrastructure on catchment hydrology. In this study, a HEC-HMS model was used to determine changes to environmental flow and discharge caused by the proposed mine infrastructure. The HEC-HMS model was previously calibrated and validated (EnviroConsult Australia Pty Ltd, 2018a; EnviroConsult Australia Pty Ltd, 2018b) and input parameters values determined.

### 4.1.1 Methodology

The methods used where:

1. Delineation of the sub-catchments for the mine affected catchments using the Quantum Geographic Information System (QGIS),
2. Applying the calibrated hydrology model, HEC-HMS (EnviroConsult Australia Pty Ltd, 2018a) to the mining lease and environs to determine rainfall runoff volumes for the ML(A) for the pre-mining topographic condition for a low, average and high rainfall year,
3. For the same rainfall scenarios, applying HEC-HMS to the proposed mine construction topography i.e. including the boxcut, waste rock dump, bund/haul road and run-of-mine pad to assess changes in catchment hydrology due to the mine infrastructure.

### 4.1.2 Simulation scenarios

Using the HEC-HMS model, 3 annual rainfall scenarios were simulated:

- Low rainfall year (1st January to 31st December 1979)
- High rainfall year (1st January to 31st December 2011)
- Average rainfall year (1st January to 31st December 1991)

SILO 24-hour rainfall data was used. Each simulation was run including antecedent rainfall from 1st July to 31st December the previous year to include the entire wet season and thereby account for saturation of the catchment at the time the annual rainfall starts (refer to EnviroConsult Australia Pty Ltd, 2018 for details). For example, for 1979 the rainfall input was from 1 July 1978 to 31 December 1978 and then 1979 was run. The total annual rainfall for each scenario is shown in *Table 3*.

*Table 3. Selected low, average and high rainfall years.*

| Rainfall scenario | Total Rainfall (mm) | Annual Exceedance Probability | Probability of an equal or lower annual rainfall depth occurs in a 5-year period |
|---|---|---|---|
| Low rainfall year (1979) | 919 | 0.99 | 0.05 |
| Average rainfall year (1991) | 1652 | 0.50 | 0.97 |
| High rainfall year (2011) | 2766 | 0.01 | 1.00 |

The monthly evaporation as listed in Section 3.1 was applied to each catchment and a daily seepage rate of 2.3 mm/day (EnviroConsult Australia Pty Ltd, 2018b) was applied to the Boxcut.

### 4.1.3 Catchment Delineation

The calibrated HEC-HMS model was used to simulate surface water discharge for all catchments intersected by ML(A) 32346 and relevant upstream catchments for the low, average and high rainfall years.

The pre-mining catchments are shown in *Figure 7*. Red dots (*Figure 7*) indicate locations where the total discharge was determined using HEC-HMS (see Section 4.2). The catchments were delineated using QGIS and a 10m digital elevation model (DEM) provided by the NTG.

The mining infrastructure catchment delineation and changed flow paths are shown in *Figure 8.* The only change was made to sub-catchments directly bordering mine infrastructure, all other catchments remain as displayed in *Figure 7*. The mining DEM, the DEM for the mine infrastructure: boxcut, waste rock dump, topsoil store, bund, contractor area and the run-of-mine (RoM) pad, was supplied by Core. Changes to catchment areas and outlet locations are shown in *Table 4*.

The total area covered by infrastructure is ≈31.4ha only about 3.3% of study catchments (946ha). The conceptual design includes best practice procedures for all infrastructure to be water-shedding structures and retention of all water on site. These methods include diversion banks, water channels and sediment retention basins. In reality, not all rainfall on the infrastructure will be retained and especially during the wet season some run-off will occur. However, the actual runoff volume directly depends on the design (i.e. storage volume) of the ponds and dams. As the design is only conceptual at this point, all hydrological model simulations were run assuming that all rainfall on the infrastructure is retained and there is no direct runoff from the infrastructure to undisturbed parts of the catchments. For simulations it was assumed that the boxcut was empty at the start of simulations and that all direct rainfall to the boxcut was lost from the system. But the model treated the water as being stored in the boxcut.

The HEC-HMS models are shown in Appendix A.

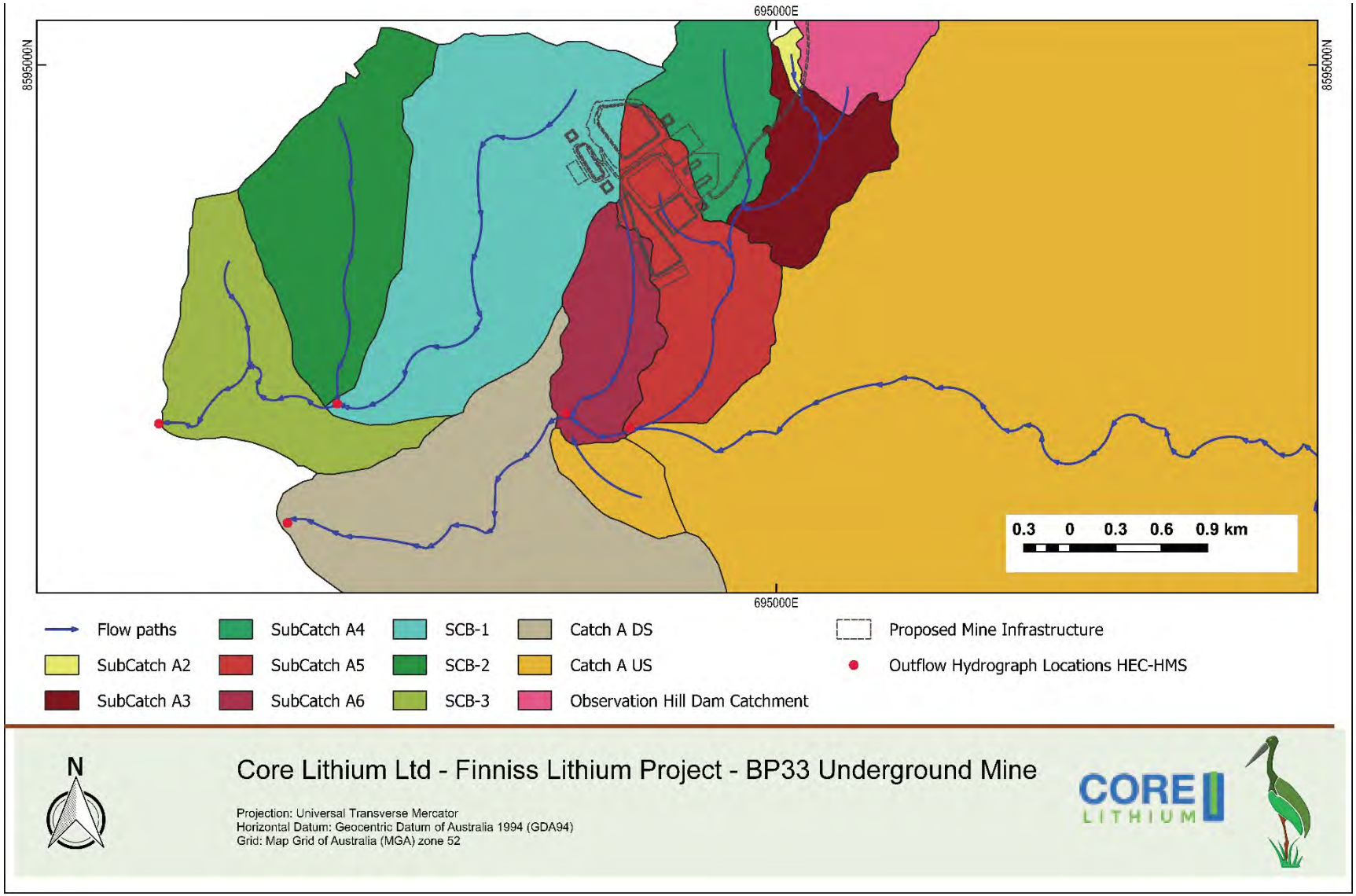



*Figure 7. Pre-Mine flow paths and sub-catchments*

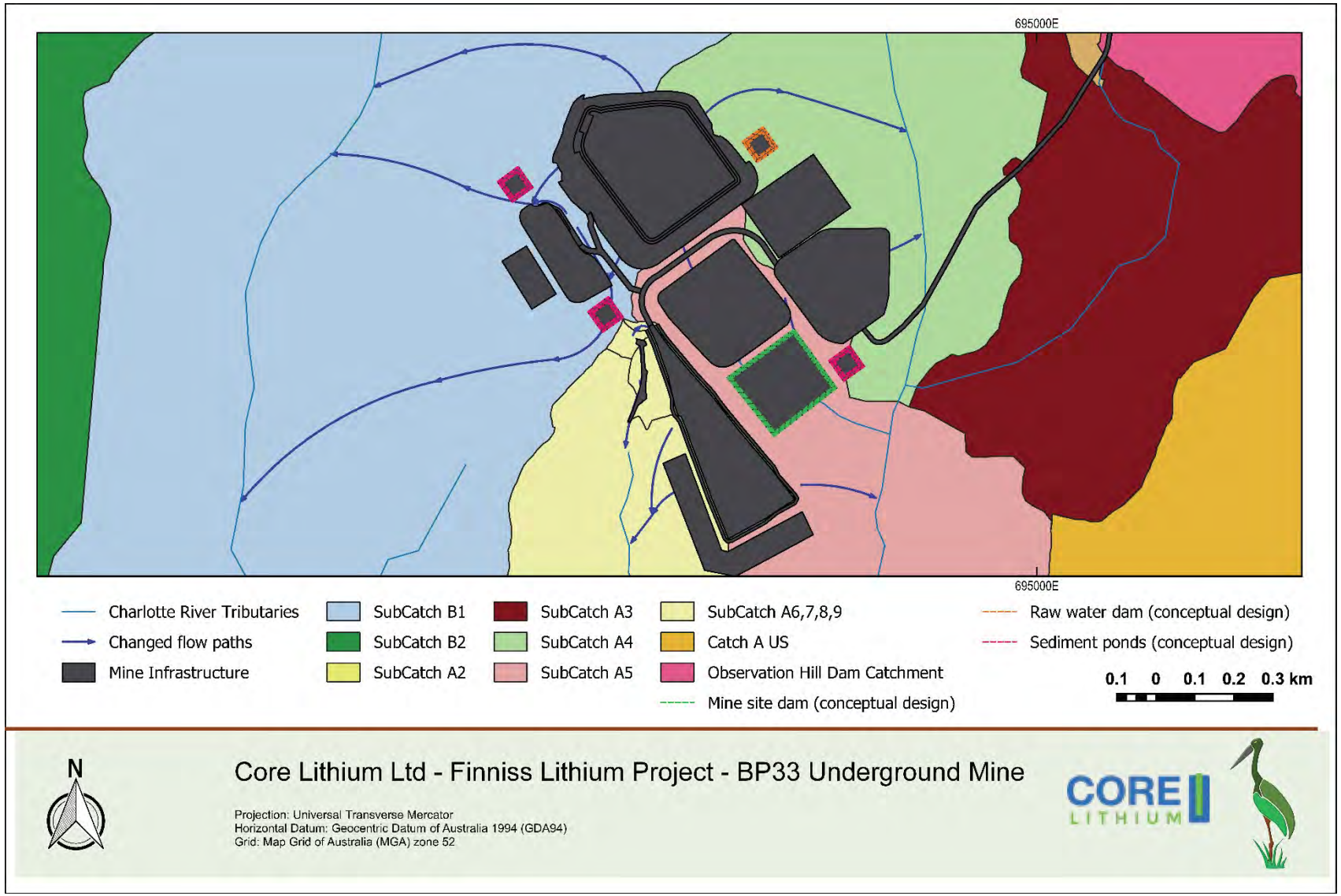



*Figure 8. Catchments affected by mine infrastructure, changed flow paths and location of mine infrastructure*

*Table 4 Catchment areas and locations (based on MGA Zone 52).*

| Catchment | Area (ha) | | Catchment Outlet Premining | | Catchment Outlet with mining | |
|---|---|---|---|---|---|---|
| | Pre-mining | With infrastructure | Easting (m) | Northing (m) | Easting (m) | Northing (m) |
| A2 | 4.7 | 4.7 | 695162 | 8594791 | 695162 | 8594791 |
| A3 | 74.7 | 74.7 | 694634 | 8593975 | 694634 | 8593975 |
| A4 | 69.4 | 95.2 | 694683 | 8593970 | 694683 | 8593970 |
| A5 | 111.7 | 111.7 | 694084 | 8595229 | 694084 | 8595229 |
| A6 | 78.6 | 0.15 | 693579 | 8592637 | 694014 | 8594171 |
| A7 | - | 5.5 | - | - | 693965 | 8594095 |
| A8 | - | 1.6 | - | - | 693997 | 8593915 |
| A9 | - | 78.8 | - | - | 693579 | 8592637 |
| A upstream | 2382.6 | 2382.6 | 693573 | 8592615 | 693573 | 8592615 |
| A downstream | 291.5 | 291.5 | 691686 | 8591979 | 691686 | 8591979 |
| B1 | 303.0 | 302.5 | 692050 | 8592746 | 692050 | 8592746 |
| B2 | 169.8 | | 692050 | 8592746 | 692050 | 8592746 |
| B3 | 134.0 | | 690989 | 8592637 | 690989 | 8592637 |
| Boxcut & bund | - | 7.3 | - | - | 694014 | 8594171 |

## 4.2 Simulation Results

### 4.2.1 Annual Catchment Discharges

Annual discharge was simulated at the outlet of the main catchments (Catchment A and B) and at relevant points within the catchments (*Figure 7 and Figure 8*). *Table 5*, *Table 6* and *Table 7* show the resulting total annual outflow volumes for pre-mining and mining conditions at the measured points for the wet, dry and average rainfall years respectively. *Figure 9* to *Figure 14* show the simulated hydrographs relative to rainfall at the outlets of catchment A and B for the pre-mining and mining scenarios.

The results indicate that the proposed mine infrastructure has little impact on the natural flow regimes. There is a slight decrease in total flow volume at the outlet of Catchment B for the mining scenario of around 2% for all rainfall scenarios, when compared to pre-mining conditions. The results for the mining scenario at the outlet of Catchment A also show a small decrease in total flow volume of around 1% for all rainfall scenarios when compared to pre-mining conditions. Compared to the overall flow volume, very little flow is stored in the boxcut (on average 0.26% of the total flow).

The reduction in flow volume is mainly due to water being retained on site in sediment ponds and the boxcut. As indicated above the percentage in flow reduction at the catchment outlets is minimal and appears to have no significant impact on the natural flow regime.

*Table 5. Results of catchment hydrology modelling for the wet year scenario.*

| Outflow Location | Drainage Area ($km^2$) | | Pre-Mine | | During Mining | |
|---|---|---|---|---|---|---|
| | Pre-Mining | During Mining | Streamflow (ML) | Losses (ML) | Streamflow (ML) | Losses (ML) |
| Catchment A5 | 4.04 | 3.97 | 9744 | 11173 | 9088 | 1885 |
| Catchment A6 | 0.79 | 0.81 | 1971 | 222 | 1956 | 272 |
| Catchment A | 30.99 | 30.92 | 77346 | 8358 | 76639 | 8886 |
| Catchment B1 | 3.03 | 3.02 | 7586 | 794 | 7278 | 1078 |
| Catchment B | 6.07 | 6.06 | 15209 | 1577 | 14910 | 1852 |
| Boxcut | - | 0.08 | - | - | - | 193 |

*Table 6. Results of catchment hydrology modelling for the dry year scenario.*

| Outflow Location | Drainage Area ($km^2$) | | Pre-Mine | | During Mining | |
|---|---|---|---|---|---|---|
| | Pre-Mining | During Mining | Streamflow (ML) | Losses (ML) | Streamflow (ML) | Losses (ML) |
| Catchment A5 | 4.04 | 3.97 | 1738 | 1974 | 1607 | 2039 |
| Catchment A6 | 0.79 | 0.81 | 391 | 337 | 391 | 349 |
| Catchment A | 30.99 | 30.92 | 15344 | 13131 | 15206 | 13210 |
| Catchment B | 6.07 | 6.06 | 3057 | 2520 | 2995 | 2575 |
| Catchment B1 | 3.03 | 3.02 | 1528 | 1257 | 1461 | 1315 |
| Boxcut | - | 0.08 | - | - | - | 59 |

*Table 7. Results of catchment hydrology modelling for the average year scenario.*

| Outflow Location | Drainage Area ($km^2$) | | Pre-Mine | | During Mining | |
|---|---|---|---|---|---|---|
| | Pre-Mining | During Mining | Streamflow (ML) | Losses (ML) | Streamflow (ML) | Losses (ML) |
| Catchment A5 | 4.04 | 3.97 | 4678 | 1995 | 4355 | 2200 |
| Catchment A6 | 0.79 | 0.81 | 988 | 322 | 976 | 354 |
| Catchment A | 30.99 | 30.92 | 38543 | 12644 | 38187 | 12893 |
| Catchment B | 6.07 | 6.06 | 7622 | 2403 | 7462 | 2549 |
| Catchment B1 | 3.03 | 3.02 | 3802 | 1203 | 3645 | 1345 |
| Boxcut | - | 0.08 | - | - | - | 114 |

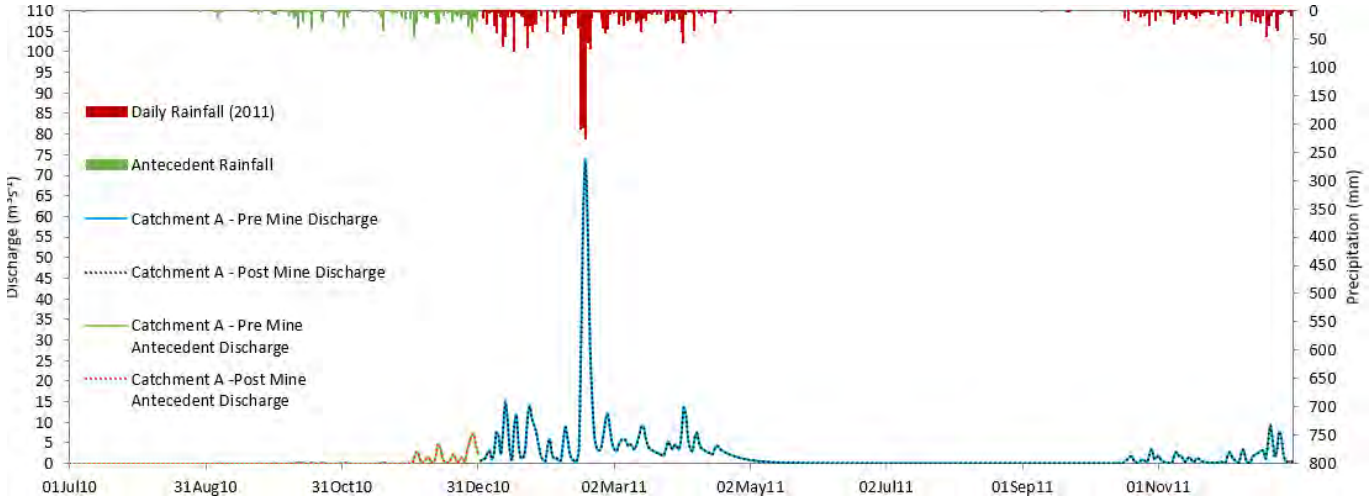



*Figure 9. High rainfall year simulation result – Catchment A*

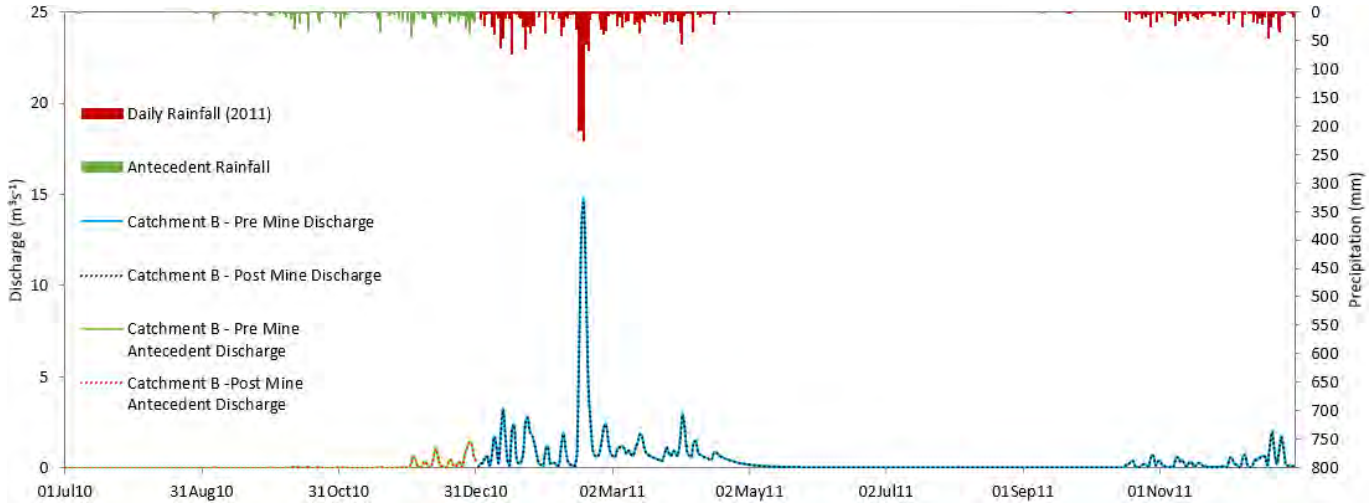



*Figure 10 High rainfall year simulation result – Catchment B*

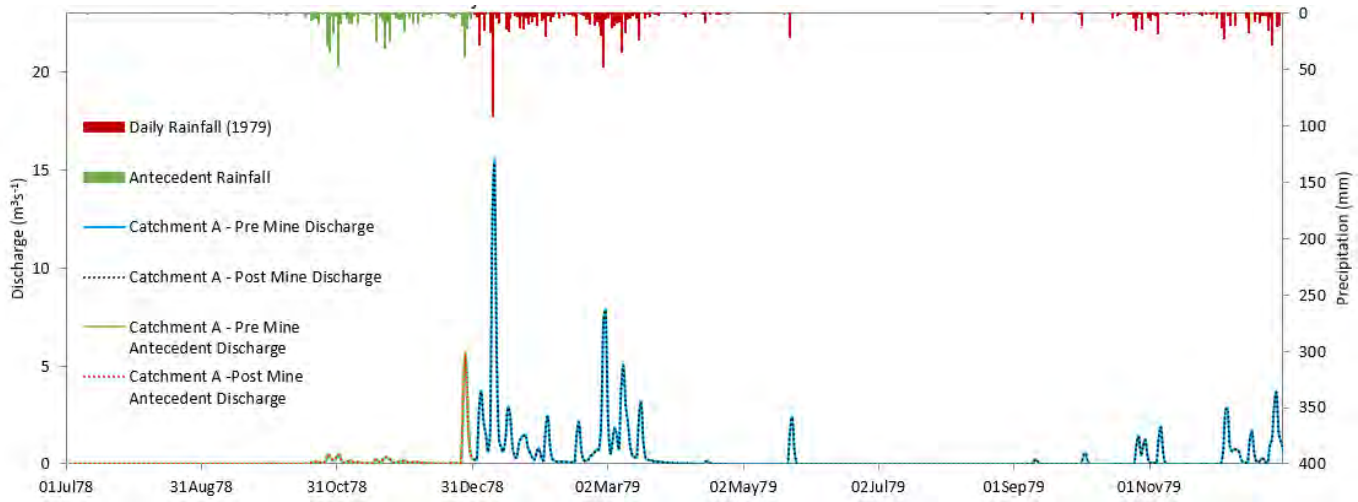



*Figure 11. Low rainfall year simulation result – Catchment A*

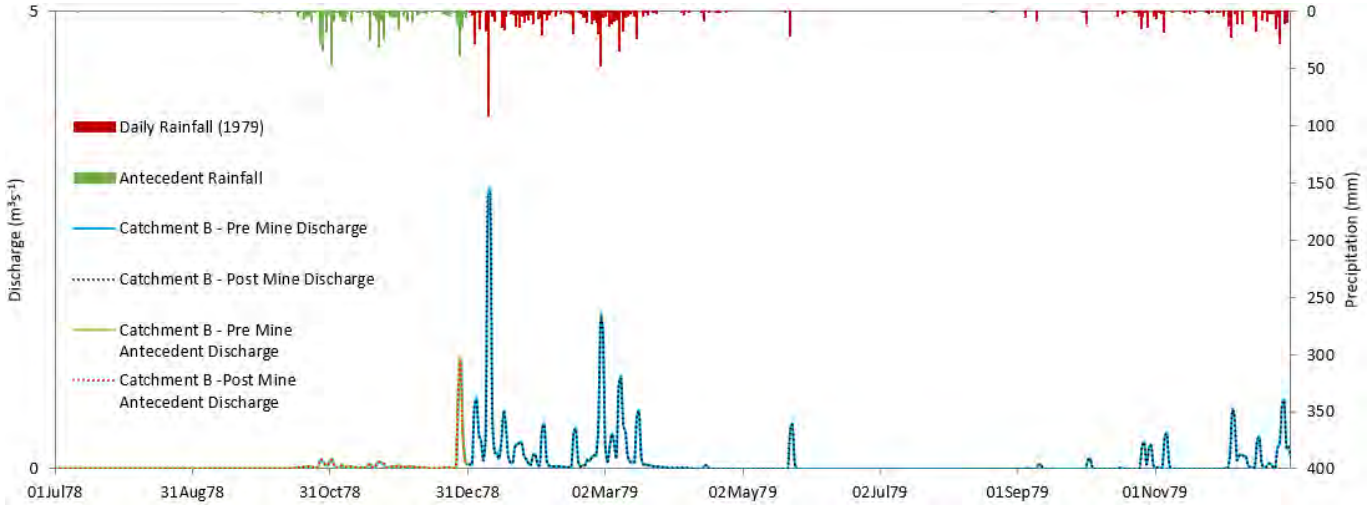



*Figure 12. Low rainfall year simulation result – Catchment B*

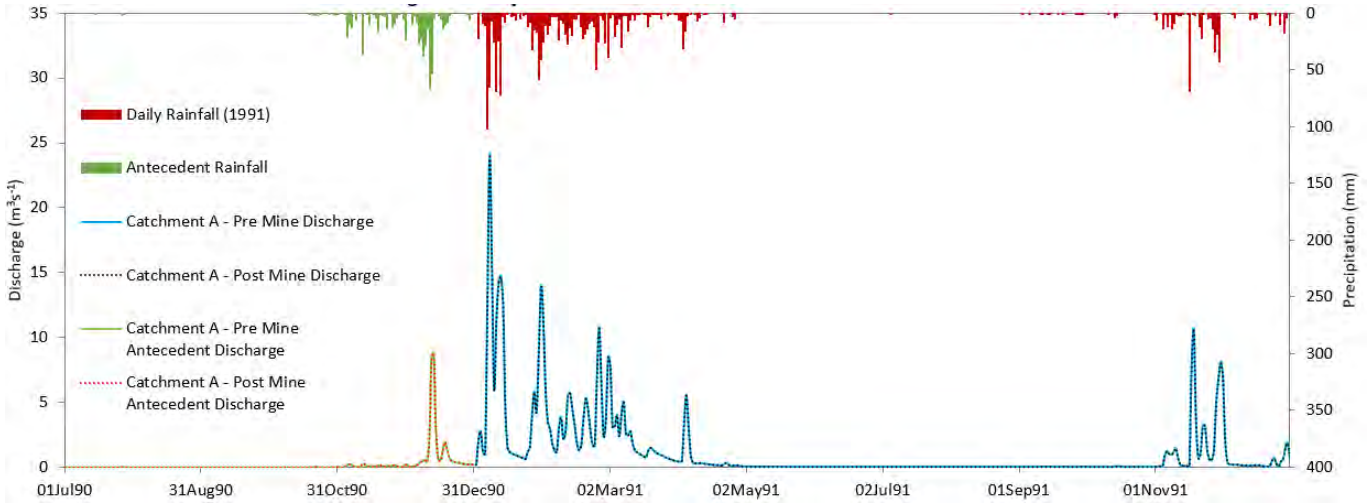



*Figure 13. Average rainfall year simulation result – Catchment A*

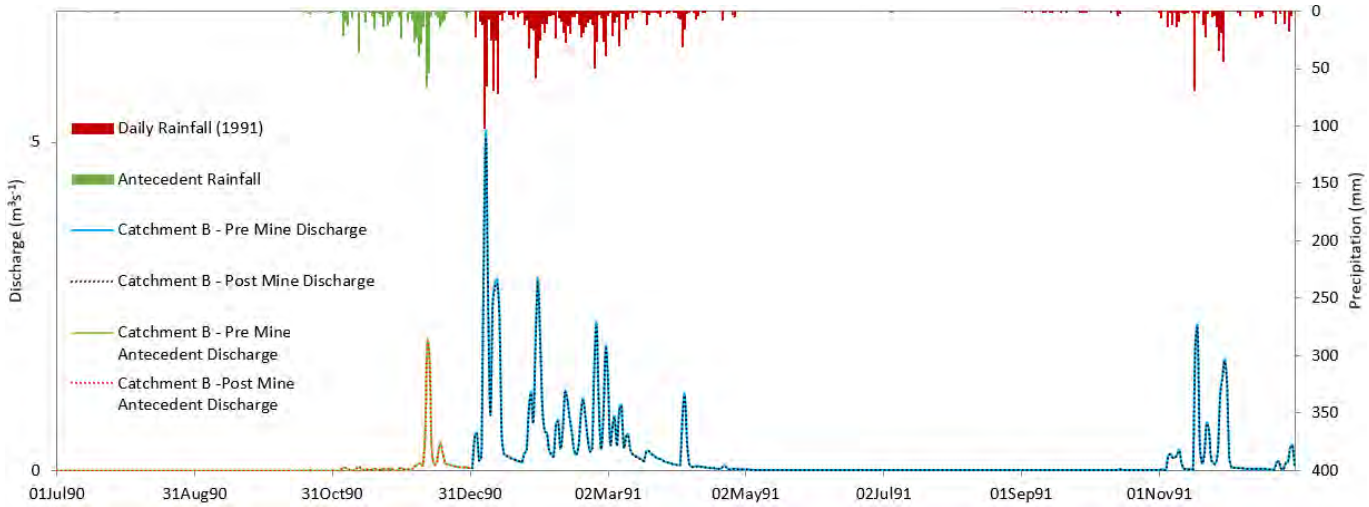



*Figure 14. Average rainfall year simulation result – Catchment B.*

### 4.2.2 Boxcut daily inflows and storage

Figure 15 to Figure 17 show the daily inflows into the Boxcut during the high, low and average rainfall years. The maximum inflow into the Boxcut is 16420 $m^3d^{-1}$ for the high rainfall scenario, 7780 $m^3d^{-1}$ for the average rainfall scenario and 6920 $m^3d^{-1}$ for the low rainfall scenario. On average, the inflows into the boxcut during the high, average and low rainfall years are 440 $m^3d^{-1}$, 270 $m^3d^{-1}$ and 157 $m^3d^{-1}$ respectively. Most of this inflow is caused by direct rainfall on the boxcut. Very little inflow occurs from upstream catchment A9 along the boxcut entrance.

Figure 18 to Figure 20 show the water stored in the boxcut and the water surface elevation in the boxcut during the three rainfall scenarios during periods of rainfall and evaporation. The maximum water stored in the boxcut is 203 000 $m^3$ for the high rainfall scenario, 120 830 $m^3$ for the average rainfall scenario and 74 660 $m^3$ for the low rainfall scenario. For the high rainfall scenario, the maximum water level rises to 31.3 above the boxcut base level. The maximum water depth for the average and low rainfall scenario is 25.3 m and 21.0 m.

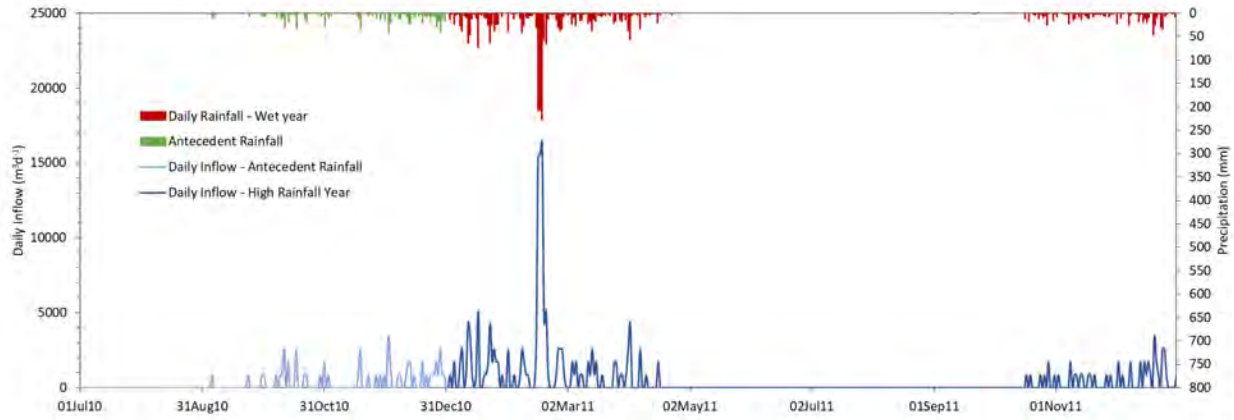



*Figure 15. Daily Inflow into the Boxcut for the high rainfall year scenario*

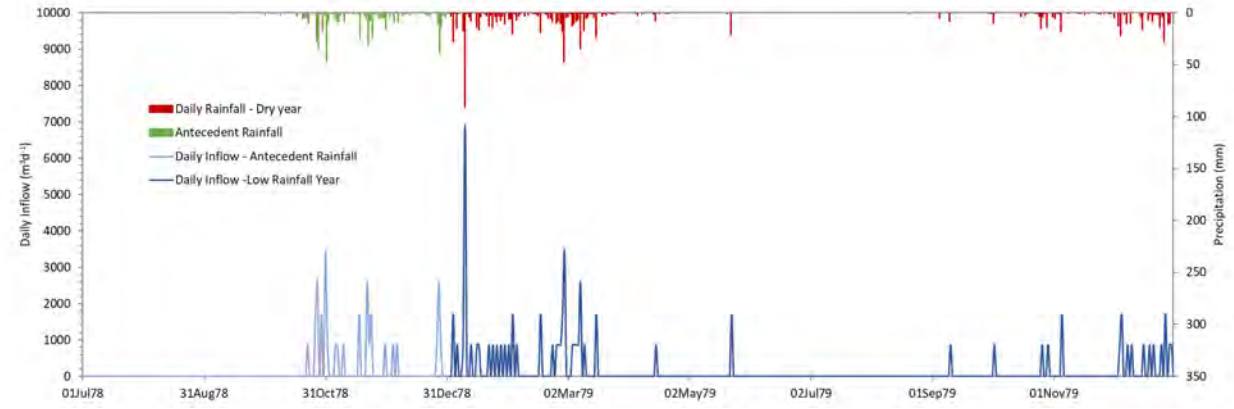



*Figure 16. Daily inflow into the Boxcut for the low rainfall year scenario*

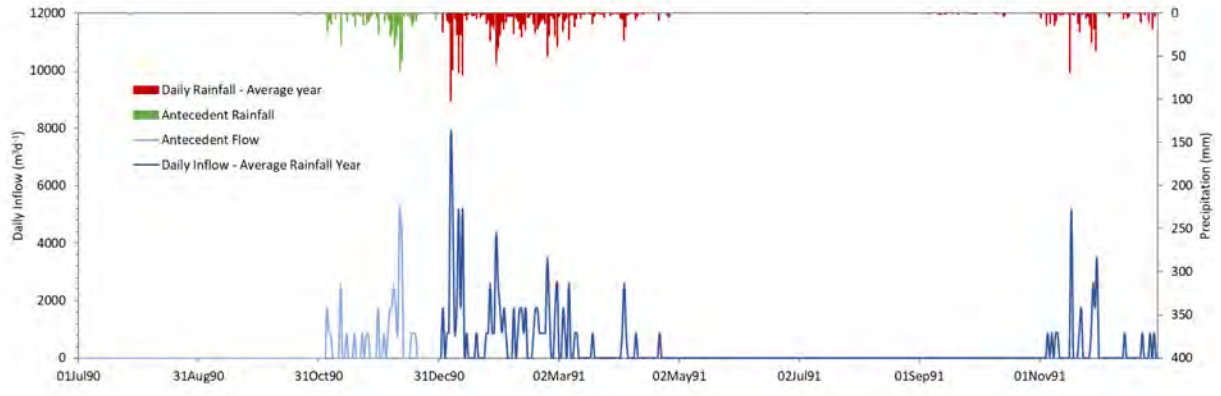



*Figure 17. Daily inflow into the Boxcut for the average rainfall year scenario*

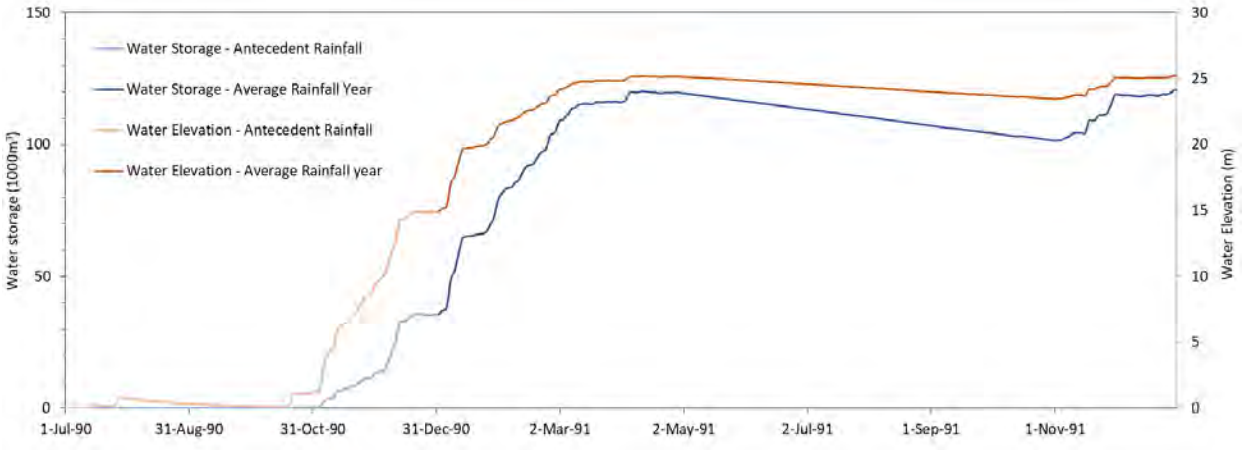



*Figure 18. Water Storage and Elevation in the Boxcut for the high rainfall year scenario*

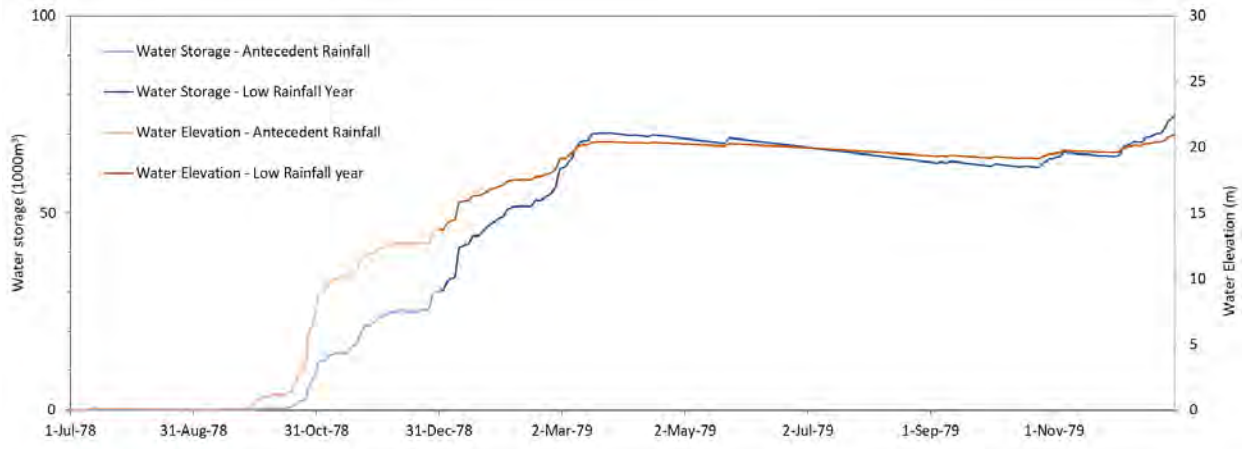



*Figure 19. Water Storage and Elevation in the Boxcut for the low rainfall year scenario*

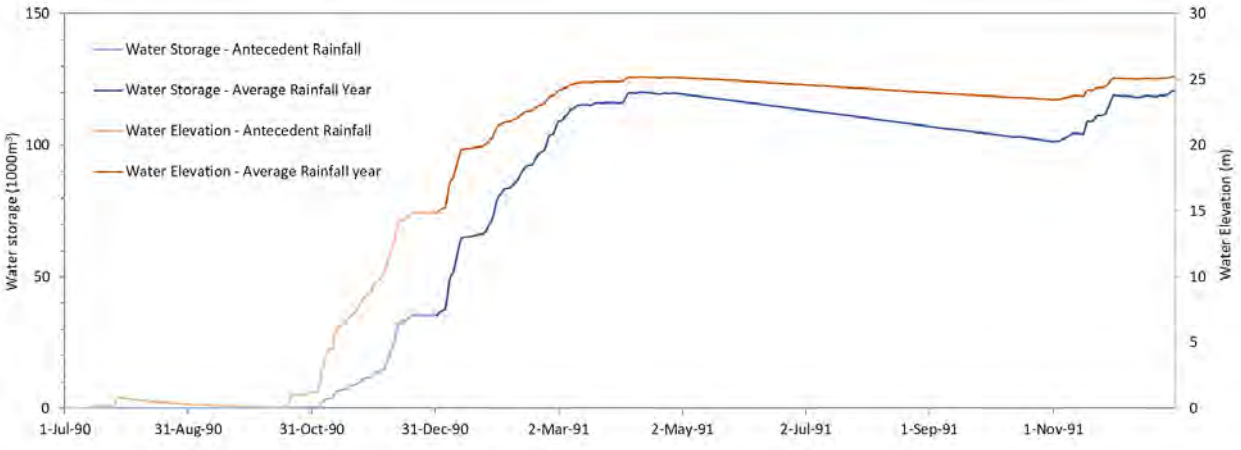



*Figure 20. Water Storage and Elevation in the Boxcut for the average rainfall year scenario*

# 5 Flood Inundation Modelling

A 1%AEP (Annual Exceedance Probability) rainfall event was used to assess flood inundation in the mine affected catchments. Two models are used for this analysis. The first is the RORBwin hydrology model which uses *Monte Carlo* simulations to determine rainfall and runoff causing the most probable peak discharge (Q) for the studied AEP event. The second is the HEC-RAS hydrodynamic model which uses the RORBwin output hydrographs and RORBwin most probable rainfall hyetograph to simulate flood inundation across the affected catchments.

## 5.1 Methodology

Methods used were:

1. Determine the hydrology of the undisturbed catchments (*Figure 7*) for a 1%AEP rainfall event,
2. Determine the hydrodynamic flow in the mine infrastructure catchments (*Figure 8*) for a 1%AEP rainfall event,
3. Compare the extent of inundation caused by a 1%AEP event in the pre-mining and mining catchments.

## 5.2 Digital Elevation Model

The following terrain data were available to use for simulations:

1. A pre-mining Cox Peninsula Northern Territory Government 10m digital elevation model (DEM) (EnviroConsult Australia Pty Ltd, 2018b) which was extended for this study,
2. A 0.5m DEM for the mine infrastructure comprising boxcut, waste landform (WL), contractors' area, run of mine pad (RoM) provided by Core Lithium Ltd, and
3. A 1m pre-mining DEM provided by Core Lithium Ltd.

## 5.3 Derivation of the 1%AEP hydrograph

A 1%AEP (annual exceedance probability) rainfall event is a recommended design event for major developments and roadways. For ungauged catchments, a probabilistic method to determine storm duration and intensity is recommended. RORBwin uses *Monte Carlo* simulations to determine critical duration and temporal distribution of the rainfall event causing the probable peak discharge (Q) for the design event in the catchment of interest.

### 5.3.1 RORBwin

RORB hydrological modelling was conducted to determine the 1% AEP inflows form undisturbed areas to the HEC-RAS mesh area. RORB is a runoff and streamflow routing program that calculate flood hydrographs from rainfall depths. The model is aerially distributed, nonlinear, and applicable to both urban and rural catchments.

The runoff catchments in *Figure 2* (pre-mine catchment) were divided into smaller sub-catchments to develop runoff routing networks for RORB modelling. *Figure 21* below presents the sub-catchments and runoff routing networks for RORB modelling. The sub catchment areas are summarized in *Table 8* below.

*Table 8 RORB sub-catchment areas*

| Catchment | Area (Ha) | Catchment | Area (Ha) | Catchment | Area (Ha) |
|---|---|---|---|---|---|
| **E1** | 464 | **N2** | 26 | **N4** | 16 |
| **E2** | 118 | **N3** | 17 | **N9** | 25 |
| **E3** | 71 | **N5** | 31 | **N6** | 89 |
| **E4** | 115 | **N7** | 10 | **N8** | 22 |
| **E5** | 375 | **S1** | 32 | **C1** | 37 |
| **E6** | 338 | **S2** | 114 | **C4** | 19 |
| **E7** | 308 | **S3** | 159 | **C5** | 62 |
| **E8** | 255 | **W1** | 329 | **C3** | 13 |
| **E9** | 322 | **W2** | 196 | **C2** | 70 |
| **N1** | 43 | **W3** | 112 | **-** | - |

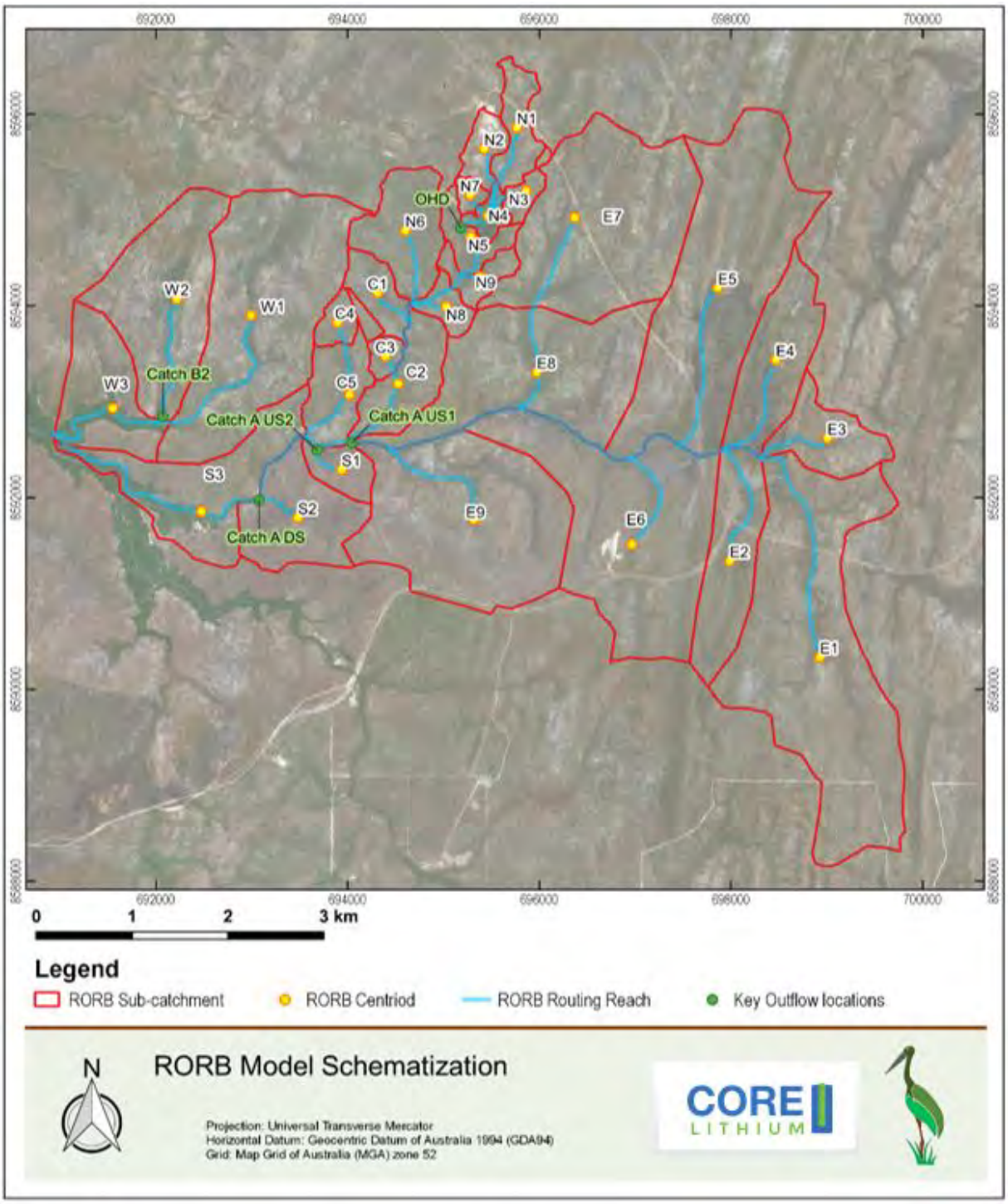



*Figure 21. RORB Model Schematization*

### 5.3.2 Design Rainfall

Design rainfall depths, temporal patterns and Areal Reduction Factors (ARF) for the 1% AEP storm events were sourced from the Australian Rainfall and Runoff (ARR 2016) online data hub.

*Table 9* shows the 1% AEP design rainfall depths for various storm durations.

*Table 9 1% AEP design rainfall depths*

| Storm event duration | Rainfall depth (mm) | Storm event duration | Rainfall depth (mm) |
|---|---|---|---|
| **1.5 hour** | 114 | **12 hour** | 260 |
| **2 hour** | 127 | **18 hour** | 312 |
| **3 hour** | 148 | **24 hour** | 356 |
| **4.5 hour** | 173 | **30 hour** | 393 |
| **6 hour** | 194 | **36 hour** | 426 |
| **9 hour** | 229 | **48 hour** | 481 |

### 5.3.3 RORB model parameters

The rainfall losses are modelled using an initial loss and a continuing loss parameter. The catchment storage and attenuation effect were determined by a $K_C$ parameter and the length of RORB reaches. The catchment linearity was represented by a m parameter. In the absence of good quality at-site gauging data for calibration the regional rainfall losses are sourced form ARR (Ball, et al., 2019) online data hub. The RORB routing parameter Kc was estimated using the regional equation recommended by RORB (Pearse, 2002). The adopted parameter values are in *Table 10*.

*Table 10 Adopted RORB model parameter values*

| Parameter | Adopted value |
|---|---|
| **Initial loss (IL)** | 39 mm/hr |
| **Continuing loss (CL)** | 5 mm/hr |
| **$K_C$** | 7.96 |
| **m** | 0.8 (default) |

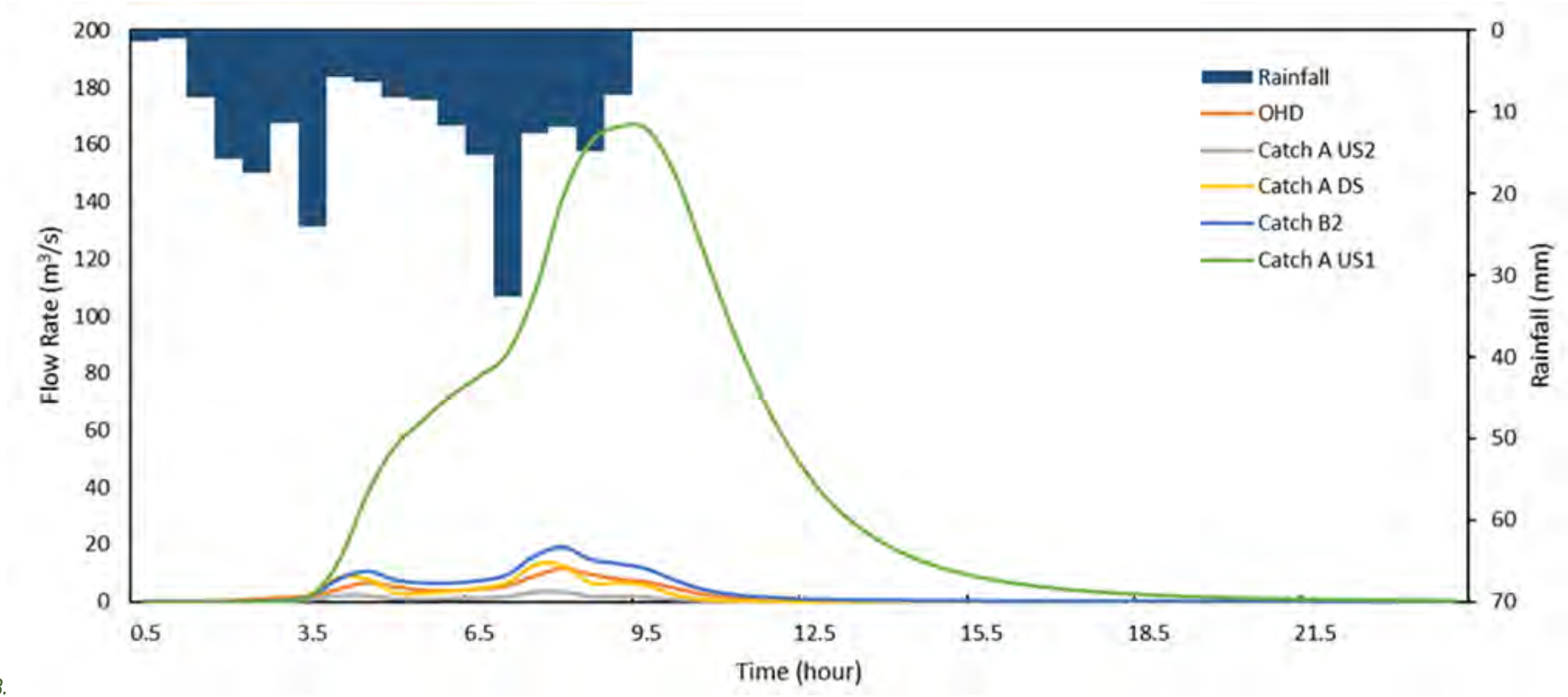
### 5.3.4 Design flood hydrograph simulation

The 1% AEP design flood was determined using RORB *Monte Carlo* simulations. Many simulations were conducted. For each simulation, the input parameters (rainfall losses and temporal patterns) were varied randomly to consider the natural variability of rainfall and catchment conditions. Review of the *Monte Carlo* simulation results at key outflow locations (*Figure 21*) indicate the critical storm duration for the mining site location is 9 hours. The 1% AEP 9-hour storm event *Monte Carlo* Peak discharges at the key outflow locations are summarised in *Table 11* below.

*Table 11 1% AEP 9-hour storm event Mote Carlo Peak discharges at the key outflow locations*

| Location | Peak flow ($m^3/s$) |
|---|---|
| **OHD** | 13.4 |
| **Catch A US1** | 177.1 |
| **Catch A US2** | 5.2 |
| **Catch A DS** | 19.0 |
| **Catch B2** | 22.7 |

Ensemble simulations were conducted for the 1% AEP 9-hour storm event using 10 temporal patterns. The temporal pattern that resulted in the peak flow closest to the *Monte Carlo* simulation result at the key outflow locations was selected as the representative temporal pattern for determining design flood hydrographs. The adopted outflow hydrographs are presented in *Figure 22* below.




28.

*Figure 22. 1%AEP Design Flood Hydrographs*

## 5.4 Inundation modelling

HEC-RAS was used to model flood inundation on the site and determine the effects of the proposed mine infrastructure on the inundation extent and the natural flow regime around the mine site. The following 2 scenarios were simulated:

1. Local inundation in the pre-mine catchments A and B for the 1%AEP rainfall event,
2. Local inundation in the mining catchment A and B for the 1%AEP rainfall event.

As discussed in Sub-section 3.4, a primary storm tide occurring in Bynoe Harbor is unlikely to affect the flood inundation across the mine site and was therefore not modelled. It was assumed that all rainfall on the infrastructure was retained on-site (see Section 4.1.3).

### 5.4.1 HEC-RAS model set-up

#### *5.4.1.1 Mesh and boundary conditions*

The HEC-RAS meshes were developed for pre-mining and mining scenarios to cover the expected inundation extent. The model meshes were constructed from available topographic and bathymetric data (Section 5.2) and refined through detailed digitising in QGIS. The HEC-RAS model meshes are made up of 15m×15m squares which uses vertices to capture ground elevations. The simulated RORBwin hydrographs at selected nodes were used as input boundary conditions to account for upstream inflow to the mesh. The model mesh and input nodes for pre-mine scenario is shown in Figure *23*. The input hydrographs for each node in *Figure 23* are shown in *Figure 22*. The model mesh and input locations for mining scenario is shown in *Figure 24*. The input hydrographs for each node in *Figure 24* are shown in *Figure 22*. In addition to the input hydrographs, the rain on grid method was used to simulate rainfall across the mesh using the most probable 1%AEP rainfall intensity and duration generated by RORBwin. The boundary condition at the downstream outlet was set as normal depth.

#### *5.4.1.2 Model roughness parameter*

The roughness parameter represents the ground surface condition which affects the behaviour (velocity and depth) of flow in the model. A previous study (EnviroConsult Australia Pty Ltd, 2018c) showed that using 2 roughness values to represent the roughness of channel and floodplain is sufficient for HEC-RAS flood inundation modelling (Zhu L, 2018). The roughness parameter used in HEC-RAS is Manning's n. The spatial distribution of Manning's n values in HEC-RAS is represented by inputting a land cover map with Manning's n zones delineated using satellite photography. The land cover map is shown in *Figure 25*. The Manning's n values are set as 0.06 for channel and channel bank and 0.10 for floodplain and other regions. These values were selected from the typical ranges of 2D roughness parameters provided in Australian Rainfall and Runoff (ARR) report (ARR, 2012).

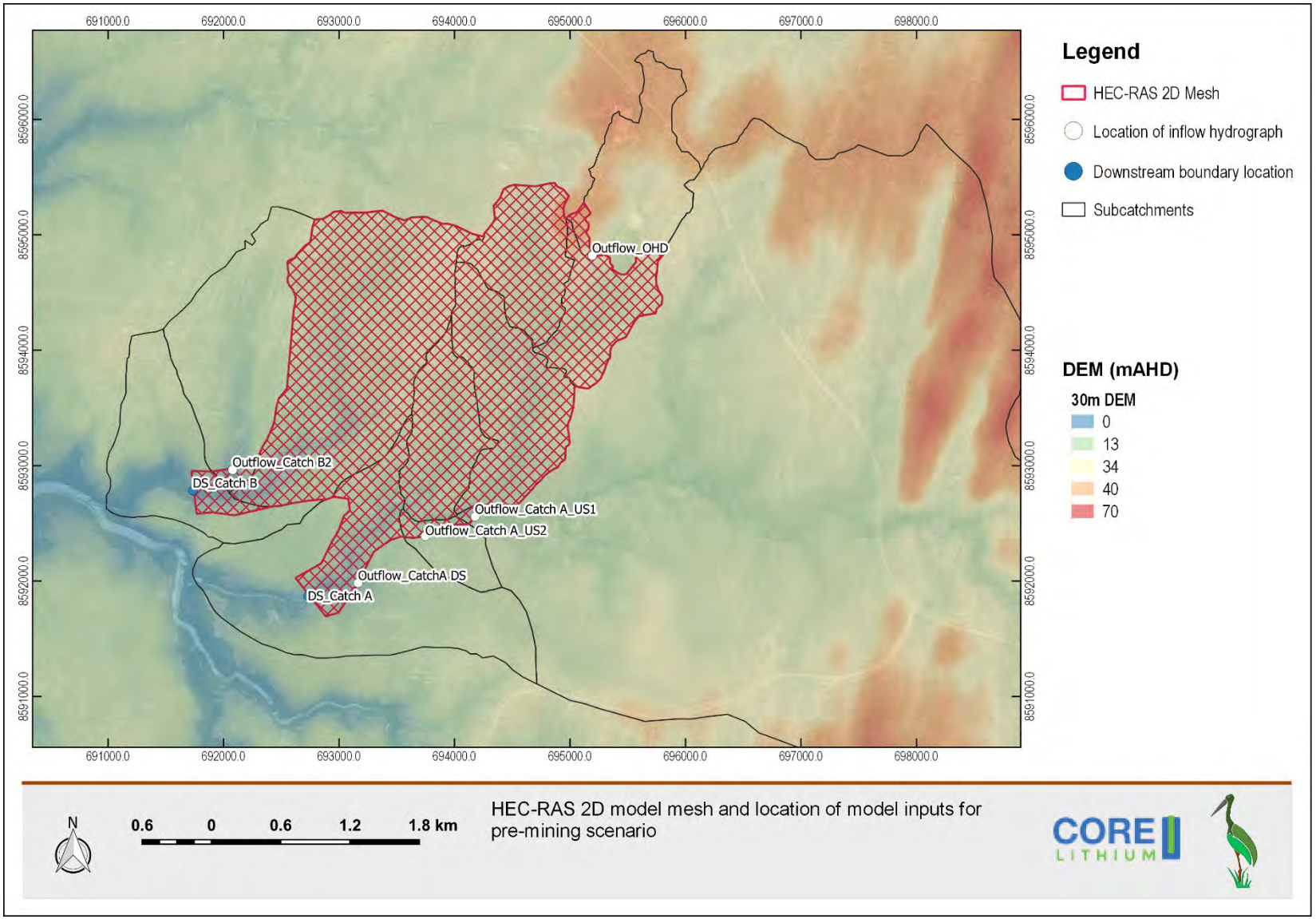



*Figure 23. HEC-RAS 2D model mesh and location of model inputs for pre-mining scenario.*

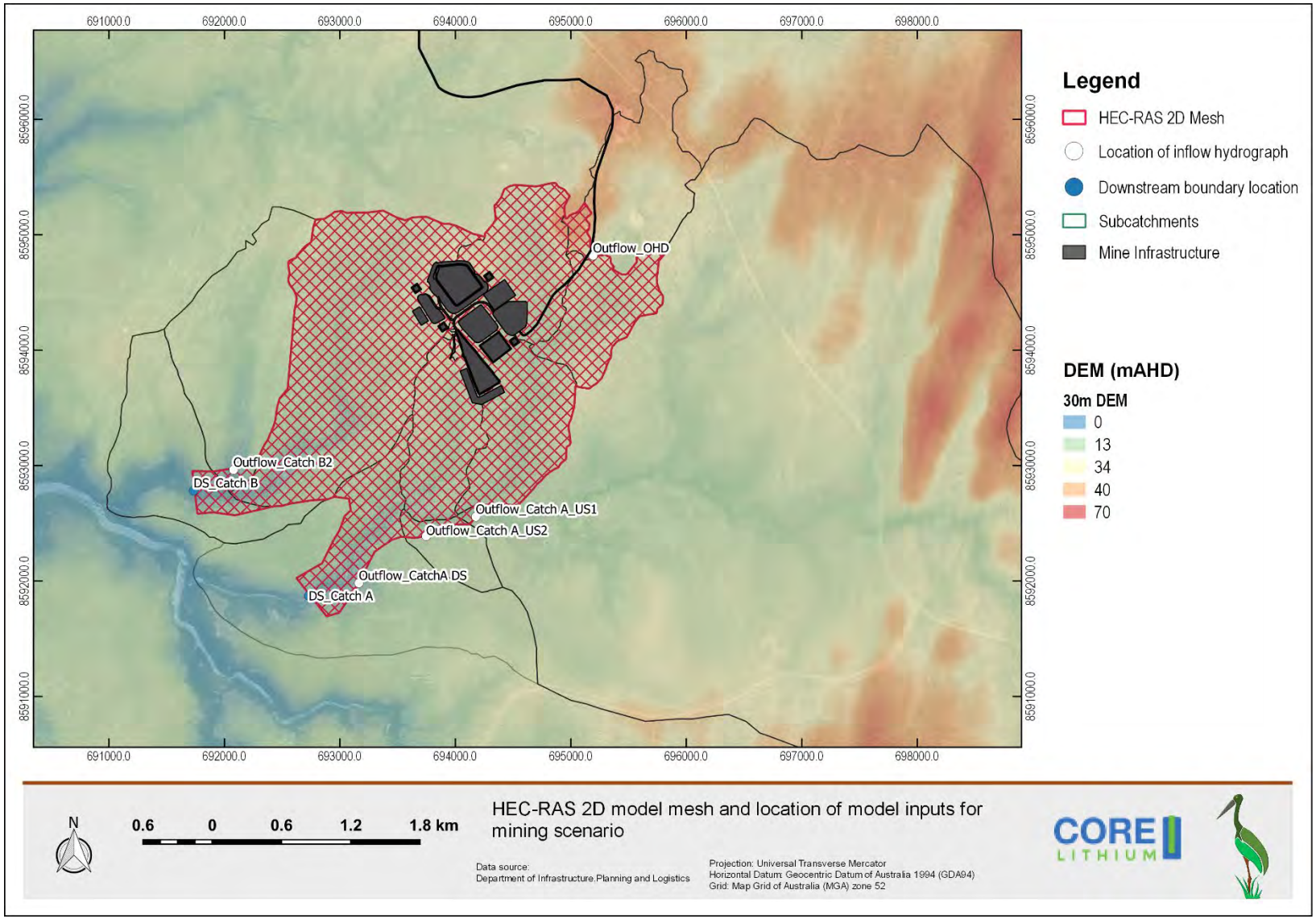



*Figure 24. HEC-RAS 2D model mesh and location of model inputs for mining scenario.*

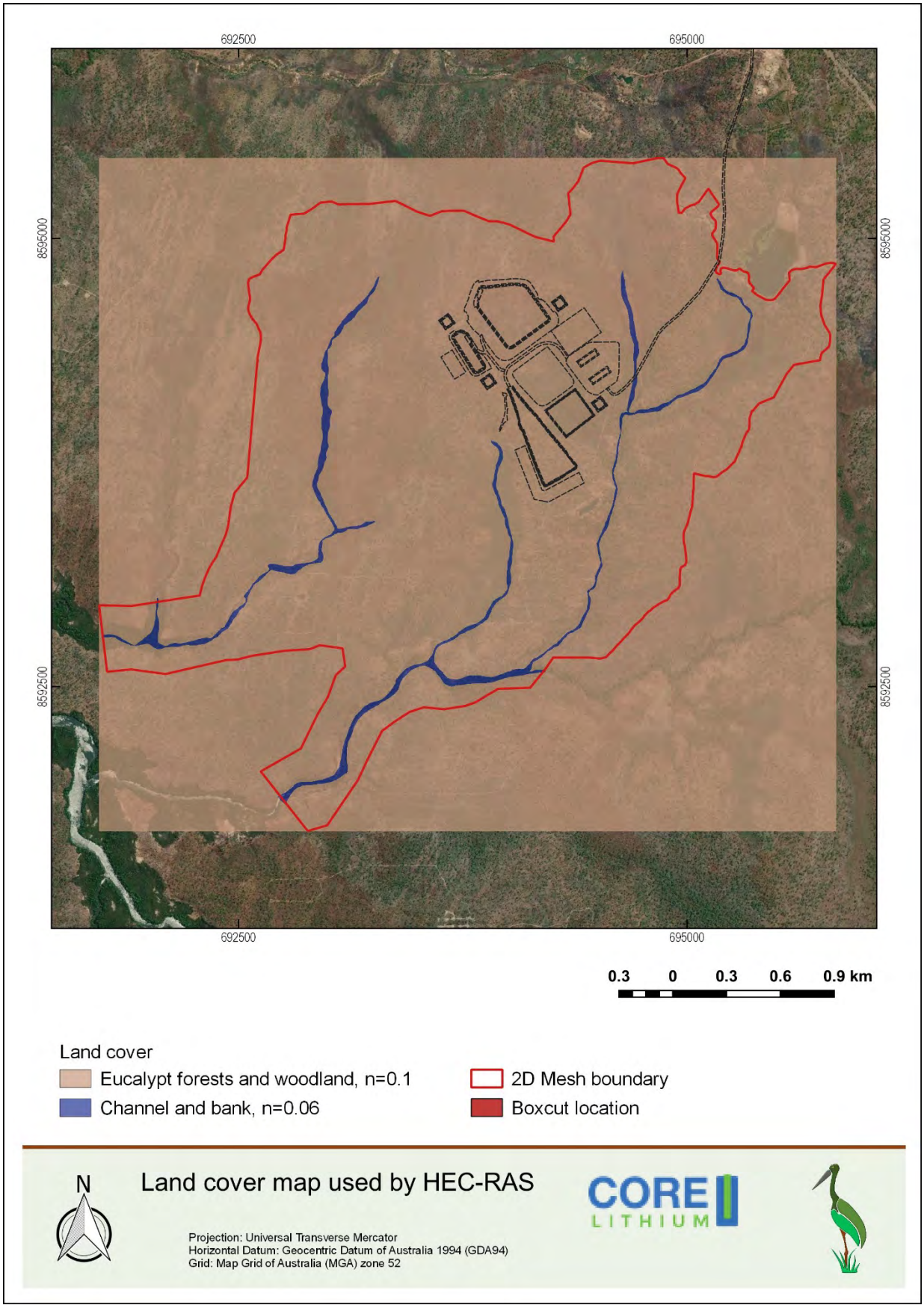



*Figure 25. Land cover map used in HEC-RAS*

### 5.4.2 Simulation results

#### *5.4.2.1 Catchment inundation*

*Figure 26* shows the pre-mine maximum flood inundation levels for the 1%AEP rainfall event for the studied catchments. *Figure 27* shows the mining scenario maximum flood inundation levels for the 1%AEP rainfall event for the studied catchments. These figures show the maximum flood levels at all points during the simulation, but these maximum levels don't necessarily occur at the same time. There is very little difference between the pre-mining and mining scenario inundation levels in the downstream reaches (*Figure 28*). Initial modelling, which did not include detailed assessment of the dam and spillway, indicates that there may small areas where there is <200mm maximum water depth at the downstream toe of the dam wall. It is likely this will only be there for a short time and results from direct rainfall. This should be considered during final design of the dam wall. There is some water accumulation in the boxcut which is to be expected. This is not the final design so inundation levels and locations across the mine site may change. The water shown in the boxcut is not through flooding but accumulation of direct rainfall.

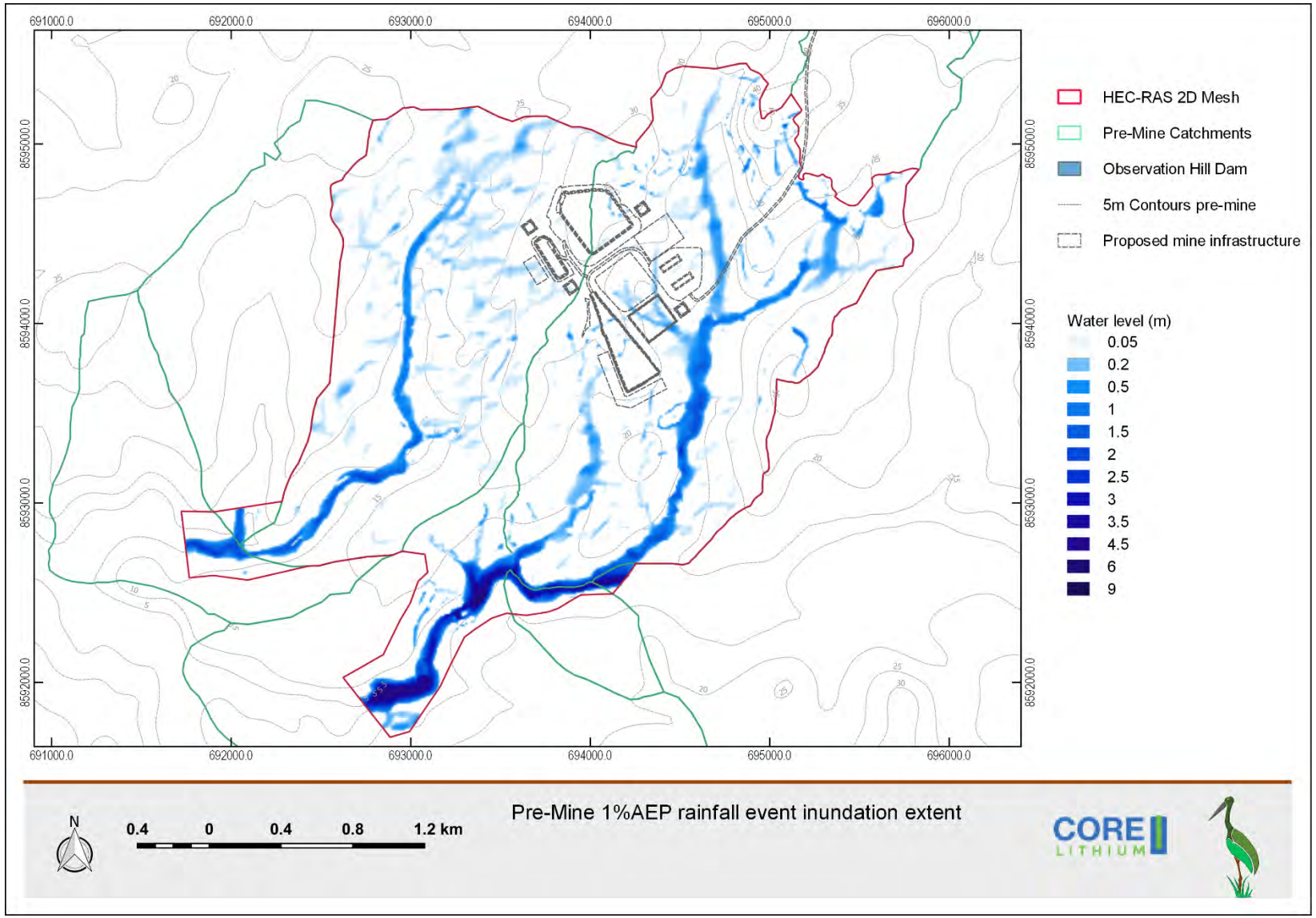



*Figure 26. Pre-mining 1%AEP flood inundation extent*

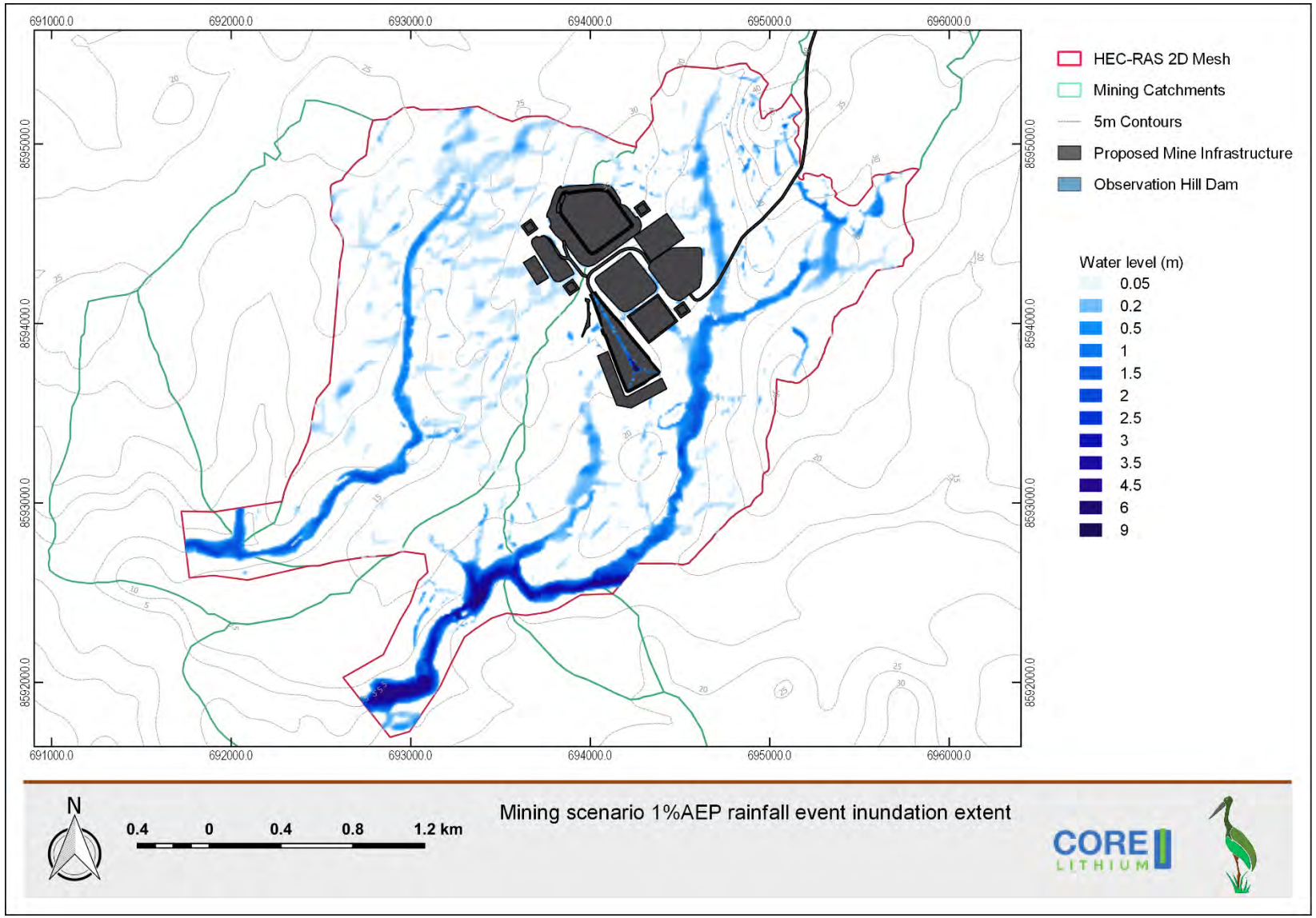



*Figure 27. Mining scenario 1%AEP flood inundation extent*

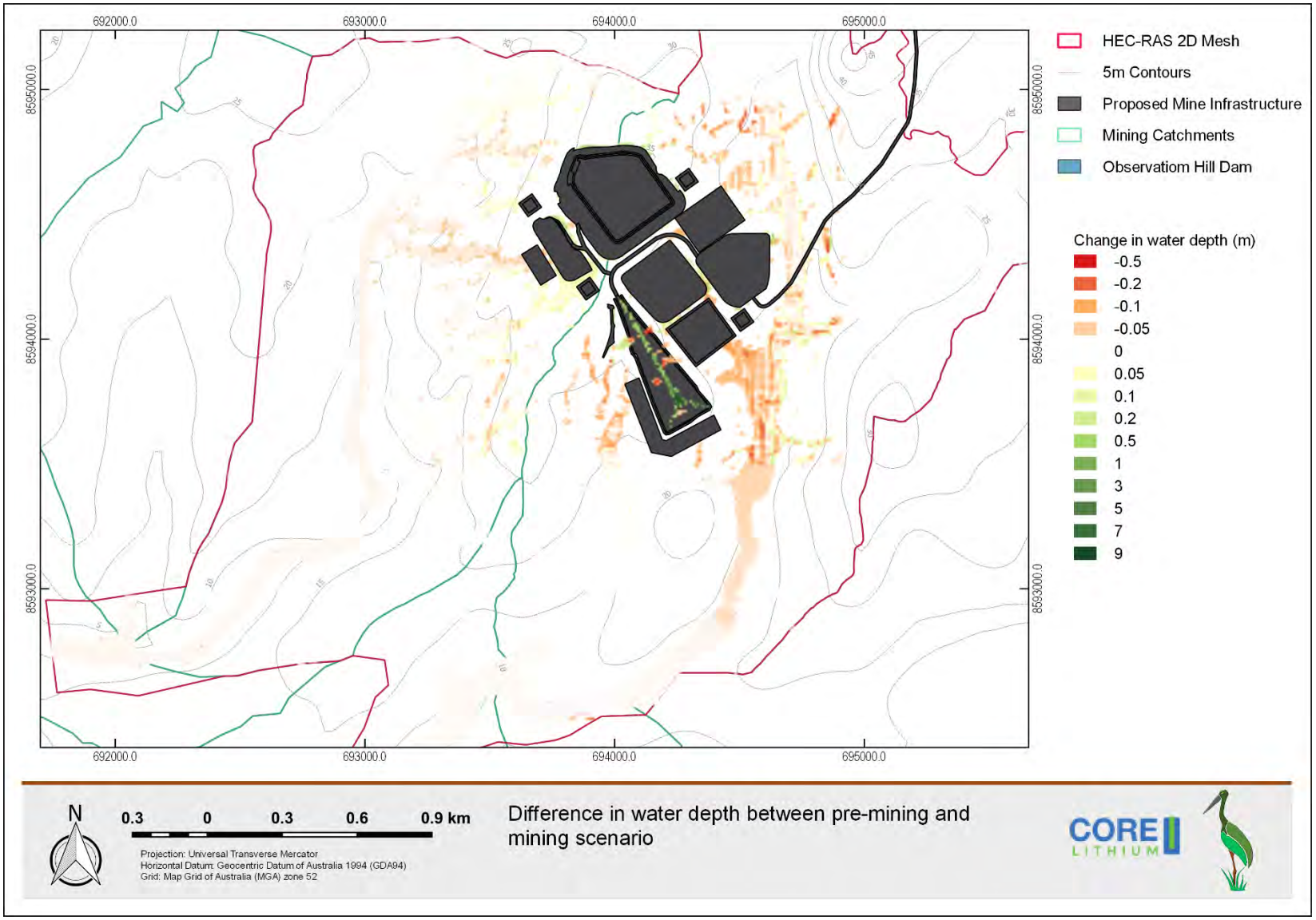



*Figure 28. Change of water depth for the mining scenario compared with pre-mining scenario*

#### 5.4.2.2 Flood hazard

There is no increased risk to people, livestock, or wildlife during flood events. Flood hazard maps were prepared (AIDR, 2017) (*Figure 29* and *Figure 30*) for the 1%AEP and these showed that the mine infrastructure has little effect on flood levels or flood hazard. Flood hazard is the product of flow velocity (V) and depth (D). The flood hazard in the lower reaches is slightly less post-mining than pre infrastructure. This is because there is a reduction in peak discharge downstream as more water is retained on site for the post-mining scenario.

Surface water across the mine site is very shallow and has very small velocity posing no risk to the mining operations. In this area where water is shown in contact with the proposed infrastructure, depths are low and hazard level low. This should be considered during final design and diversion drain used if necessary.

All water bodies and the boxcut are bunded which will prevent access by humans and livestock. The bunds may not prevent access by smaller native animals.

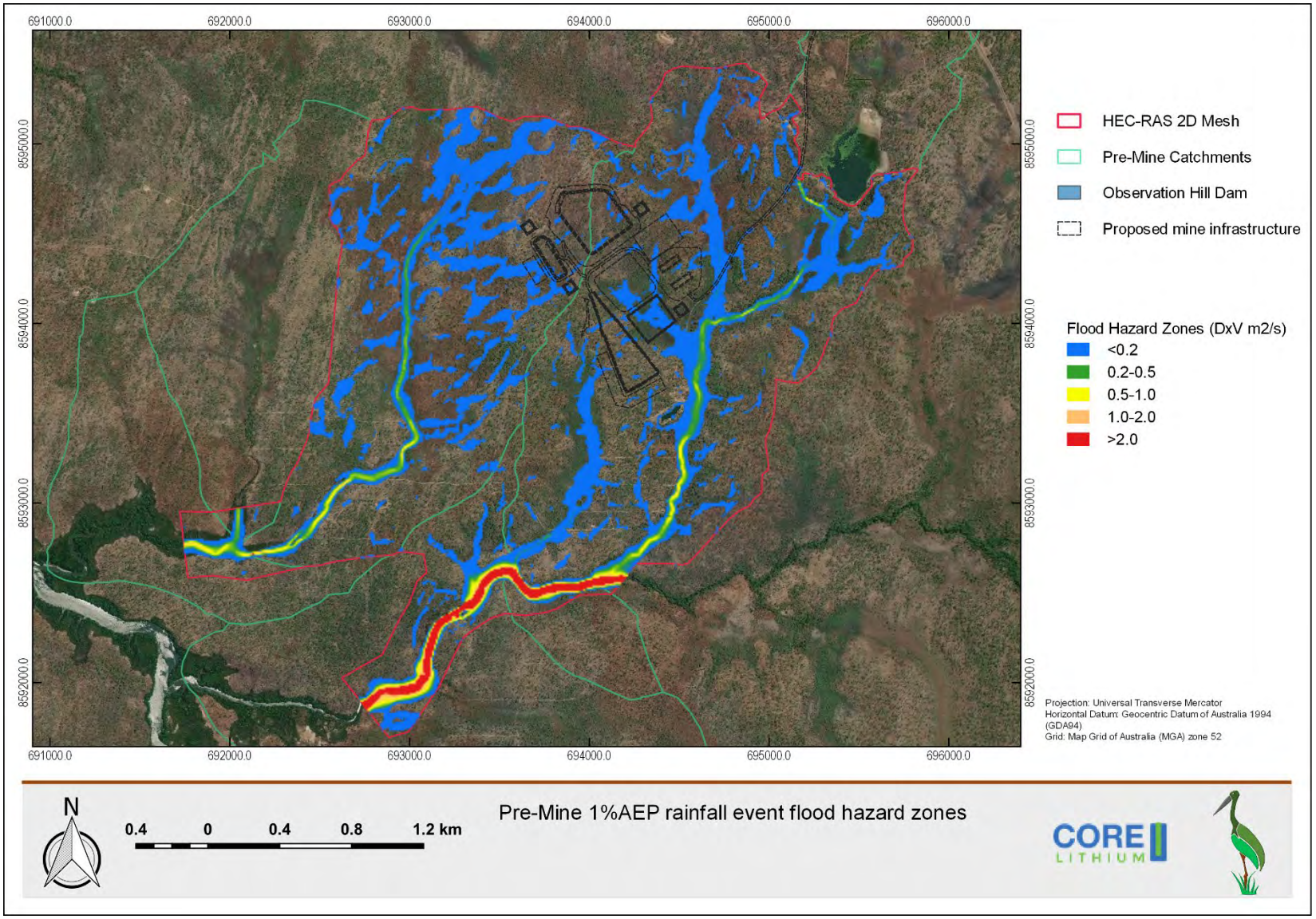



*Figure 29. Flood hazard zones for the pre-mining scenario for a 1%AEP rainfall event*

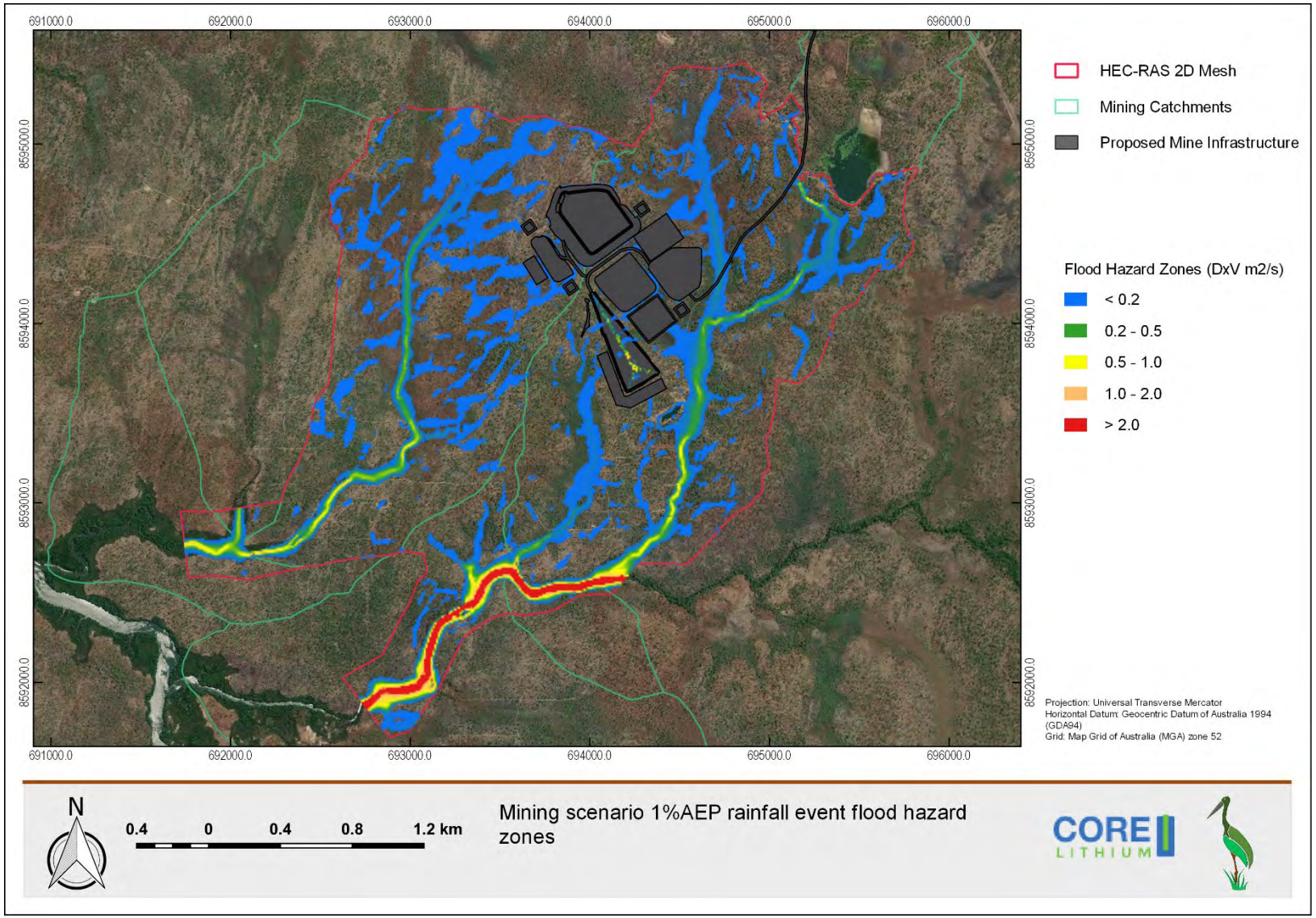



*Figure 30. Flood hazard zones for the mining scenario for a 1%AEP rainfall event*

#### 5.4.2.3 Maximum discharge

*Table 12* shows the maximum discharges at the mesh outlet for the pre-mining and mining scenario and estimated peak discharges from the Regional Flood Frequency Estimation (RFFE) method for the simulated 1%AEP event. The RFFE method is an online tool developed by Engineers Australia to estimate design flood peak discharge. Inputs are catchment outlet, centroid co-ordinates and catchment area. RFFE was used to determine the peak discharge at the outlet of the catchments for 1%AEP rainfall event. The peak discharge values are used as a calibration/validation tool for the inundation risk modelling.

As shown in *Table 12*, the simulated discharges for the pre-mining and mining scenarios closely correlate with the RFFE estimated peak discharges and lie well within the upper (95%) and lower (5%) confidence limits. *Table 12* also shows that the difference between pre-mining and mining scenario peak discharges are less than 1 $m^3s^{-1}$, indicating that the mine infrastructure has very little influence on the natural flow regime.

*Table 12. Pre-mining and mining simulation and RFFE peak discharges at the mesh outlet for the 1%AEP event*

| | Pre-mining scenario | Mining scenario | RFFE estimation | | |
|---|---|---|---|---|---|
| | | | Estimated discharge | 5% confidence limit | 95% confidence limit |
| Maximum discharge ($m^3s^{-1}$) | 237 | 236 | 298 | 96 | 883 |

#### 5.4.2.4 Cross-sections

Four cross-sections were taken to plot the differences in water surface elevation between pre-mining and mining simulations. The location of the cross-sections is shown in *Figure 31* to *Figure 35*. These figures show water surface elevation across the pre-mining and mining terrain for the simulated 1%AEP event. There are no significant differences in water surface elevation between the pre-mining and mining scenario outside the areas occupied by mine infrastructure.

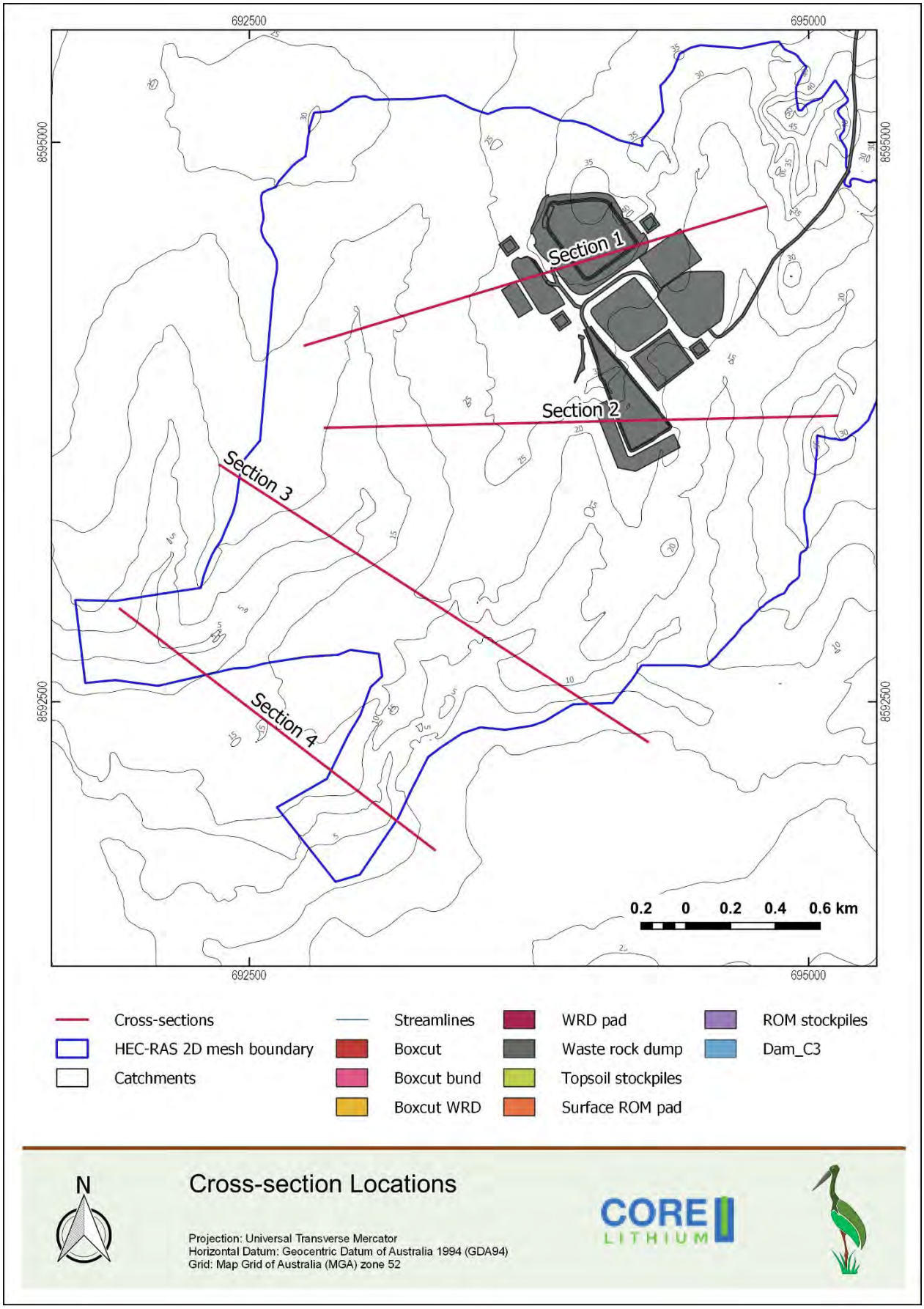



*Figure 31. Location of cross-sections showing water depth for the pre-mining and mining scenario*

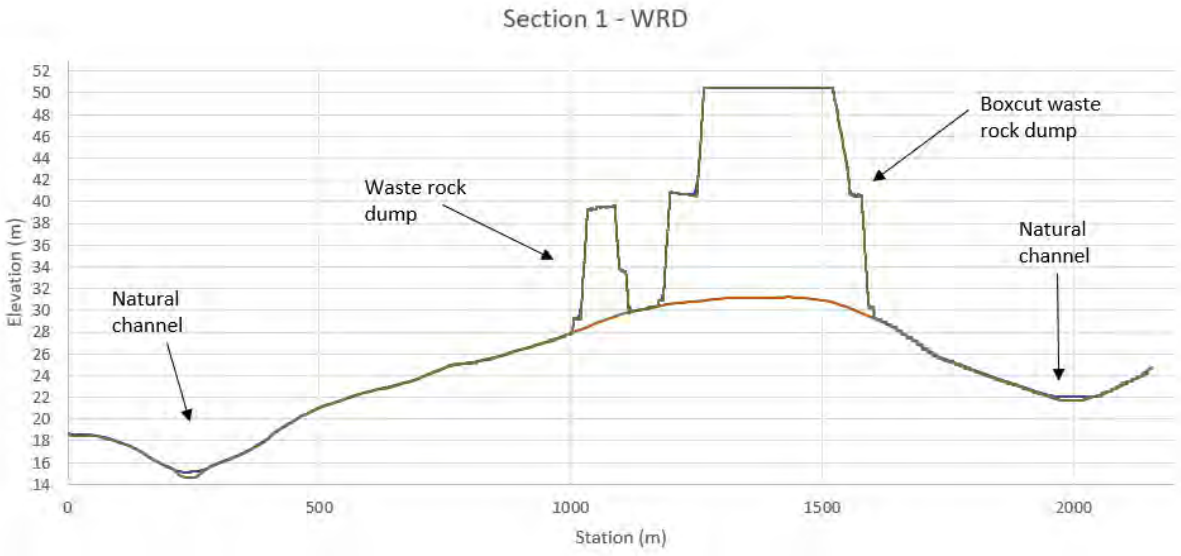



*Figure 32. Cross-section 1 through waste rock dump showing pre-mine and mine scenario water depths for the 1%AEP event*

*Figure 33. Cross-section 2 through boxcut showing pre-mine and mine scenario water depths for the 1%AEP event*

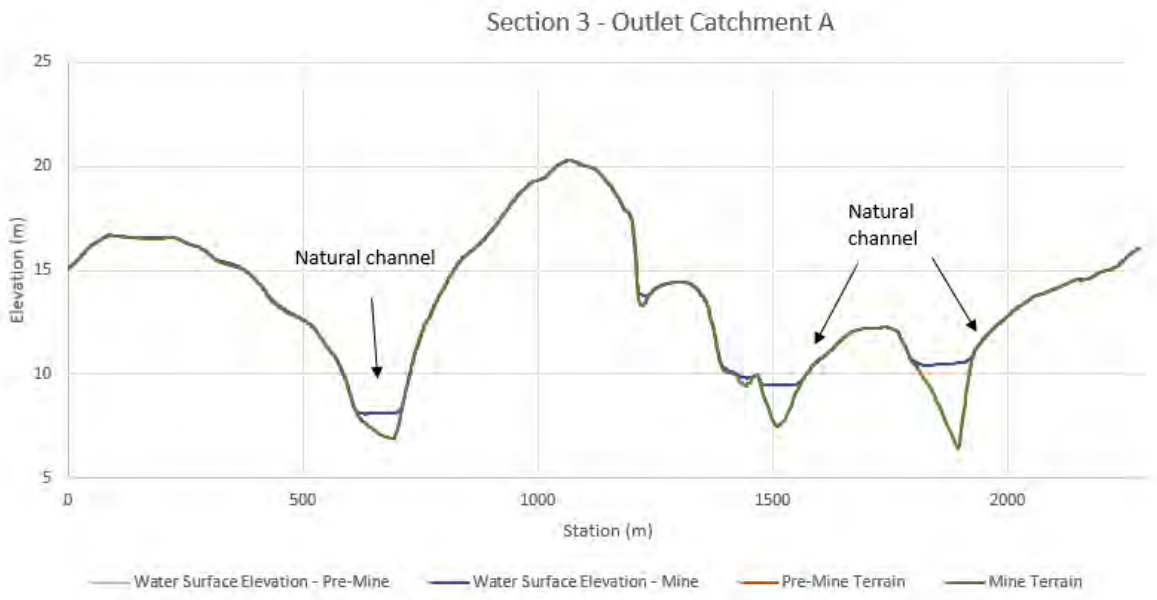



*Figure 34. Cross-section 3 near catchment A outlet showing pre-mine and mine scenario water depths for the 1%AEP event*

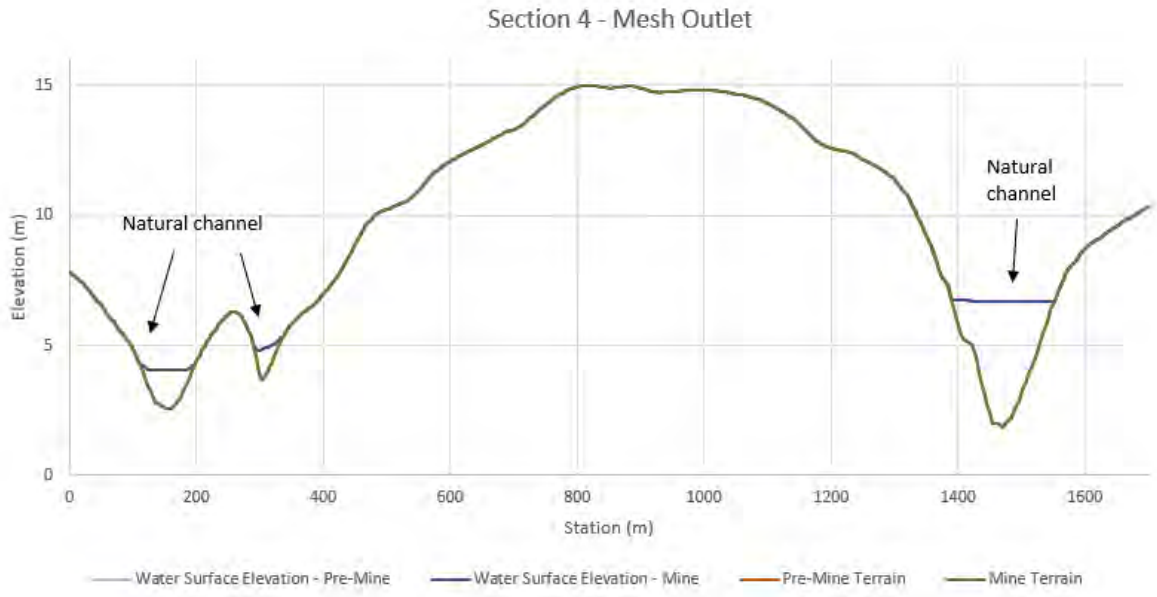



*Figure 35. Cross-section 4 near mesh outlet showing pre-mine and mine scenario water depths for the 1%AEP event*

# 6 Summary

Hydrologic modelling with HEC-HMS for wet, average and dry rainfall years showed very little difference between the pre-mining and mining conditions. The largest change was a 2% decrease in discharge for the mining condition from catchment B. For catchment A, the decrease in discharge was around 1% for the mining condition. The decreased discharge for the mining condition results from applying the assumption that all rain on the site is retained in sediment ponds and mine site dams. There is no impact on environmental flows.

The maximum inflow into the Boxcut is 16420 $m^3d^{-1}$ for a high rainfall scenario, 7780 $m^3d^{-1}$ for the average rainfall scenario and 6920 $m^3d^{-1}$ for the low rainfall scenario. On average, the inflows into the boxcut during the high, average and low rainfall years are 440 $m^3d^{-1}$, 270 $m^3d^{-1}$ and 157 $m^3d^{-1}$ respectively. Most of this inflow is caused by direct rainfall on the boxcut. Very little inflow occurs from upstream catchments.

For three-year rainfall scenarios, the maximum water stored in the boxcut is 203 000 $m^3$ for the high rainfall scenario, 120 830 $m^3$ for the average rainfall scenario and 74 660 $m^3$ for the low rainfall scenario. For the high rainfall scenario, the maximum water level rises to 31.3 above the boxcut base level. The maximum water depth for the average and low rainfall scenario is 25.3 m and 21.0 m.

Flood inundation modelling indicated that there is little difference in inundation between pre-mining and mining conditions apart from some rainfall being stored in the boxcut. For floodplain inundation, further downstream, there is negligible difference between pre-mining and mining conditions.

Flood hazard mapping showed no increased risk to humans, wildlife or livestock for the mining condition. Flood hazard is less post-mining because more water is retained on site, slightly reducing peak flow downstream. The only risk from surface water to the mining operations is through direct rainfall. Groundwater inflow has not been considered in this study.

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# Appendix A – HEC-HMS Models

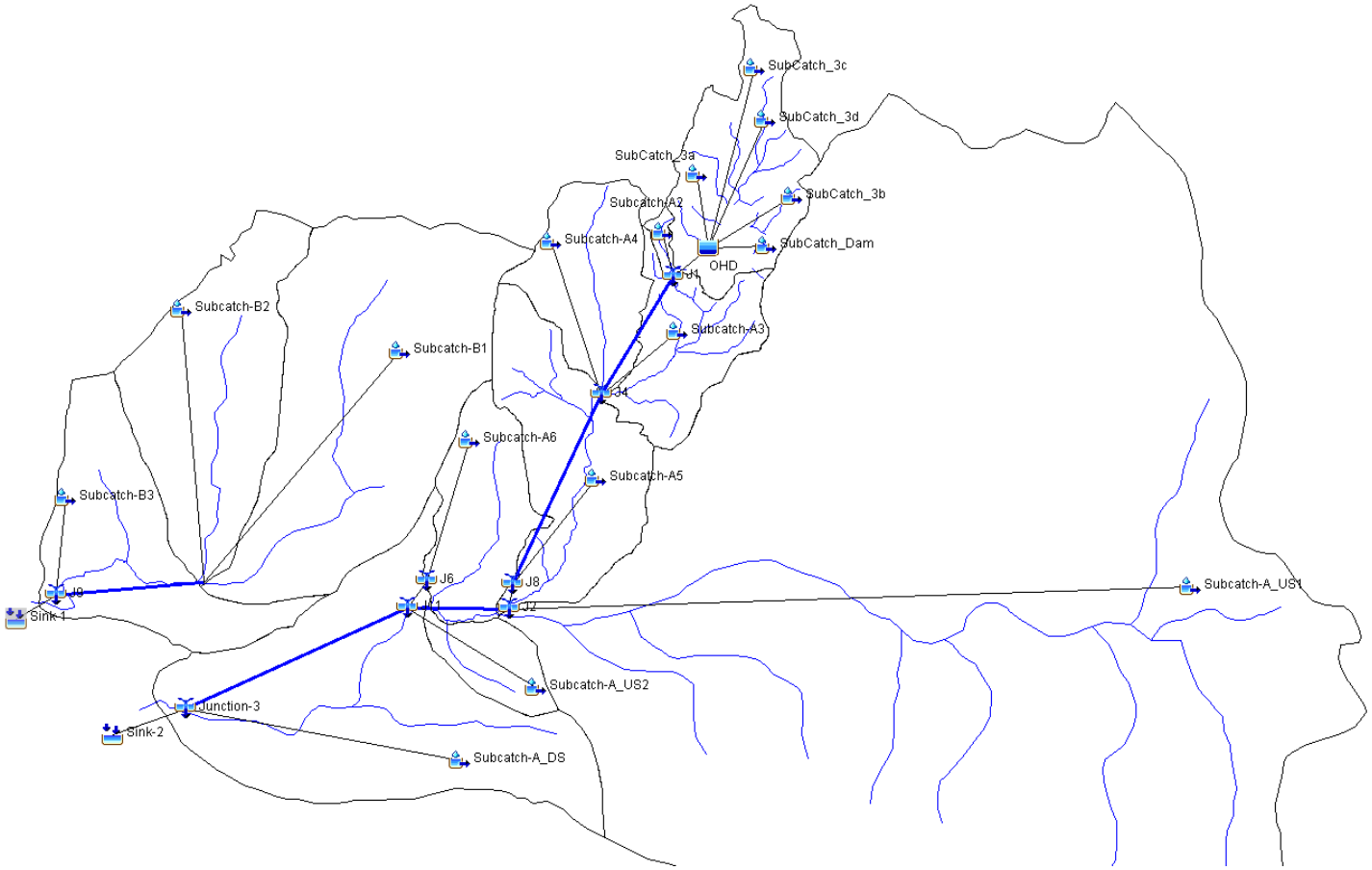


*Figure 36. Pre-mining HEC-HMS Model*

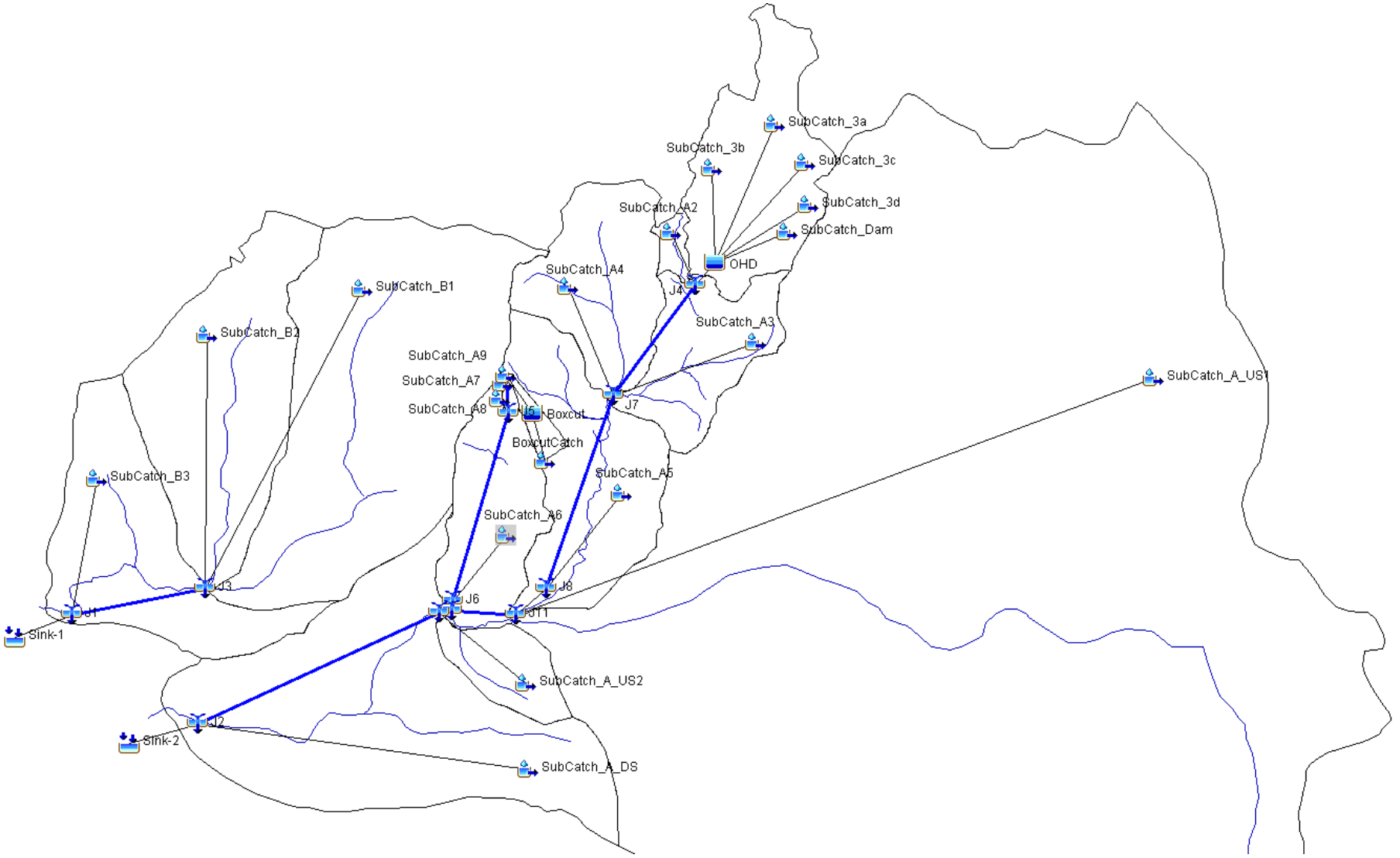


*Figure 37. Mining scenario HEC-HMS model*

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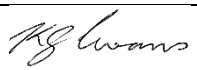
| Draft | Johanna Luck | Ken Evans | Ken Evans |  | 29/01/2020 |
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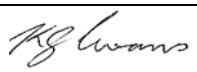
| Final | Ken Evans | Ken Evans | Ken Evans |  | 22/04/2020 |

# Appendix D Ecology

# Ecological assessment
# BP33 Lithium Project
## Core Lithium

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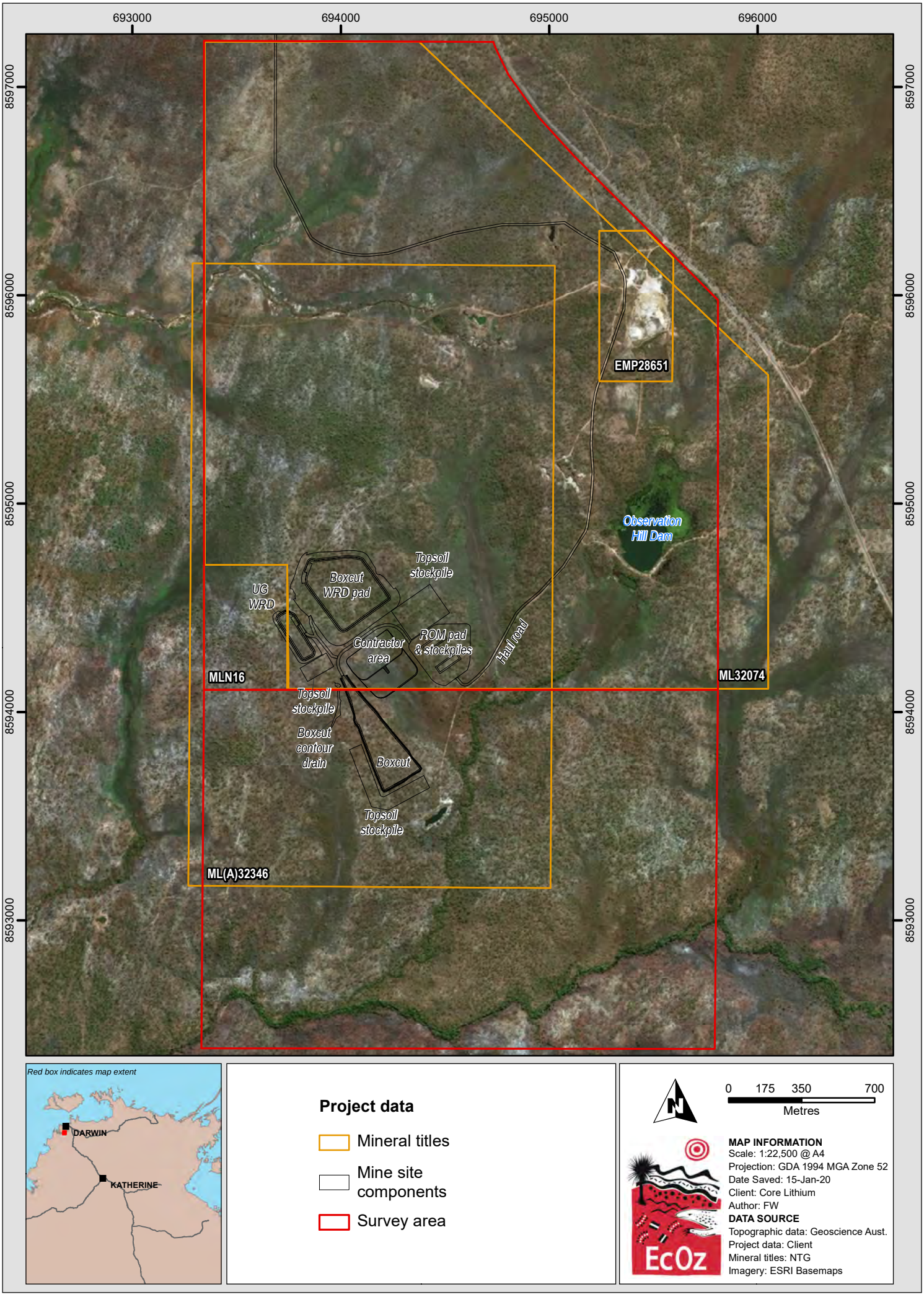
# 1 INTRODUCTION

Core Lithium (Core) is proposing to develop and operate an underground lithium mine on the Cox Peninsula, approximately 33 km west of Berry Springs. The project is known as BP33 Lithium Project and comprises a box cut portal to the underground resource, onsite waste rock dumps and a 12 km haul road to the Grants project processing plant. Collectively, these components are referred to throughout this report as the 'Project area' (Figure 1).

The project is being referred to the Northern Territory Environmental Protection Authority under the *Environmental Assessment Act* (Northern Territory) through a Notice of Intent. To inform an assessment of the potential impacts from the project, EcOz Environmental Consultants (EcOz) were engaged to assess and report on the ecological values within, and surrounding, of the Project area.

To address these requirements, this report presents:

- Verification of existing land unit to a scale of 1:10 000 to identify sensitive vegetation and to inform suitable habitat for threatened species.
- A 'likelihood of occurrence' assessment using desktop information to determine which threatened species have a reasonable likelihood of occurring within the Project footprint (as defined in Section 4.1).
- The methods and results of targeted threatened species surveys within the Project area to identify the presence (or likely presence) of threatened species.




Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ19171 - BP33 NOI\01 Project Files\Report maps\Ecology assessment\Fig 1-1 Location map.mxd

**Figure 1. Map of the location of the Project area**

# 2 LAND UNITS

A land unit is 'a reasonably homogenous part of a land surface, distinct from surrounding terrain with consistent properties in landform, soil and vegetation' (Jessop & King 1997). Land unit mapping can be used to help identify ecological values, such as threatened species habitat and sensitive vegetation types.

## 2.1 Method

The current *Land Units of the Greater Darwin Region* 1:25,000 (Fogarty et al. 1984) was used as a basis to select sites within and surrounding the Project area for ground-truthing land units. Further assessment was undertaken to validate desktop land unit information according to visually uniform land, soil and vegetation features. This involved referencing 1:10,000 aerial imagery to realign mapped land unit boundaries of Fogarty et al. (1984) according to visually uniform land, soil and vegetation features.

The field survey involved collecting flora composition and structural data of vegetation communities at 48 survey sites across the survey area; with varying number sites located within each vegetation community. The survey area covered approximately 1,100 ha inclusive of the Project area. Vegetation sites provide a description of the landform, vegetation and soil. The information collected was: landform, soil type (surface examination only), vegetation structure, vegetation description and three dominant flora species within each stratum (including height range, average height and percent cover). The vegetation community assessments and mapping techniques were in accordance with the *Northern Territory Guidelines and Field Methodology for Vegetation Survey and Mapping* (Brocklehurst et al. 2007). Field work was undertaken by EcOz botanists David van den Hoek and Nicole Clark between 28 November and 13 December 2019.

Representative site photographs were taken at each survey site. All mapping and editing was performed using GIS software (ArcGIS 10.2) in ESRI shape file format.

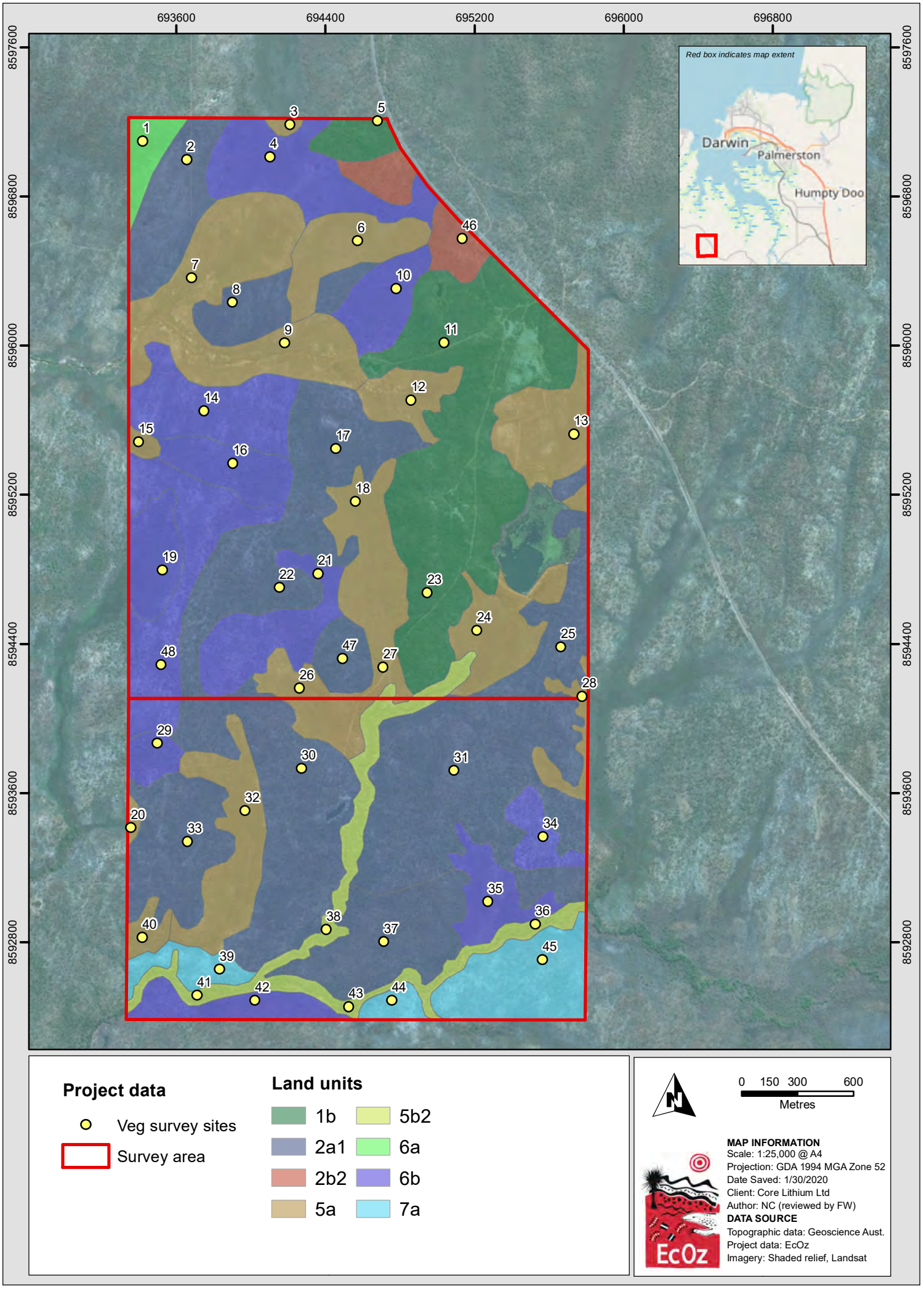
## 2.2 Results

Eight distinct land units were described within the survey area at a scale of 1:10,000 – see Table 1 and Figure 3. Full land unit descriptions are provided in Appendix A. Land unit 2a1 – *Eucalyptus miniata* and *Eucalyptus tetrodonta* mid high woodland on rises – is the most widespread within the survey area, followed by land unit 5a – *Eucalyptus alba* mid open woodland in alluvial plains (Figure 2). There are also significant areas of poorly-drained *Grevillea pteridifolia*, *Pandanus spiralis*, and *Lophostemon lactifluus* shrublands.

**Figure 2. Photographs showing land units 2a1 (left) and 5a (right)**

**Table 1. Ground-truthed land units within survey area**

| No. | Landform | Vegetation description | Drainage | Soil | Total (ha) |
|---|---|---|---|---|---|
| 1b | Low hills | *Eucalyptus tetrodonta*, *Eucalyptus miniata*, *Eucalyptus tectifica* mid woodland over *Terminalia ferdinandiana*, *Eucalyptus tetrodonta*, *Erythrophleum chlorostachys* mid open shrubland over *Alloteropsis semialata*, *Eriachne sp* mid tussock grassland | Very rapid | Rudosols | 130.4 |
| 2a1 | Rises | *Eucalyptus miniata*, *Eucalyptus tetrodonta* mid high woodland over *Erythrophleum chlorostachys*, *Livistona humilis*, *Eucalyptus miniata* mid open shrubland over *Alloteropsis semialata*, *Eriachne sp* mid tussock grassland | Rapid | Rudosols | 386.3 |
| 2b2 | Rises | *Eucalyptus tetrodonta*, *Eucalyptus miniata*, *Eucalyptus tectifica* mid woodland over *Terminalia ferdinandiana*, *Eucalyptus tetrodonta*, *Erythrophleum chlorostachys* mid open shrubland over *Alloteropsis semialata*, *Eriachne sp* mid tussock grassland | Rapid | Kandosols | 16.1 |
| 5a | Alluvial plains | *Eucalyptus alba* mid open woodland over *Pandanus spiralis*, *Lophostemon lactifluus*, *Xanthostemon paradoxus* mid sparse shrubland over *Sorghum intrans*, *Imperata cylindrica* mid tussock grassland<br>*Grevillea pteridifolia*, *Pandanus spiralis*, *Lophostemon lactifluus* mid sparse shrubland over *Alloteropsis semialata*, *Sorghum intrans* mid tussock grassland | Slow (subject to wet-season waterlogging and inundation | Hydrosols | 244.2 |
| 7a | Alluvial plains | *Grevillea pteridifolia*, *Pandanus spiralis*, *Lophostemon lactifluus* mid sparse shrubland over *Alloteropsis semialata*, *Sorghum intrans* mid tussock grassland | Moderate (occasional wet-season inundation) | Kandosols | 47.1 |
| 5b2 | Drainage system | *Melaleuca leucadendra*, *Corymbia polycarpa*, *Xanthostemon eucalyptoides* mid open forest over *Pandanus aquaticus*, *Xanthostemon eucalyptoides*, *Leptospermum madidum* tall shrubland over sedge sp., *Alloteropsis semialata* high open tussock grassland | Poor (waterlogged in wet-season) | Hydrosols | 40.6 |
| 6a | Drainage system | *Corymbia polycarpa*, *Erythrophleum chlorostachys*, *Corymbia confertiflora* mid open woodland over *Grevillea pteridifolia*, *Xanthostemon paradoxus*, *Livistona humilis* mid shrubland over *Alloteropsis semialata*, *Eriachne sp* mid tussock grassland | Very poor (subject to wet-season inundation) | Hydrosols | 8.8 |
| 6b | Drainage system | *Corymbia polycarpa*, *Erythrophleum chlorostachys*, *Corymbia confertiflora* mid open woodland over *Grevillea pteridifolia*, *Xanthostemon paradoxus*, *Livistona humilis* mid shrubland over *Alloteropsis semialata*, *Eriachne sp* mid tussock grassland | Poor (waterlogged in wet-season) | Hydrosols | 229.3 |




Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ19264 - LSA Scaturchio subdivision\01 Project Files\Fig 2. Land unit map.mxd

**Figure 3. Map of ground-truthed land units relevant to the Project area**

# 3 WEEDS

Some species of introduced flora are declared to be weeds under the NT *Weeds Management Act* because of the environmental and economic harm they can cause. Class A weeds are to be eradicated by land owners and occupiers. Class B weeds must have their growth and spread controlled by land owners and occupiers. Introduced flora species that are not covered under the *Weeds Management Act* are referred to as *environmental weeds*. The Commonwealth Government has also categorised some species as Weeds of National Significance (WoNS).

Weed distribution is often related to environmental disturbances caused by the construction of roads and tracks, cattle grazing and feral animals. A review of the NT Weed Branch weed dataset shows no declared weed species have been recorded within the Project area, but there are a few records adjacent to it on the Cox Peninsula Rd for Gamba Grass *(Andropogon gayanus)*, Perennial Mission Grass (*Cenchrus polystachios*) and Paddy's Lucerne (*Sida rhombifolia).*

Field surveys determined that weed density is relatively low across the project area, despite a land use history of exploration activities and resource extraction. A few Gamba Grass and Perennial Mission Grass plants were observed along the access track from the Cox Peninsula Rd. All these records are located in the disturbed area in the north-east corner of the survey area.

The Project area lies within the *Darwin Regional Weed Management Plan 2015-2020* (DLRM 2015). The plan focusses on weeds that are most important to the region, categorising them as either:

- *Priority weeds* (requiring priority management action).
- *Opportunistic weeds* (requiring management because they commonly appear after control of priority weeds).
- *Alert weeds* (has the potential to have a high level of impact to the region should it become established, and the likelihood of the species naturalising and spreading in the region is perceived to be high).

All such weeds listed in Table 2 were recorded within a 20 km buffer surrounding the Project area. The buffered zone surrounding the Project area was chosen to account for potential weed spread and/or introduction.

**Table 2. Declared weed species within a 20 km buffer surrounding the Project area**

| Common name | Botanical name | Class* | WoNS | Status in management plan | Records within Project footprint |
|---|---|---|---|---|---|
| Gamba Grass | *Andropogon gayanus* | B | Yes | Priority | Yes |
| Bellyache Bush | *Jatropha gossypiifolia* | A | Yes | Priority | |
| Mimosa | *Mimosa pigra* | B | Yes | Priority | - |
| Olive Hymenachne | *Hymenachne amplexicaulis* | B | Yes | Priority | - |
| Parkinsonia | *Parkinsonia aculeata* | B | Yes | Priority | - |
| Perennial Mission Grass | *Cenchrus polystachios* | B | - | Priority | Yes |
| Grader Grass | *Themeda quadrivalvis* | B | - | Priority | - |

**Class A = to be eradicated; Class B = growth and spread to be controlled; WONS = Weed of National Significance*

# 4 THREATENED SPECIES ASSESSMENT

This section outlines the procedure and results of the threatened species 'likelihood of occurrence' assessment conducted for this report. The assessment was undertaken using available mapping information, as well as databases of existing records and potential species.

The purpose of this assessment is to identify those species that may need to be included in the project's risk assessment, and those that can be reasonable excluded from further consideration because they are unlikely to occur within the Project footprint.

*Note: This process is not a risk assessment as it does not take into account project activities and their potential impacts.*

## 4.1 Project footprint

The project footprint is the extent to which project activities (during construction and/or operations) could have a significant impact upon ecological values and/or sensitive receptors.

Relevant potential impacts to threatened species include loss of habitat due to land clearing and changes in surface water quality and/or quantity. Therefore, the Project footprint is considered to be the Project area – i.e. all areas that will be subject to land disturbance (with a buffer of a few hundred metres), the drainage lines leading from those areas into Charlotte River, and the Charlotte River itself downstream from those drainage lines to the tidal zone.

## 4.2 Categories

The International Union for the Conservation of Nature (IUCN) nominates a set of criteria used to identify species at risk of extinction. These criteria are used to define categories of risk – see Figure 4 – which are used by the Northern Territory Government to determine which threatened species are listed under the *TPWC Act*, and by the Commonwealth Government to determine which threatened species are listed under the *EPBC Act*. This report focuses on species that are listed as Vulnerable, Endangered or Critically Endangered under the *TPWC Act*, the *EPBC Act* or both.

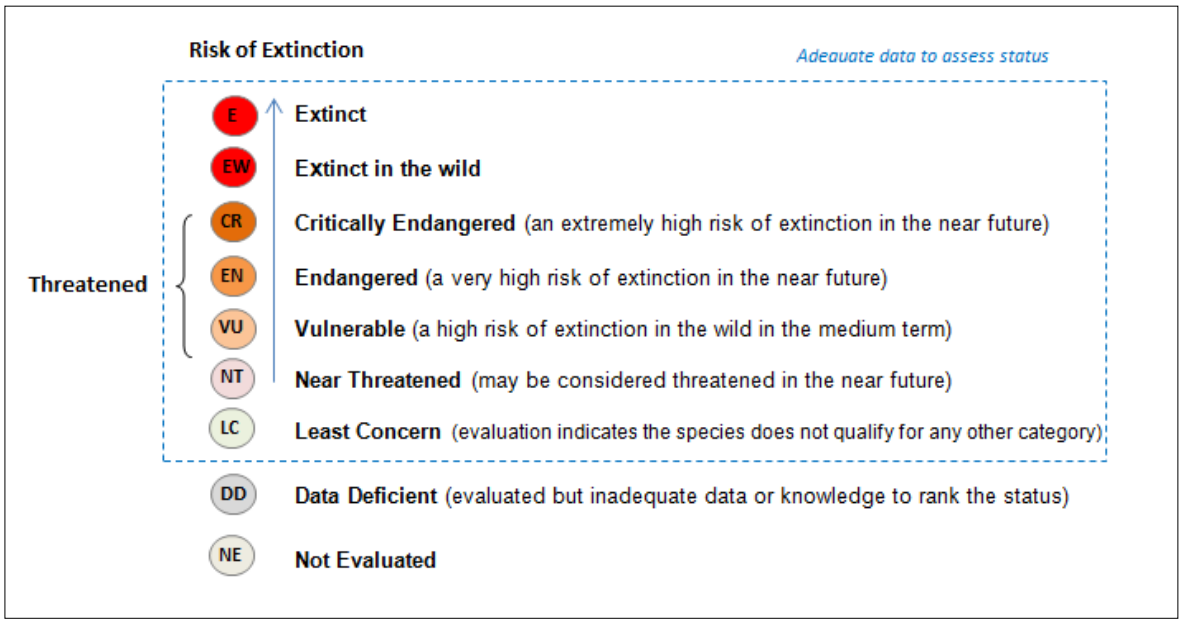



**Figure 4. The IUCN red list categories of risk for species**

## 4.3 Likelihood of occurrence within the Project footprint

The following procedure was used to determine which threatened species have the potential to occur in the project footprint:

- Species records from the latest version of the NT Flora and Fauna Atlas were clipped to the Darwin Coastal bioregion. Bioregions give a broad area with largely similar habitat characteristics and species assemblages. Clipping data to them ensures all potential species are captured in order to undertake a project-specific 'likelihood of occurrence' assessment.
- The EPBC Protected Matters Search Tool (PMST) was used to generate a report using a 100 km buffer from the project area. This PMST is an online enquiry tool managed by the Commonwealth Department of the Environment and Energy which interrogates a range of existing flora and fauna data, as well as predictive modelling to speculate on the presence of species within a search area. The PMST uses a grid system to determine which protected matters it encapsulates for a particular search. The PMST report (Appendix B) was generated on 19 December 2019.
- As detailed in Appendix C, a list of 73 threatened species have the potential to occur in the terrestrial ecosystems within the Darwin Coastal bioregion. For each of these threatened species, the likelihood of it occurring within the project footprint was then assessed based on desktop information that relates to habitat requirements, distribution, number and dates of proximate records, and the land unit information described in Section 2. Likelihood ratings were defined as follows:
    a) **HIGH** – it is expected that this species lives within the Project footprint because there is core habitat and recent proximate records.
    b) **MEDIUM** – this species may live within the Project footprint because there is suitable habitat; however, there is evidence that lowers its likelihood of occurrence (known range contraction of the species in the region, no recent records with the search area, substantial loss of habitat within the Project footprint since previous records, species is naturally-rare or occurs at a low density etc.).
    c) **LOW** – this species may occur, as a vagrant, within the Project footprint; however, there is only marginally-suitable habitat.
    d) **NONE** – there is strong evidence (no suitable habitat and/or the species is considered likely to be regionally-extinct) that this species will not occur within the Project footprint.

Those species that have a high or medium likelihood of occurrence are listed in Table 3. A discussion was had with David Rhind from the Flora and Fauna Division of the Department of Environment and Natural Resources on 25 September 2019 to ensure that these results aligned with the concerns of the department. Given the small Project area, it was decided to only survey for species for which the project footprint represented important habitat. This is akin to the process followed for the Grants Project EIS.

**Table 3. Threatened species 'likelihood of occurrence' assessment**

| Likelihood | Species | Class | Status | |
|---|---|---|---|---|
| | | | EPBC | TPWC |
| HIGH | **Partridge Pigeon** (eastern subspecies) *(Geophaps smithii smithii)* | Bird | VU | VU |
| | **Black-footed Tree-rat** (Kimberley and mainland NT subspecies) *(Mesembriomys gouldii gouldii)* | Mammal | EN | VU |
| | **Bare-rumped Sheath-tail Bat** *(Saccolaimus saccolaimus (nudicluniatus))* | Mammal | VU | - |
| | **a plant** *(Typhonium praetermissum)* | Plant | - | VU |
| MEDIUM | **Masked Owl (northern subspecies)** *(Tyto novaehollandiae kimberli)* | Bird | VU | VU |
| | **Northern Quoll** (*Dasyurus hallucatus)* | Mammal | EN | CR |
| | **Pale Field-rat** (*Rattus tunneyi)* | Mammal | - | VU |
| | **Mertens' Water Monitor** (*Varanus mertensi)* | Reptile | - | VU |
| | **Mitchell's Water Monitor** (*Varanus mitchelli)* | Reptile | - | VU |
| | **Floodplain Monitor** (*Varanus panoptes)* | Reptile | - | VU |
| | **Trigger plant** *(Stylidium ensatum)* | Flora | EN | EN |
| LOW | **Red Goshawk** *(Erythrotriorchis radiatus)* | Bird | VU | VU |
| | **Gouldian Finch** *(Erythrura gouldiae)* | Bird | EN | VU |
| | **Grey Falcon** *(Falco hypoleucos)* | Bird | - | VU |
| | **Crested Shrike-tit (northern subspecies)** *(Falcunculus frontatus whitei)* | Bird | VU | - |
| | **Australian Painted Snipe** *(Rostratula (benghalensis) australis)* | Bird | EN | VU |
| | **Fawn Antechinus** *(Antechinus bellus)* | Mammal | VU | EN |
| | **Ghost Bat** (*Macroderma gigas)* | Mammal | VU | - |
| | **Northern Brush-tailed Phascogale** *(Phascogale pirata)* | Mammal | VU | EN |
| | **False Water Rat** (*Xeromys myoides)* | Mammal | VU | - |
| | **Darwin Cycad** (*Cycas armstrongii)* | Flora | - | VU |
| | **a plant** *(Helicteres macrothrix)* | Flora | EN | EN |

## 4.4 Habitat quality assessment

Three threatened fauna species were determined to have a high likelihood of occurrence within the Project footprint – Bare-rumped Sheath-tail Bat, Black-footed Tree-rat and Partridge Pigeon. Habitat values for these three species are assessed below. Broadly, throughout the Cox Peninsula there are many areas of suitable habitat for these species; the quality of that habitat within the Project footprint is similar to that elsewhere in the region. If these species are present, the Project footprint does not contain especially important habitat for them.

### 4.4.1 Bare-rumped Sheath-tail Bat

Bare-rumped Sheath-tail Bat is a large insectivorous bat that occurs in north-eastern Queensland and in the monsoonal tropics of the NT. There have been relatively few records of the species across this wide distribution, which suggest either that the subspecies is rare, that it has a fragmented distribution or that

records may also have been confused with closely-related species. In the NT, specimens have been collected from Pandanus woodland fringing the sedgelands of the South Alligator River and Eucalyptus tall open forests (Friend & Braithwaite 1986; Churchill 1998) with more recent records from Howard Springs (Milne et al. 2009). Most records occur within near-coastal habitats with one recent exception (Jasper Gorge) 150 km inland (Woinarski et al. 2014). The species forages above the canopy and roosts in deep tree hollows within *Eucalyptus miniata, E. tetrodonta* and *Melaleuca leucadendra* (Churchill 1998). Hollows in these tree species have also been used as breeding roosts (Churchill 1998).

The most severe threat to Bare-rumped Sheathtail Bats is habitat loss and fragmentation – in particular the loss of roost trees (Woinarski et al. 2014). Throughout the Cox Peninsula there are many areas of suitable tall Eucalypt nesting habitat. Within the Project footprint, land units 1b, 2a1 and 2b2 have tall Eucalypts.

### 4.4.2 Black-footed Tree-rat

This species is known from woodlands and open forests with large trees and a moderately diverse mid-storey in near-coastal areas (Figure 5). Black-footed Tree-rats require fruit and seed resources including Pandanus fruits, and fruiting trees and shrubs (Rankmore 2006). The species shelters in tree hollows and occasionally Pandanus (Hill 2012), and is thought to be more prevalent in woodlands with infrequent and low intensity fires (Price et al. 2005).

Throughout the Cox Peninsula there are large areas of woodland that is potential habitat for the Black-footed Tree-rat. Within the Project footprint, such habitat occurs within land units 1b, 2a1, 2b2, 5a, 5b2, 6a and 6b

### 4.4.3 Partridge Pigeon

The Partridge Pigeon occurs in open forests and woodlands with an understorey of grasses (Woinarski 2006). The species prefers woodland dominated by *Eucalyptus tetrodonta* and *E. miniata* (Braithwaite 1985; Garnett et al. 2011; Higgins & Davies 1996). According to Fraser (2001), Partridge Pigeons favour a structurally-patchy savanna understorey at a relatively intricate scale. In all seasons, the species prefers to feed in areas that have an open ground layer (e.g. following fire); however, pairs are more likely to nest where there is dense vegetation cover.

Throughout the Cox Peninsula there are large areas of woodland that is potential habitat for the Partridge Pigeon (Figure 5). Within the Project footprint, such habitat occurs within land unit 1b, 2a1, 2b2, 5a, 6a and 6b.

**Figure 5. Photographs showing typical Eucalyptus woodlands with sparse understorey**

## 4.5 Field surveys

Two flora species were determined to have a high or medium likelihood of occurrence within the Project footprint – *Typhonium praetermissum* and *Stylidium ensatum*. That assessment was based on NT Government habitat modelling and the land unit mapping presented in Section 2.2. This section of the report describes the field surveys for these two species.

### 4.5.1 *Typhonium praetermissum*

***Background***

*Typhonium praetermissum* is a small perennial herb with aerial parts present during the annual wet season, usually between December and April (Figure 6). This species occurs in open woodland and favours relatively unshaded areas in red brown clay and shallow or gravelly lateritic soils (Cowie & Westaway 2012). *T. praetermissum* plants are typically found in small, relatively open (unshaded) patched of gravel or gravelly sandy substrate supporting less than 20 % vegetation ground cover and located on the edge of lateritic plateau areas in a somewhat subdued landscape. Emergence of plants is most likely after sufficient rainfall from at least one significant monsoon event, usually from around the end of January (Ian Cowie, Senior Botanist NT Herbarium, pers. comm., Jan. 2020).

*T. praetermissum* is endemic to the Northern Territory and Greater Darwin region, the known distribution extending from the Gunn Point area, south to Noonamah Ridge and west to Cox Peninsula (Cuff & Green 2019). A targeted survey for this species for the adjacent Grants Project by EcOz in 2019 did not result in any records.

Previous surveys in other areas have recorded the species in four land units; 3b, 3c, 2a1 and 1c (Cuff & Green 2019). Within the Project footprint, land units 2a1 and 6b potentially provide suitable habitat for the species. The species is most likely to occur along the margin of land units where the eroding low rise of one land unit creates a gravelly surface adjacent to a low lying wetter area. This type of habitat was observed during the field surveys

**Figure 6. Photographs of active *Typhonium praetermissum***

***Methods***

DENR has developed a habitat model for *Typhonium praetermissum* for the Greater Darwin region. A desktop search found there are areas modelled as containing moderate likelihood *Typhonium praetermissum* habitat within the survey area (see Figure 8).

A survey for *T. praetermissum* was undertaken, subsequent to the land unit survey, to determine presence/absence. Prior to heading to the site, EcOz contacted the NT Herbarium to confirm the emergence of the species for the beginning of the season. Surveyors also visited a known sub-population. The survey

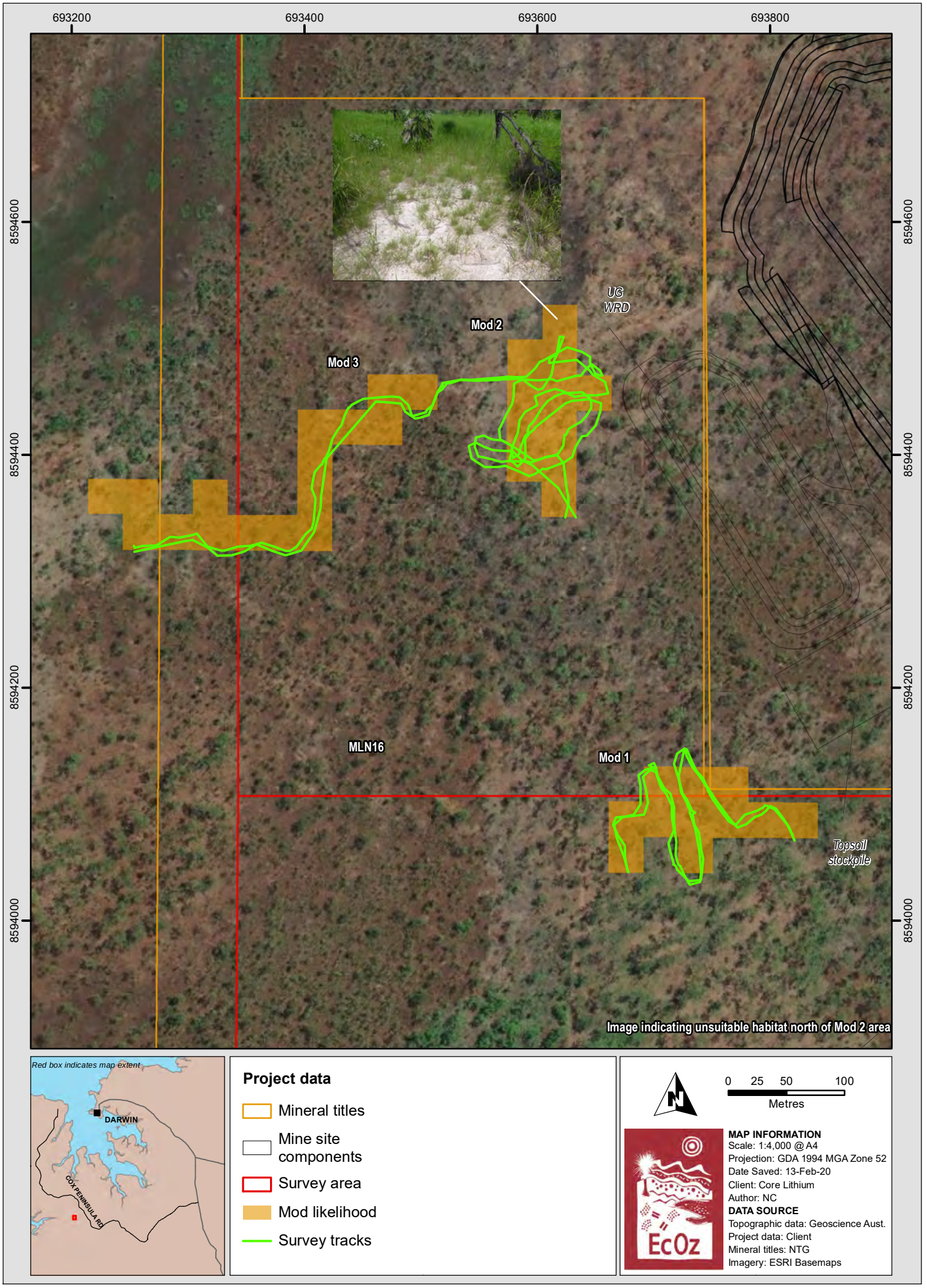
was led by Nicole Clark who has significant previous experience in surveying for the species. The survey focused on three areas modelled as moderate likelihood habitat within the disturbance footprint (Figure 8). Those areas were navigated by foot using a random meander method, with the intent of covering at least 10% of the survey area. Surveyors walked adjacent to each other (10 m apart) and an average survey width of 2m observed either side was applied while meandering. A waypoint was recorded with handheld GPS for each plant observed during the survey. The GPS was also used to record survey range and effort.

***Results***

Although there were patches of potentially-suitable habitat; well drained reddish/brown lateritic surface gravels, *T. praetermissum* was not detected during the February 2020 field survey (Figure 8 and Figure 7 for habitat photographs). A total of 3.8 km of meander lines were searched within the 3.4 ha of moderate likelihood area associated with the disturbed area (see Figure 8).

Areas modelled as moderate likelihood, but supporting wet indicator species and subject to poor drainage species, were considered unlikely habitat and, for this reason, not surveyed. A drainage area was noted north of Moderate likelihood Area 2 (Mod 2), and sections to the north of Moderate likelihood Area 3 (Mod 3) also appeared unsuitable and not surveyed – see Figure 8.

**Figure 7. Photographs of potential *Typhonium praetermissum* habitat (2a1 left & 6b right)**




Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ19171 - BP33 NOI\01 Project Files\Report maps\Ecology assessment\Fig XX Typhonium survey results v2.mxd

**Figure X-X. Map of project location**

### 4.5.2 *Stylidium ensatum*

***Background***

*Stylidium ensatum* is a small annual herb that inhabits margins of drainage areas in damp heavy clay or peaty soil (Cowie & Westaway 2012b). These drainage margins are required to stay wet well into the dry season (Holmes et al. 2005). The species is identifiable when flowering in June-July. Field surveys were undertaken November to January, therefore, the presence of water in the mid dry season water could not be determined. However, within the Project footprint, the broad drainage areas which experience more severe waterlogging for extended periods, could be expected to be the most suitable habitat. This corresponds to areas within land unit 5a, 6b and 7a on alluvial plains or drainage systems (as per Figure 3). These areas of potential habitat are shown in Figure 10 within land units 5a, 6b and 7a).

A targeted survey for this species for the adjacent Grants Project did not result in any records.

**Figure 9. Photographs of *Stylidium ensatum leaf* (left) and flower (right)**

***Survey area selection***

DENR has developed a habitat model for *Stylidium ensatum* for the Greater Darwin region. A desktop search found there are areas of high likelihood of *Stylidium ensatum* habitat within the survey area (see Figure 10).

Existing land unit and vegetation mapping, and satellite imagery were examined to identify potential areas of suitable *Stylidium ensatum* habitat to be targeted for on-ground investigation. Relevant features used to determine potentially suitable locations for on-ground survey were:

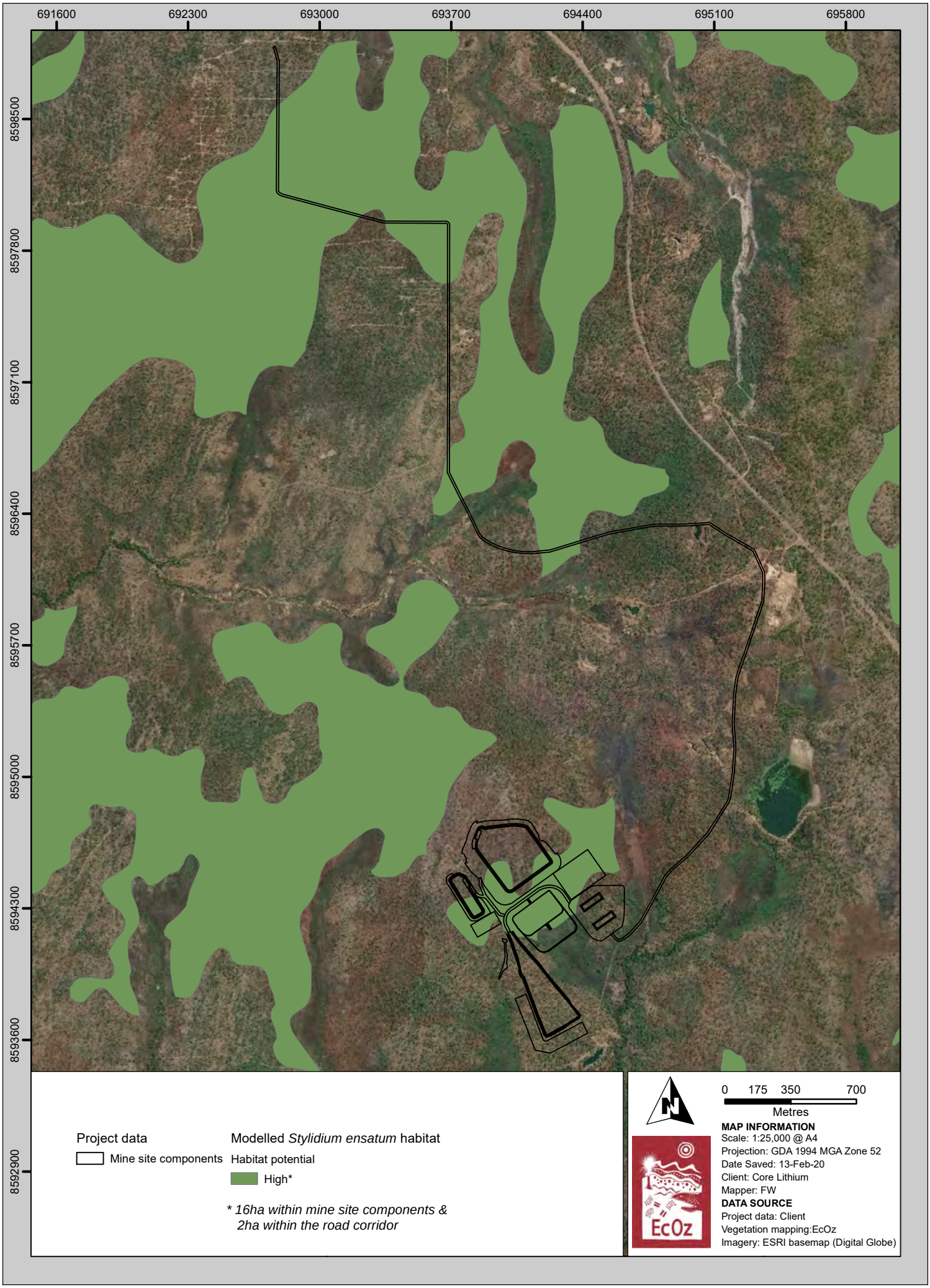
- Areas that are poorly drained with seasonal inundation or waterlogging and have hydrosols soils – i.e. they are saturated with water for extended periods, are generally a greyish colour and have a high organic content.
- Shallow inundation or saturated soils in the mid dry season.
- Overstorey consisting of *Lophostemon lactifluus, Pandanus spiralis* and/or *Melaleuca* spp.
- Ground layer incorporating grasses and herbs that occur in poorly-drained habitats.
- Relatively open overstorey.

***Proposed methods***

The survey will focus on areas modelled as high likelihood habitat within the Project footprint (excluding tracks) – see Figure 10. During the surveys, areas of high and moderate likelihood habitat will be walked and navigated using GPS.

Potential habitat will be surveyed in June-July 2020, led by EcOz botanist Nicole Clark who has previous experience in surveying for the species. A check site located near Girraween Road will be visited prior to survey to inspect a known population of *S. ensatum* for flowering, detectability, and to record attributes of the habitat where the species is known to occur.

Given the relative area within the disturbance footprint, identified areas of suitable habitat will be surveyed using a random meander method with the aim of assessing the entire area of suitable habitat. GPS tracks will record survey range and effort, and photographs of habitats will be taken.




Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ19171 - BP33 NOI\01 Project Files\Report maps\Figure X-X. Map of modelled Stylidium ensatum habitat in proximity to the project footprint.mxd

**Figure X-X. Map of modelled Stylidium ensatum habitat in proximity to the project footprint**

# 5 DISCUSSION & CONCLUSIONS

The survey area comprised of eight land units. *Eucalyptus miniata* and *Eucalyptus tetrodonta* mid high woodland on rises is the most widespread within the survey area, followed by *Eucalyptus alba* mid open woodland in alluvial plains. There are also significant areas of poorly-drained *Grevillea pteridifolia*, *Pandanus spiralis*, and *Lophostemon lactifluus* shrublands.

Three threatened fauna species were determined to have a high likelihood of occurrence within the Project footprint – Bare-rumped Sheath-tail Bat, Black-footed Tree-rat and Partridge Pigeon. Habitat values for these three species are assessed below. Broadly, throughout the Cox Peninsula there are many areas of suitable habitat for these species; the quality of that habitat within the Project footprint is similar to that elsewhere in the region. If these species are present, the Project footprint does not contain especially important habitat for them.

Government modelling indicates that the Project footprint also provides potential habitat for two threatened flora species – *Typhonium praetermissum* and *Stylidium ensatum.* Surveys during November and December were not able to determine the presence of these species as individuals are only emergent in the mid wet and early dry. A *Typhonium praetermissum* targeted survey in February 2020 did not result in any occurrence records for the species. A *Stylidium ensatum* survey is proposed for June-July. The species was not previously recorded in a similar nearby survey in 2019.

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# APPENDIX A VEGETATION DESCRIPTIONS

| **Land unit – 1b** | |
|---|---|
| **NVIS Code:** T7i | |
| **Vegetation Description:** *Eucalyptus tetrodonta* +/- *Eucalyptus miniata*, *Eucalyptus tectifica* mid woodland over *Terminalia ferdinandiana*, *Eucalyptus tetrodonta*, *Erythrophleum chlorostachys* mid open shrubland over *Alloteropsis semialata*, *Eriachne* sp., *Eucalyptus tetrodonta* (re-sprouts) mid tussock grassland | |
| **Upper 1:** Mid high woodland dominated by *Eucalyptus tetrodonta* (100%), *Eucalyptus miniata* (75%), *Eucalyptus tectifica* (30%) | |
| **Mid 1:** Mid open shrubland dominated by *Terminalia ferdinandiana* (100%), *Erythrophleum chlorostachys* (66.6%), *Eucalyptus tetrodonta* (66.6%) | |
| **Ground 1:** Mid high tussock grassland dominated by *Alloteropsis semialata* (100%), *Eriachne sp.* (66.6%), *Eucalyptus tetrodonta* (re-sprouts) (33.3%) | |
| | |
| **No. of sites:** 3 (5,11, 23) | |
| **Other common species** | |
| **Upper stratum (U1):** - | |
| **Mid stratum (M1):** *Livistona humilis* (33.3%) and *Eucalyptus miniata* (33.3%) | |
| **Ground stratum (G1):** *Hibbertia dilatata* (33.3%), *Brachychiton paradoxus* (33.3%), and *Pandanus spiralis* (33.3%) | |
| **Total area of project area:** 130.421 ha | |
| **Land form:** Steeply sloping ridge terrain, slope 10 to 40% | |
| **Soils:** Leptic Rudosol | **Drainage:** Very rapid |

**Structural summary:**

| Strata | Modal growth form | Mean cover % | Mean height (m) | NVIS code |
|---|---|---|---|---|
| Upper U1 | Tree | 33.3 (25 – 40) | 18 (16 – 20) | T7i |
| Mid M1 | Shrub | 23.3 (20 – 25) | 9.3 (8 – 11) | S3i |
| Ground G1 | Tussock grass | 55 (40 – 60) | 0.7 (0.5 – 0.8) | G2c |

| **Land unit – 2a1** | | | | |
|---|---|---|---|---|
| **NVIS Code:** T7i, T7c | | | | |
| **Vegetation Description:** *Eucalyptus tetrodonta* +/- *Eucalyptus miniata*, *Eucalyptus tectifica* mid woodland over *Terminalia ferdinandiana*, *Eucalyptus tetrodonta*, *Erythrophleum chlorostachys* mid open shrubland over *Alloteropsis semialata*, *Eriachne* sp., *Eucalyptus tetrodonta* (re-sprouts) mid tussock grassland | | | | |
| **Upper 1:** Mid high woodland dominated by *Eucalyptus miniata* (90%), *Corymbia certiflora* (20%) | | | | |
| **Mid 1:** Mid high open shrubland of *Erythrophleum chlorostachys* (60%), *Livistona humilis* (40%), *Eucalyptus miniata* (40%). | | | | |
| **Ground 1:** Mid high tussock grassland dominated by *Alloteropsis semialata* (100%), *Eriachne sp*. (60%), *Heteropogon triticeus* (30%) and *Hibbertia dilatata* (30%). | | | | |
| | | | | |
| **No. of sites:** 10 (2,8,25,31,37,33,47,17,22,30) | | | | |
| **Other common species** | | | | |
| **Upper stratum (U1):** *Eucalyptus tectifica* (10%), *Eucalyptus tetrodonta*, (20%), *Corymbia bleeseri* (10%), *Corymbia foelscheana* (10%) | | | | |
| **Mid stratum (M1):** *Acacia lamprocarpa* (30%), *Corymbia bleeseri* (10%), *Corymbia foelscheana* (10%), *Eucalyptus tectifica* (10%), *Eucalyptus tetrodonta* (10%), *Grevillea decurrens* (20%), *Pandanus spiralis* (20%), *Terminalia ferdinandiana* (10%) and Xanthostemon paradoxus (10%). | | | | |
| **Ground stratum (G1):** *Erythrophleum chlorostachys* (20%), *Eucalyptus miniata* (10 %), *Eucalyptus tetrodonta* (10%), *Sorghum intrans* (10%) *and Syzygium eucalyptoides bleeseri* (10%). | | | | |
| **Total area of project area:** 386.346 ha | | | | |
| **Land form:** Low rises and associated upper, slope 0.5 to 4 % | | | | |
| **Soils:** Brown kandosols | | **Drainage:** Rapid | | |
| **Structural summary:** | | | | |
| **Strata** | **Modal growth form** | **Mean cover %** | **Mean height (m)** | **NVIS code** |
| Upper U1 | Tree | 27 (15 – 40) | 15.35 (11.5 - 18) | T7i |
| Mid M1 | Shrub | 30 (10-70) | 6.6 (3 - 10) | S3i |
| Ground G1 | Tussock grass | 50 (40 – 60) | 0.93 (0.6 –1.5) | G2c |

| Land unit – 2b2 | | | | |
|---|---|---|---|---|
| **NVIS Code:** T7r, (T7i) | | | | |
| **Vegetation Description:** *Eucalyptus tetrodonta*, *Eucalyptus miniata*, *Eucalyptus tectifica* mid woodland over *Terminalia ferdinandiana*, *Eucalyptus tetrodonta*, *Erythrophleum chlorostachys* mid open shrubland over *Alloteropsis semialata*, *Eriachne sp* mid tussock grassland | | | | |
| **Upper 1:** Mid high woodland dominated by *Eucalyptus tetrodonta* (100%) | | | | |
| **Mid 1:** Mid high shrubland dominated by *Eucalyptus tetrodonta* (100%), *Livistona humilis* (100%) and *Corymbia foelscheana* (100%). | | | | |
| **Ground 1:** Mid high closed tussock grassland dominated by *Alloteropsis semialata* (100%), *Petalostigma quadriloculare* (100%) and *Eucalyptus tetrodonta* (100%). | | | | |
| | | | | |
| **No. of sites:** 2 (46) | | | | |
| **Other common species** | | | | |
| **Upper stratum (U1):** - | | | | |
| **Mid stratum (M1):** - | | | | |
| **Ground stratum (G1):** - | | | | |
| **Total area of project area:** 16.182 ha | | | | |
| **Land form:** Gentle side slope, slope 2 to 5% | | | | |
| **Soils:** Brown Kandosols | | **Drainage:** Rapid | | |
| **Structural summary:** | | | | |

| Strata | Modal growth form | Mean cover % | Mean height (m) | NVIS code |
|---|---|---|---|---|
| Upper U1 | Tree | 40 | 16 | T7i |
| Mid M1 | Shrub | 35 | 8 | S3i |
| Ground G1 | Tussock grass | 70 | 1 | G2c |

| **Land unit – 5a** | |
|---|---|
| **NVIS Code:** T7r, (T7i) | |
| **Vegetation Description:** *Eucalyptus alba* mid open woodland over *Pandanus spiralis*, *Lophostemon lactifluus*, *Xanthostemon paradoxus* mid sparse shrubland over *Sorghum intrans*, *Imperata cylindrica* mid tussock grassland. ***And/or*** *Grevillea pteridifolia*, *Pandanus spiralis*, *Lophostemon lactifluus* mid sparse shrubland over *Alloteropsis semialata*, *Sorghum intrans* mid tussock grassland | |
| **Upper 1:** Mid high open woodland dominated by *Eucalyptus alba* (50%), *Syzygium eucalyptoides subsp. bleeseri* ((25%) and *Erythrophleum chlorostachys* (25%) | |
| **Mid 1:** Mid high sparse shrubland dominated by *Pandanus spiralis* (80%), *Grevillea pteridifolia* (66.6%) and *Lophostemon lactifluus* (53.3%) | |
| **Ground 1:** Mid high tussock grassland dominated by *Alloteropsis semialata* (73.3%), *Sorghum intrans* (60%) and *Lophostemon lactifluus* (40%). | |
| | |
| **No. of sites:** 15 (3,6,7,9,15,13,24,28,32,20,18,26,27,12,40) | |
| **Other common species** | |
| **Upper stratum (U1):** - | |
| **Mid stratum (M1):** *Banksia dentata* (6.67%), *Livistona humilis* (20%), *Melaleuca nervosa* (20%), *Petalostigma pubescens* (6.67 %) and *Xanthostemon paradoxus* (6.67%) | |
| **Ground stratum (G1):** *Heteropogon triticeus* (20%), *Imperata cylindrica* (6.6%), *Melaleuca nervosa* (20%), *Pandanus spiralis* (6.6%), *Eriachne Sp*. (20%) and *Sehima nervosum* (13.3%). | |
| **Total area of project area:** 244.224 ha | |
| **Land form:** Narrow alluvial plains with upland terrain, slope <1.0% | |
| **Soils:** Chromosolic Redoxic Hydrosol | **Drainage:** Slow, subject to wet season waterlogging and inundation |

**Structural summary:**

| Strata | Modal growth form | Mean cover % | Mean height (m) | NVIS code |
|---|---|---|---|---|
| Upper U1 | Tree | 10.6 (2 - 25) | 11.3 (3 - 15) | T7i |
| Mid M1 | Shrub | 17.6 (5 - 65) | 4.9 (2 - 10) | S3i |
| Ground G1 | Tussock grass | 67 (50 - 85) | 0.7 (0.5 – 1) | G2c |

| **Land unit – 5b2** | |
|---|---|
| **NVIS Code:** T7c (T8c) | |
| **Vegetation Description:** *Melaleuca leucadendra*, *Corymbia polycarpa*, *Xanthostemon eucalyptoides* mid open forest over *Pandanus aquaticus*, *Xanthostemon eucalyptoides*, *Leptospermum madidum* tall shrubland over sedge sp., *Alloteropsis semialata* high open tussock grassland | |
| **Upper 1:** Mid high open forest dominated by *Melaleuca leucadendra* (75%), *Corymbia polycarpa* (75%) and *Xanthostemon eucalyptoides* (50%) | |
| **Mid 1:** Tall shrubland dominated by *Leptospermum madidum* (75%), *Pandanus aquaticus* (75%) and *Xanthostemon eucalyptoides* (75%) | |
| **Ground 1:** Mid high open tussock grassland dominated by *Sedge sp.* (75%), *Pandanus aquaticus* (50%) and *Alloteropsis semialata* (50%). | |
| | |
| **No. of sites:** 4 (36,38,41 & 43) | |
| **Other common species** | |
| **Upper stratum (U1):** *Melaleuca viridiflora* (25%) and *Syzygium armstrongii* (25%) | |
| **Mid stratum (M1):** *Barringtonia acutangula* (25%), *Helicia australasica* (25%) *and Calophyllum sp.* (25%). | |
| **Ground stratum (G1):** *Flagellaria indica* (25%), *Germania sp* (25%) and *Xanthostemon eucalyptoides* (25%). | |
| **Total area of project area:** 40.625 ha | |
| **Land form:** Narrow drainage floors with incised drainage lines, slope < 1.5% | |
| **Soils:** Kandosolic Redoxic Hydrosol | **Drainage:** Slow, water logged in wet season |
| **Structural summary:** | |

| Strata | Modal growth form | Mean cover % | Mean height (m) | NVIS code |
|---|---|---|---|---|
| Upper U1 | Tree | 55 (50 - 60) | 24 (16 – 32) | T7i |
| Mid M1 | Shrub | 71.25 (65 – 85) | 12.75 (10 – 16) | S3i |
| Ground G1 | Tussock grass | 15 (10 - 20) | 0.72 ( 0.5 – 1) | G2c |

| **Land unit – 6a** | |
|---|---|
| **NVIS Code:** T7i, T7c | |
| **Vegetation Description:** *Corymbia polycarpa*, *Erythrophleum chlorostachys*, *Corymbia confertiflora* mid open woodland over *Grevillea pteridifolia*, *Xanthostemon paradoxus*, *Livistona humilis* mid shrubland over *Alloteropsis semialata*, *Eriachne sp* mid tussock grassland | |
| **Upper 1:** low open woodland dominated by *Erythrophleum chlorostachys* (100%) and *Xanthostemon paradoxus* (100%). | |
| **Mid 1:** Mid high shrubland dominated by *Xanthostemon paradoxus* (100%), *Grevillea pteridifolia* (100%) and *Banksia dentata* (100%). | |
| **Ground 1:** Mid high tussock grassland dominated by *Alloteropsis semialata* (100%), *Syzygium eucalyptoides subsp. bleeseri* (100%) and *Eriachne sp.* (100%) | |
| | |
| **No. of sites:** 1 (1) | |
| **Other common species** | |
| **Upper stratum (U1):** - | |
| **Mid stratum (M1):** - | |
| **Ground stratum (G1):** - | |
| **Total area of project area:** 8.886 ha | |
| **Land form:** Broad lowland plains, slope >0.5% | |
| **Soils:** Chromosolic Redoxic Hydrosol | **Drainage:** Very Slow, subject to wet season inundation |

**Structural summary:**

| Strata | Modal growth form | Mean cover % | Mean height (m) | NVIS code |
|---|---|---|---|---|
| Upper U1 | Tree | 15 | 7.5 | T7i |
| Mid M1 | Shrub | 10 | 6 | S3i |
| Ground G1 | Tussock grass | 60 | 0.8 | G2c |

| **Land unit – 6b** | |
|---|---|
| **NVIS Code:** T7r (T6r, T7i) | |
| **Vegetation Description:** *Corymbia polycarpa*, *Erythrophleum chlorostachys*, *Corymbia confertiflora* mid open woodland over *Grevillea pteridifolia*, *Xanthostemon paradoxus*, *Livistona humilis* mid shrubland over *Alloteropsis semialata*, *Eriachne sp* mid tussock grassland | |
| **Upper 1:** Mid high open woodland dominated by *Corymbia polycarpa* (72.7%), *Corymbia polycarpa* (54.5%) and *Corymbia confertiflora* (27.2%). | |
| **Mid 1:** Mid high shrubland dominated by *Grevillea pteridifolia* (53.33%), *Livistona humilis* (45.45%) and *Xanthostemon paradoxus* (33.33%). | |
| **Ground 1:** Mid high tussock grassland dominated by *Alloteropsis semialata* (100%), *Eriachne sp.* (54.5%) and *Lophostemon lactifluus* (26.6%). | |
| | |
| **No. of sites:** 11 (4,10,14,16,19,21,29,34,35,42,48) | |
| **Other common species** | |
| **Upper stratum (U1): -** *Corymbia bella* (9.09%), *Lophostemon lactifluus* (9.09%), *Melaleuca nervosa* (9.09%) and *Syzygium eucalyptoides subsp. bleeseri* (9.09%). | |
| **Mid stratum (M1):** - *Banksia dentata* (18.18%), *Erythrophleum chlorostachys* (18.18%), *Lophostemon lactifluus* (18.18%), *Melaleuca nervosa* (9.09%) and *Verticordia cunninghamii* (9.09%) | |
| **Ground stratum (G1):** - Heteropogon triticeus (9.09%), Melaleuca nervosa (9.09%), *Sorghum intrans* (9.09%), *Sehima nervosum* (9.09%), *Eriachne sp.* (18.18%) and *Eriachne ciliata* (9.09%). | |
| **Total area of project area:** 229.350 ha | |
| **Land form:** Broad drainage floors and creek margins | |
| **Soils:** Tenosolic Oxyaquic Hydrosol | **Drainage:** Slow, subject to wet season inundation |

**Structural summary:**

| Strata | Modal growth form | Mean cover % | Mean height (m) | NVIS code |
|---|---|---|---|---|
| Upper U1 | Tree | 17.8 (2 – 35) | 11.3 (7 – 16) | T7i |
| Mid M1 | Shrub | 32.3 ( 10 – 60) | 7.1 (6 – 9) | S3i |
| Ground G1 | Tussock grass | 53.2 (30 – 70) | 0.81 (0.8 – 1) | G2c |

| **Land unit – 7a** | |
|---|---|
| **NVIS Code:** T7r (T6r, T7i) | |
| **Vegetation Description:** *Grevillea pteridifolia*, *Pandanus spiralis*, *Lophostemon lactifluus* mid sparse shrubland over *Alloteropsis semialata*, *Sorghum intrans* mid tussock grassland | |
| **Upper 1:** Mid high shrubland dominated by *Corymbia confertiflora* (33.3%) | |
| **Mid 1:** Mid high shrubland dominated by *Melaleuca viridiflora* (66.6%) | |
| **Ground 1:** Mid high tussock grassland dominated by Sehima nervosum ((66.6%) and *Eriachne sp.* (66.6%) | |
| | |
| **No. of sites:** 3 (39,44,45) | |
| **Other common species** | |
| **Upper stratum (U1): -** | |
| **Mid stratum (M1):** *Banksia dentata* (33.3%), *Erythrophleum chlorostachys* (33.3%), *Grevillea pteridifolia, Livistona humilis* (33.3%) and *Xanthostemon paradoxus* (33.3%). | |
| **Ground stratum (G1):** *Alloteropsis semialata* (33.3%), *Melaleuca viridiflora* (33.3%), *Sorghum intrans* (33.3%), *Syzygium eucalyptoides subsp.bleeseri* (33.3%) and *Eriachne ciliata* (33.3%). | |
| **Total area of project area:** 47.156 ha | |
| **Land form:** Fringes and levees of major channels, Slope 0.5 to 2% | |
| **Soils:** Brown Kandosols | **Drainage:** Medium, occasional wet season inundation |

**Structural summary:**

| Strata | Modal growth form | Mean cover % | Mean height (m) | NVIS code |
|---|---|---|---|---|
| Upper U1 | Tree | 4 | 10 | T7i |
| Mid M1 | Shrub | 25 (15 – 30) | 6.6 (5 – 9) | S3i |
| Ground G1 | Tussock grass | 51.6 (50 – 55) | 0.9 (0.8 – 1) | G2c |

# APPENDIX B EPBC PROTECTED MATTERS SEARCH REPORT

Australian Government
Department of the Environment and Energy

# EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

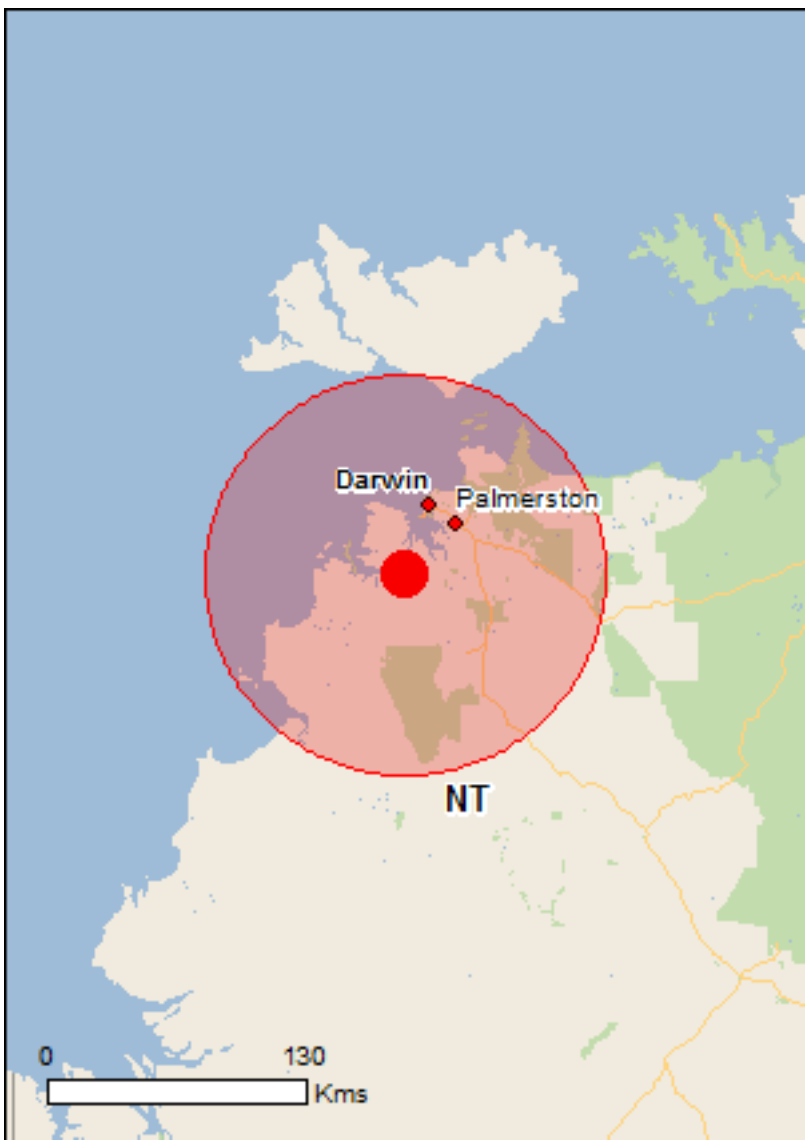
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 19/12/19 13:11:32


Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements


This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 100.0Km

# Summary

## Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

| | |
|---|---|
| World Heritage Properties: | None |
| National Heritage Places: | None |
| Wetlands of International Importance: | None |
| Great Barrier Reef Marine Park: | None |
| Commonwealth Marine Area: | 1 |
| Listed Threatened Ecological Communities: | None |
| Listed Threatened Species: | 58 |
| Listed Migratory Species: | 73 |

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

| | |
|---|---|
| Commonwealth Land: | 36 |
| Commonwealth Heritage Places: | 8 |
| Listed Marine Species: | 111 |
| Whales and Other Cetaceans: | 15 |
| Critical Habitats: | None |
| Commonwealth Reserves Terrestrial: | None |
| Australian Marine Parks: | None |

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

| | |
|---|---|
| State and Territory Reserves: | 25 |
| Regional Forest Agreements: | None |
| Invasive Species: | 34 |
| Nationally Important Wetlands: | 7 |
| Key Ecological Features (Marine) | None |

# Details

## Matters of National Environmental Significance

### Commonwealth Marine Area [ Resource Information ]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

| Name |
|---|
| EEZ and Territorial Sea |

### Marine Regions [ Resource Information ]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

| Name |
|---|
| North |

### Listed Threatened Species [ Resource Information ]

| Name | Status | Type of Presence |
|---|---|---|
| Birds | | |
| Calidris canutus<br>Red Knot, Knot [855] | Endangered | Species or species habitat known to occur within area |
| Calidris ferruginea<br>Curlew Sandpiper [856] | Critically Endangered | Species or species habitat known to occur within area |
| Calidris tenuirostris<br>Great Knot [862] | Critically Endangered | Roosting known to occur within area |
| Charadrius leschenaultii<br>Greater Sand Plover, Large Sand Plover [877] | Vulnerable | Roosting known to occur within area |
| Charadrius mongolus<br>Lesser Sand Plover, Mongolian Plover [879] | Endangered | Roosting known to occur within area |
| Epthianura crocea  tunneyi<br>Alligator Rivers Yellow Chat, Yellow Chat (Alligator Rivers) [67089] | Endangered | Species or species habitat known to occur within area |
| Erythrotriorchis radiatus<br>Red Goshawk [942] | Vulnerable | Species or species habitat known to occur within area |
| Erythrura gouldiae<br>Gouldian Finch [413] | Endangered | Species or species habitat known to occur within area |
| Falcunculus frontatus  whitei<br>Crested Shrike-tit (northern), Northern Shrike-tit [26013] | Vulnerable | Species or species habitat likely to occur within area |
| Geophaps smithii  smithii<br>Partridge Pigeon (eastern) [64441] | Vulnerable | Species or species |

| Name | Status | Type of Presence |
|---|---|---|
| | | habitat known to occur within area |
| Limosa lapponica baueri<br>Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380] | Vulnerable | Species or species habitat may occur within area |
| Limosa lapponica menzbieri<br>Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432] | Critically Endangered | Species or species habitat may occur within area |
| Melanodryas cucullata melvillensis<br>Tiwi Islands Hooded Robin, Hooded Robin (Tiwi Islands) [67092] | Critically Endangered | Species or species habitat likely to occur within area |
| Numenius madagascariensis<br>Eastern Curlew, Far Eastern Curlew [847] | Critically Endangered | Species or species habitat known to occur within area |
| Rostratula australis<br>Australian Painted Snipe [77037] | Endangered | Species or species habitat known to occur within area |
| Tyto novaehollandiae kimberli<br>Masked Owl (northern) [26048] | Vulnerable | Species or species habitat known to occur within area |
| Tyto novaehollandiae melvillensis<br>Tiwi Masked Owl, Tiwi Islands Masked Owl [26049] | Endangered | Species or species habitat known to occur within area |
| Mammals | | |
| Antechinus bellus<br>Fawn Antechinus [344] | Vulnerable | Species or species habitat known to occur within area |
| Balaenoptera borealis<br>Sei Whale [34] | Vulnerable | Species or species habitat may occur within area |
| Balaenoptera musculus<br>Blue Whale [36] | Endangered | Species or species habitat may occur within area |
| Balaenoptera physalus<br>Fin Whale [37] | Vulnerable | Species or species habitat may occur within area |
| Conilurus penicillatus<br>Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132] | Vulnerable | Species or species habitat known to occur within area |
| Dasyurus hallucatus<br>Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331] | Endangered | Species or species habitat known to occur within area |
| Hipposideros inornatus<br>Arnhem Leaf-nosed Bat [86675] | Endangered | Species or species habitat may occur within area |
| Macroderma gigas<br>Ghost Bat [174] | Vulnerable | Breeding known to occur within area |
| Megaptera novaeangliae<br>Humpback Whale [38] | Vulnerable | Species or species habitat may occur within area |
| Mesembriomys gouldii gouldii<br>Black-footed Tree-rat (Kimberley and mainland Northern Territory), Djintamoonga, Manbul [87618] | Endangered | Species or species habitat known to occur within area |
| Mesembriomys gouldii melvillensis<br>Black-footed Tree-rat (Melville Island) [87619] | Vulnerable | Species or species habitat known to occur |

| Name | Status | Type of Presence within area |
|---|---|---|
| Petrogale concinna canescens<br>Nabarlek (Top End) [87606] | Endangered | Species or species habitat known to occur within area |
| Phascogale pirata<br>Northern Brush-tailed Phascogale [82954] | Vulnerable | Species or species habitat known to occur within area |
| Saccolaimus saccolaimus nudicluniatus<br>Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889] | Vulnerable | Species or species habitat known to occur within area |
| Sminthopsis butleri<br>Butler's Dunnart [302] | Vulnerable | Species or species habitat known to occur within area |
| Xeromys myoides<br>Water Mouse, False Water Rat, Yirrkoo [66] | Vulnerable | Species or species habitat known to occur within area |
| **Plants** | | |
| Atalaya brevialata<br>[86125] | Critically Endangered | Species or species habitat known to occur within area |
| Burmannia sp. Bathurst Island (R.Fensham 1021)<br>[82017] | Endangered | Species or species habitat likely to occur within area |
| Clausena excavata<br>[68631] | Critically Endangered | Species or species habitat known to occur within area |
| Goodenia quadrifida<br>[56035] | Vulnerable | Species or species habitat known to occur within area |
| Helicteres macrothrix<br>[86586] | Endangered | Species or species habitat known to occur within area |
| Stylidium ensatum<br>a triggerplant [86366] | Endangered | Species or species habitat known to occur within area |
| Typhonium jonesii<br>a herb [62412] | Endangered | Species or species habitat likely to occur within area |
| Typhonium mirabile<br>a herb [79227] | Endangered | Species or species habitat likely to occur within area |
| Typhonium taylori<br>a herb [65904] | Endangered | Species or species habitat likely to occur within area |
| Xylopia monosperma<br>a shrub [82030] | Endangered | Species or species habitat likely to occur within area |
| **Reptiles** | | |
| Acanthophis hawkei<br>Plains Death Adder [83821] | Vulnerable | Species or species habitat known to occur within area |
| Caretta caretta<br>Loggerhead Turtle [1763] | Endangered | Foraging, feeding or related behaviour known to occur within area |
| Chelonia mydas<br>Green Turtle [1765] | Vulnerable | Breeding known to occur |

| Name | Status | Type of Presence |
|---|---|---|
| | | within area |
| Dermochelys coriacea<br>Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Breeding likely to occur within area |
| Eretmochelys imbricata<br>Hawksbill Turtle [1766] | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| Lepidochelys olivacea<br>Olive Ridley Turtle, Pacific Ridley Turtle [1767] | Endangered | Breeding known to occur within area |
| Lucasium occultum<br>Yellow-snouted Gecko, Yellow-snouted Ground Gecko [82993] | Endangered | Species or species habitat likely to occur within area |
| Natator depressus<br>Flatback Turtle [59257] | Vulnerable | Breeding known to occur within area |
| Sharks | | |
| Carcharodon carcharias<br>White Shark, Great White Shark [64470] | Vulnerable | Species or species habitat may occur within area |
| Glyphis garricki<br>Northern River Shark, New Guinea River Shark [82454] | Endangered | Breeding known to occur within area |
| Glyphis glyphis<br>Speartooth Shark [82453] | Critically Endangered | Species or species habitat known to occur within area |
| Pristis clavata<br>Dwarf Sawfish, Queensland Sawfish [68447] | Vulnerable | Species or species habitat known to occur within area |
| Pristis pristis<br>Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756] | Vulnerable | Species or species habitat known to occur within area |
| Pristis zijsron<br>Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442] | Vulnerable | Species or species habitat known to occur within area |
| Rhincodon typus<br>Whale Shark [66680] | Vulnerable | Species or species habitat may occur within area |

Listed Migratory Species [ Resource Information ]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

| Name | Threatened | Type of Presence |
|---|---|---|
| Migratory Marine Birds | | |
| Anous stolidus<br>Common Noddy [825] | | Species or species habitat likely to occur within area |
| Apus pacificus<br>Fork-tailed Swift [678] | | Species or species habitat likely to occur within area |
| Calonectris leucomelas<br>Streaked Shearwater [1077] | | Species or species habitat known to occur within area |
| Fregata ariel<br>Lesser Frigatebird, Least Frigatebird [1012] | | Species or species habitat known to occur within area |
| Fregata minor<br>Great Frigatebird, Greater Frigatebird [1013] | | Species or species habitat known to occur within area |

| Name | Threatened | Type of Presence |
|---|---|---|
| Sternula albifrons | | |
| Little Tern [82849] | | Breeding known to occur within area |
| Migratory Marine Species | | |
| Anoxypristis cuspidata | | |
| Narrow Sawfish, Knifetooth Sawfish [68448] | | Species or species habitat known to occur within area |
| Balaenoptera borealis | | |
| Sei Whale [34] | Vulnerable | Species or species habitat may occur within area |
| Balaenoptera edeni | | |
| Bryde's Whale [35] | | Species or species habitat may occur within area |
| Balaenoptera musculus | | |
| Blue Whale [36] | Endangered | Species or species habitat may occur within area |
| Balaenoptera physalus | | |
| Fin Whale [37] | Vulnerable | Species or species habitat may occur within area |
| Carcharodon carcharias | | |
| White Shark, Great White Shark [64470] | Vulnerable | Species or species habitat may occur within area |
| Caretta caretta | | |
| Loggerhead Turtle [1763] | Endangered | Foraging, feeding or related behaviour known to occur within area |
| Chelonia mydas | | |
| Green Turtle [1765] | Vulnerable | Breeding known to occur within area |
| Crocodylus porosus | | |
| Salt-water Crocodile, Estuarine Crocodile [1774] | | Species or species habitat likely to occur within area |
| Dermochelys coriacea | | |
| Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Breeding likely to occur within area |
| Dugong dugon | | |
| Dugong [28] | | Species or species habitat known to occur within area |
| Eretmochelys imbricata | | |
| Hawksbill Turtle [1766] | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| Isurus oxyrinchus | | |
| Shortfin Mako, Mako Shark [79073] | | Species or species habitat likely to occur within area |
| Isurus paucus | | |
| Longfin Mako [82947] | | Species or species habitat likely to occur within area |
| Lepidochelys olivacea | | |
| Olive Ridley Turtle, Pacific Ridley Turtle [1767] | Endangered | Breeding known to occur within area |
| Manta alfredi | | |
| Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994] | | Species or species habitat likely to occur within area |
| Manta birostris | | |
| Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995] | | Species or species habitat likely to occur within area |
| Megaptera novaeangliae | | |
| Humpback Whale [38] | Vulnerable | Species or species habitat may occur within area |

| Name | Threatened | Type of Presence |
|---|---|---|
| Natator depressus<br>Flatback Turtle [59257] | Vulnerable | Breeding known to occur within area |
| Orcaella heinsohni<br>Australian Snubfin  Dolphin [81322] | | Species or species habitat known to occur within area |
| Orcinus orca<br>Killer Whale, Orca [46] | | Species or species habitat may occur within area |
| Pristis clavata<br>Dwarf Sawfish, Queensland Sawfish [68447] | Vulnerable | Species or species habitat known to occur within area |
| Pristis pristis<br>Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756] | Vulnerable | Species or species habitat known to occur within area |
| Pristis zijsron<br>Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442] | Vulnerable | Species or species habitat known to occur within area |
| Rhincodon typus<br>Whale Shark [66680] | Vulnerable | Species or species habitat may occur within area |
| Sousa chinensis<br>Indo-Pacific Humpback Dolphin [50] | | Breeding known to occur within area |
| Tursiops aduncus  (Arafura/Timor Sea populations)<br>Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900] | | Species or species habitat known to occur within area |
| **Migratory Terrestrial Species** | | |
| Cecropis daurica<br>Red-rumped Swallow [80610] | | Species or species habitat known to occur within area |
| Cuculus optatus<br>Oriental Cuckoo, Horsfield's Cuckoo [86651] | | Species or species habitat known to occur within area |
| Hirundo rustica<br>Barn Swallow [662] | | Species or species habitat known to occur within area |
| Motacilla cinerea<br>Grey Wagtail [642] | | Species or species habitat known to occur within area |
| Motacilla flava<br>Yellow Wagtail [644] | | Species or species habitat known to occur within area |
| Rhipidura rufifrons<br>Rufous Fantail [592] | | Species or species habitat known to occur within area |
| **Migratory Wetlands Species** | | |
| Acrocephalus orientalis<br>Oriental Reed-Warbler [59570] | | Species or species habitat may occur within area |
| Actitis hypoleucos<br>Common Sandpiper [59309] | | Species or species habitat known to occur within area |
| Arenaria interpres<br>Ruddy Turnstone [872] | | Roosting known to occur within area |
| Calidris acuminata<br>Sharp-tailed Sandpiper [874] | | Roosting known to occur |

| Name | Threatened | Type of Presence |
|---|---|---|
| | | within area |
| Calidris alba<br>Sanderling [875] | | Roosting known to occur within area |
| Calidris canutus<br>Red Knot, Knot [855] | Endangered | Species or species habitat known to occur within area |
| Calidris ferruginea<br>Curlew Sandpiper [856] | Critically Endangered | Species or species habitat known to occur within area |
| Calidris melanotos<br>Pectoral Sandpiper [858] | | Species or species habitat known to occur within area |
| Calidris ruficollis<br>Red-necked Stint [860] | | Roosting known to occur within area |
| Calidris subminuta<br>Long-toed Stint [861] | | Roosting known to occur within area |
| Calidris tenuirostris<br>Great Knot [862] | Critically Endangered | Roosting known to occur within area |
| Charadrius dubius<br>Little Ringed Plover [896] | | Roosting known to occur within area |
| Charadrius leschenaultii<br>Greater Sand Plover, Large Sand Plover [877] | Vulnerable | Roosting known to occur within area |
| Charadrius mongolus<br>Lesser Sand Plover, Mongolian Plover [879] | Endangered | Roosting known to occur within area |
| Charadrius veredus<br>Oriental Plover, Oriental Dotterel [882] | | Roosting known to occur within area |
| Gallinago megala<br>Swinhoe's Snipe [864] | | Roosting known to occur within area |
| Gallinago stenura<br>Pin-tailed Snipe [841] | | Roosting likely to occur within area |
| Glareola maldivarum<br>Oriental Pratincole [840] | | Roosting known to occur within area |
| Limicola falcinellus<br>Broad-billed Sandpiper [842] | | Roosting known to occur within area |
| Limnodromus semipalmatus<br>Asian Dowitcher [843] | | Roosting known to occur within area |
| Limosa lapponica<br>Bar-tailed Godwit [844] | | Species or species habitat known to occur within area |
| Limosa limosa<br>Black-tailed Godwit [845] | | Roosting known to occur within area |
| Numenius madagascariensis<br>Eastern Curlew, Far Eastern Curlew [847] | Critically Endangered | Species or species habitat known to occur within area |
| Numenius minutus<br>Little Curlew, Little Whimbrel [848] | | Roosting known to occur within area |
| Numenius phaeopus<br>Whimbrel [849] | | Roosting known to occur within area |
| Pandion haliaetus<br>Osprey [952] | | Breeding known to occur within area |

| Name | Threatened | Type of Presence |
|---|---|---|
| Pluvialis fulva<br>Pacific Golden Plover [25545] | | Roosting known to occur within area |
| Pluvialis squatarola<br>Grey Plover [865] | | Roosting known to occur within area |
| Tringa brevipes<br>Grey-tailed Tattler [851] | | Roosting known to occur within area |
| Tringa glareola<br>Wood Sandpiper [829] | | Roosting known to occur within area |
| Tringa incana<br>Wandering Tattler [831] | | Roosting known to occur within area |
| Tringa nebularia<br>Common Greenshank, Greenshank [832] | | Species or species habitat known to occur within area |
| Tringa stagnatilis<br>Marsh Sandpiper, Little Greenshank [833] | | Roosting known to occur within area |
| Xenus cinereus<br>Terek Sandpiper [59300] | | Roosting known to occur within area |

## Other Matters Protected by the EPBC Act

### Commonwealth Land [ Resource Information ]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

| Name |
|---|
| Commonwealth Land - |
| Commonwealth Land - Australian Customs Service |
| Commonwealth Land - Australian Government Solicitor |
| Commonwealth Land - Department of Administrative Services |
| Commonwealth Land - Department of Community Services & Health |
| Commonwealth Land - Department of Immigration Local Government & Ethnic Affairs |
| Commonwealth Land - Department of Transport & Regional Development |
| Commonwealth Land - Deputy Crown Solicitor |
| Commonwealth Land - Director of Property Services Defence Estate |
| Commonwealth Land - National Transmission Agency |
| Defence - AUSTRALIAN ARMY BAND - DARWIN |
| Defence - BERRIMAH ONE |
| Defence - DARWIN - AP10 RADAR SITE - LEE POINT |
| Defence - DARWIN - AP3 RECEIVING STATION - LEE POINT |
| Defence - DARWIN - TRANSMITTING STATION '11 MILE' |
| Defence - DARWIN RELOCATIONS CENTRE |
| Defence - DARWIN RIVER GRAVEL QUARRY |
| Defence - DEFENCE FORCE CAREERS REFERENCE CENTRE |
| Defence - ELIZABETH DOWNS STATION RADAR SITE |
| Defence - Esanda Builidng |
| Defence - HMAS COONAWARRA (Berrimah) |
| Defence - HUMPTY DOO TRANSMITTING STATION |
| Defence - KANGAROO FLATS TRAINING AREA |
| Defence - KOWANDI NORTH COMMUNICATION STATION |
| Defence - KOWANDI SOUTH REPEATING STATION |
| Defence - LARRAKEYAH BARRACKS |
| Defence - LEANYER BOMBING RANGE |
| Defence - MT GOODWIN RADAR SITE |
| Defence - Patrol Boat Base (DARWIN NAVAL BASE) |
| Defence - QUAIL ISLAND BOMBING RANGE |
| Defence - RAAF BASE DARWIN |
| Defence - ROBERTSON BARRACKS (Waler Barracks) |
| Defence - SHOAL BAY RECEIVING STATION |
| Defence - STOKES HILL OIL FUEL INSTALLATION |

| Name |
|---|
| Defence - WINNELLIE ONE |
| Defence - WINNELLIE TWO |

## Commonwealth Heritage Places [ Resource Information ]

| Name | State | Status |
|---|---|---|
| Historic | | |
| Adelaide River War Cemetery | NT | Listed place |
| Larrakeyah Barracks Headquarters Building | NT | Listed place |
| Larrakeyah Barracks Precinct | NT | Listed place |
| Larrakeyah Barracks Sergeants Mess | NT | Listed place |
| RAAF Base Commanding Officers Residence | NT | Listed place |
| RAAF Base Precinct | NT | Listed place |
| RAAF Base Tropical Housing Type 2 | NT | Listed place |
| RAAF Base Tropical Housing Type 3 | NT | Listed place |

## Listed Marine Species [ Resource Information ]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

| Name | Threatened | Type of Presence |
|---|---|---|
| Birds | | |
| Acrocephalus orientalis<br>Oriental Reed-Warbler [59570] | | Species or species habitat may occur within area |
| Actitis hypoleucos<br>Common Sandpiper [59309] | | Species or species habitat known to occur within area |
| Anous stolidus<br>Common Noddy [825] | | Species or species habitat likely to occur within area |
| Anseranas semipalmata<br>Magpie Goose [978] | | Species or species habitat may occur within area |
| Apus pacificus<br>Fork-tailed Swift [678] | | Species or species habitat likely to occur within area |
| Ardea alba<br>Great Egret, White Egret [59541] | | Breeding known to occur within area |
| Ardea ibis<br>Cattle Egret [59542] | | Breeding likely to occur within area |
| Arenaria interpres<br>Ruddy Turnstone [872] | | Roosting known to occur within area |
| Calidris acuminata<br>Sharp-tailed Sandpiper [874] | | Roosting known to occur within area |
| Calidris alba<br>Sanderling [875] | | Roosting known to occur within area |
| Calidris canutus<br>Red Knot, Knot [855] | Endangered | Species or species habitat known to occur within area |
| Calidris ferruginea<br>Curlew Sandpiper [856] | Critically Endangered | Species or species habitat known to occur within area |
| Calidris melanotos<br>Pectoral Sandpiper [858] | | Species or species habitat known to occur within area |
| Calidris ruficollis<br>Red-necked Stint [860] | | Roosting known to occur within area |
| Calidris subminuta<br>Long-toed Stint [861] | | Roosting known to occur |

| Name | Threatened | Type of Presence |
|---|---|---|
| | | within area |
| Calidris tenuirostris<br>Great Knot [862] | Critically Endangered | Roosting known to occur within area |
| Calonectris leucomelas<br>Streaked Shearwater [1077] | | Species or species habitat known to occur within area |
| Charadrius dubius<br>Little Ringed Plover [896] | | Roosting known to occur within area |
| Charadrius leschenaultii<br>Greater Sand Plover, Large Sand Plover [877] | Vulnerable | Roosting known to occur within area |
| Charadrius mongolus<br>Lesser Sand Plover, Mongolian Plover [879] | Endangered | Roosting known to occur within area |
| Charadrius ruficapillus<br>Red-capped Plover [881] | | Roosting known to occur within area |
| Charadrius veredus<br>Oriental Plover, Oriental Dotterel [882] | | Roosting known to occur within area |
| Chrysococcyx osculans<br>Black-eared Cuckoo [705] | | Species or species habitat known to occur within area |
| Fregata ariel<br>Lesser Frigatebird, Least Frigatebird [1012] | | Species or species habitat known to occur within area |
| Fregata minor<br>Great Frigatebird, Greater Frigatebird [1013] | | Species or species habitat known to occur within area |
| Gallinago megala<br>Swinhoe's Snipe [864] | | Roosting known to occur within area |
| Gallinago stenura<br>Pin-tailed Snipe [841] | | Roosting likely to occur within area |
| Glareola maldivarum<br>Oriental Pratincole [840] | | Roosting known to occur within area |
| Haliaeetus leucogaster<br>White-bellied Sea-Eagle [943] | | Breeding known to occur within area |
| Heteroscelus brevipes<br>Grey-tailed Tattler [59311] | | Roosting known to occur within area |
| Heteroscelus incanus<br>Wandering Tattler [59547] | | Roosting known to occur within area |
| Himantopus himantopus<br>Pied Stilt, Black-winged Stilt [870] | | Roosting known to occur within area |
| Hirundo daurica<br>Red-rumped Swallow [59480] | | Species or species habitat known to occur within area |
| Hirundo rustica<br>Barn Swallow [662] | | Species or species habitat known to occur within area |
| Limicola falcinellus<br>Broad-billed Sandpiper [842] | | Roosting known to occur within area |
| Limnodromus semipalmatus<br>Asian Dowitcher [843] | | Roosting known to occur within area |
| Limosa lapponica<br>Bar-tailed Godwit [844] | | Species or species |

| Name | Threatened | Type of Presence |
|---|---|---|
| | | habitat known to occur within area |
| Limosa limosa<br>Black-tailed Godwit [845] | | Roosting known to occur within area |
| Merops ornatus<br>Rainbow Bee-eater [670] | | Species or species habitat may occur within area |
| Motacilla cinerea<br>Grey Wagtail [642] | | Species or species habitat known to occur within area |
| Motacilla flava<br>Yellow Wagtail [644] | | Species or species habitat known to occur within area |
| Numenius madagascariensis<br>Eastern Curlew, Far Eastern Curlew [847] | Critically Endangered | Species or species habitat known to occur within area |
| Numenius minutus<br>Little Curlew, Little Whimbrel [848] | | Roosting known to occur within area |
| Numenius phaeopus<br>Whimbrel [849] | | Roosting known to occur within area |
| Pandion haliaetus<br>Osprey [952] | | Breeding known to occur within area |
| Pluvialis fulva<br>Pacific Golden Plover [25545] | | Roosting known to occur within area |
| Pluvialis squatarola<br>Grey Plover [865] | | Roosting known to occur within area |
| Rhipidura rufifrons<br>Rufous Fantail [592] | | Species or species habitat known to occur within area |
| Rostratula benghalensis (sensu lato)<br>Painted Snipe [889] | Endangered* | Species or species habitat known to occur within area |
| Sterna albifrons<br>Little Tern [813] | | Breeding known to occur within area |
| Stiltia isabella<br>Australian Pratincole [818] | | Roosting known to occur within area |
| Tringa glareola<br>Wood Sandpiper [829] | | Roosting known to occur within area |
| Tringa nebularia<br>Common Greenshank, Greenshank [832] | | Species or species habitat known to occur within area |
| Tringa stagnatilis<br>Marsh Sandpiper, Little Greenshank [833] | | Roosting known to occur within area |
| Xenus cinereus<br>Terek Sandpiper [59300] | | Roosting known to occur within area |
| Fish | | |
| Campichthys tricarinatus<br>Three-keel Pipefish [66192] | | Species or species habitat may occur within area |
| Choeroichthys brachysoma<br>Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194] | | Species or species habitat may occur within area |

| Name | Threatened | Type of Presence |
|---|---|---|
| Choeroichthys suillus<br>Pig-snouted Pipefish [66198] | | Species or species habitat may occur within area |
| Corythoichthys amplexus<br>Fijian Banded Pipefish, Brown-banded Pipefish [66199] | | Species or species habitat may occur within area |
| Corythoichthys flavofasciatus<br>Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200] | | Species or species habitat may occur within area |
| Corythoichthys haematopterus<br>Reef-top Pipefish [66201] | | Species or species habitat may occur within area |
| Corythoichthys schultzi<br>Schultz's Pipefish [66205] | | Species or species habitat may occur within area |
| Doryrhamphus excisus<br>Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211] | | Species or species habitat may occur within area |
| Doryrhamphus janssi<br>Cleaner Pipefish, Janss' Pipefish [66212] | | Species or species habitat may occur within area |
| Festucalex cinctus<br>Girdled Pipefish [66214] | | Species or species habitat may occur within area |
| Halicampus brocki<br>Brock's Pipefish [66219] | | Species or species habitat may occur within area |
| Halicampus grayi<br>Mud Pipefish, Gray's Pipefish [66221] | | Species or species habitat may occur within area |
| Halicampus spinirostris<br>Spiny-snout Pipefish [66225] | | Species or species habitat may occur within area |
| Haliichthys taeniophorus<br>Ribboned Pipehorse, Ribboned Seadragon [66226] | | Species or species habitat may occur within area |
| Hippichthys cyanospilos<br>Blue-speckled Pipefish, Blue-spotted Pipefish [66228] | | Species or species habitat may occur within area |
| Hippichthys parvicarinatus<br>Short-keel Pipefish, Short-keeled Pipefish [66230] | | Species or species habitat may occur within area |
| Hippichthys penicillus<br>Beady Pipefish, Steep-nosed Pipefish [66231] | | Species or species habitat may occur within area |
| Hippocampus histrix<br>Spiny Seahorse, Thorny Seahorse [66236] | | Species or species habitat may occur within area |
| Hippocampus kuda<br>Spotted Seahorse, Yellow Seahorse [66237] | | Species or species habitat may occur within area |
| Hippocampus planifrons<br>Flat-face Seahorse [66238] | | Species or species habitat may occur within area |

| Name | Threatened | Type of Presence |
|---|---|---|
| Hippocampus spinosissimus<br>Hedgehog Seahorse [66239] | | Species or species habitat may occur within area |
| Micrognathus micronotopterus<br>Tidepool Pipefish [66255] | | Species or species habitat may occur within area |
| Solegnathus hardwickii<br>Pallid Pipehorse, Hardwick's Pipehorse [66272] | | Species or species habitat may occur within area |
| Solegnathus lettiensis<br>Gunther's Pipehorse, Indonesian Pipefish [66273] | | Species or species habitat may occur within area |
| Solenostomus cyanopterus<br>Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183] | | Species or species habitat may occur within area |
| Syngnathoides biaculeatus<br>Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279] | | Species or species habitat may occur within area |
| Trachyrhamphus bicoarctatus<br>Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280] | | Species or species habitat may occur within area |
| Trachyrhamphus longirostris<br>Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281] | | Species or species habitat may occur within area |
| **Mammals** | | |
| Dugong dugon<br>Dugong [28] | | Species or species habitat known to occur within area |
| **Reptiles** | | |
| Acalyptophis peronii<br>Horned Seasnake [1114] | | Species or species habitat may occur within area |
| Aipysurus duboisii<br>Dubois' Seasnake [1116] | | Species or species habitat may occur within area |
| Aipysurus eydouxii<br>Spine-tailed Seasnake [1117] | | Species or species habitat may occur within area |
| Aipysurus laevis<br>Olive Seasnake [1120] | | Species or species habitat may occur within area |
| Astrotia stokesii<br>Stokes' Seasnake [1122] | | Species or species habitat may occur within area |
| Caretta caretta<br>Loggerhead Turtle [1763] | Endangered | Foraging, feeding or related behaviour known to occur within area |
| Chelonia mydas<br>Green Turtle [1765] | Vulnerable | Breeding known to occur within area |
| Crocodylus johnstoni<br>Freshwater Crocodile, Johnston's Crocodile, Johnston's River Crocodile [1773] | | Species or species habitat may occur within area |
| Crocodylus porosus<br>Salt-water Crocodile, Estuarine Crocodile [1774] | | Species or species habitat likely to occur within area |

| Name | Threatened | Type of Presence |
|---|---|---|
| Dermochelys coriacea<br>Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Breeding likely to occur within area |
| Disteira kingii<br>Spectacled Seasnake [1123] | | Species or species habitat may occur within area |
| Disteira major<br>Olive-headed Seasnake [1124] | | Species or species habitat may occur within area |
| Enhydrina schistosa<br>Beaked Seasnake [1126] | | Species or species habitat may occur within area |
| Eretmochelys imbricata<br>Hawksbill Turtle [1766] | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| Hydrelaps darwiniensis<br>Black-ringed Seasnake [1100] | | Species or species habitat may occur within area |
| Hydrophis atriceps<br>Black-headed Seasnake [1101] | | Species or species habitat may occur within area |
| Hydrophis coggeri<br>Slender-necked Seasnake [25925] | | Species or species habitat may occur within area |
| Hydrophis elegans<br>Elegant Seasnake [1104] | | Species or species habitat may occur within area |
| Hydrophis inornatus<br>Plain Seasnake [1107] | | Species or species habitat may occur within area |
| Hydrophis mcdowelli<br>null [25926] | | Species or species habitat may occur within area |
| Hydrophis ornatus<br>Spotted Seasnake, Ornate Reef Seasnake [1111] | | Species or species habitat may occur within area |
| Hydrophis pacificus<br>Large-headed Seasnake, Pacific Seasnake [1112] | | Species or species habitat may occur within area |
| Lapemis hardwickii<br>Spine-bellied Seasnake [1113] | | Species or species habitat may occur within area |
| Lepidochelys olivacea<br>Olive Ridley Turtle, Pacific Ridley Turtle [1767] | Endangered | Breeding known to occur within area |
| Natator depressus<br>Flatback Turtle [59257] | Vulnerable | Breeding known to occur within area |
| Parahydrophis mertoni<br>Northern Mangrove Seasnake [1090] | | Species or species habitat may occur within area |
| Pelamis platurus<br>Yellow-bellied Seasnake [1091] | | Species or species habitat may occur within area |

| Whales and other Cetaceans | | [ Resource Information ] |
|---|---|---|
| Name | Status | Type of Presence |
| Mammals | | |

| Name | Status | Type of Presence |
|---|---|---|
| Balaenoptera borealis<br>Sei Whale [34] | Vulnerable | Species or species habitat may occur within area |
| Balaenoptera edeni<br>Bryde's Whale [35] | | Species or species habitat may occur within area |
| Balaenoptera musculus<br>Blue Whale [36] | Endangered | Species or species habitat may occur within area |
| Balaenoptera physalus<br>Fin Whale [37] | Vulnerable | Species or species habitat may occur within area |
| Delphinus delphis<br>Common Dophin, Short-beaked Common Dolphin [60] | | Species or species habitat may occur within area |
| Grampus griseus<br>Risso's Dolphin, Grampus [64] | | Species or species habitat may occur within area |
| Megaptera novaeangliae<br>Humpback Whale [38] | Vulnerable | Species or species habitat may occur within area |
| Orcaella brevirostris<br>Irrawaddy Dolphin [45] | | Species or species habitat known to occur within area |
| Orcinus orca<br>Killer Whale, Orca [46] | | Species or species habitat may occur within area |
| Pseudorca crassidens<br>False Killer Whale [48] | | Species or species habitat likely to occur within area |
| Sousa chinensis<br>Indo-Pacific Humpback Dolphin [50] | | Breeding known to occur within area |
| Stenella attenuata<br>Spotted Dolphin, Pantropical Spotted Dolphin [51] | | Species or species habitat may occur within area |
| Tursiops aduncus<br>Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418] | | Species or species habitat likely to occur within area |
| Tursiops aduncus (Arafura/Timor Sea populations)<br>Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900] | | Species or species habitat known to occur within area |
| Tursiops truncatus s. str.<br>Bottlenose Dolphin [68417] | | Species or species habitat may occur within area |

## Extra Information

| State and Territory Reserves | [ Resource Information ] |
|---|---|
| Name | State |
| Adelaide River Foreshore | NT |
| Black Jungle / Lambells Lagoon Conservation Reserve | NT |
| Blackmore River | NT |
| Buffalo Creek | NT |
| Casuarina | NT |
| Channel Island | NT |
| Channel Point | NT |
| Charles Darwin | NT |

| Name | State |
|---|---|
| Djukbinj | NT |
| Fogg Dam | NT |
| George Brown Darwin | NT |
| Harrison Dam | NT |
| Holmes Jungle | NT |
| Howard Springs | NT |
| Howard Springs | NT |
| Knuckey Lagoons | NT |
| Leaning Tree Lagoon | NT |
| Litchfield | NT |
| Manton Dam Recreation Area | NT |
| Mary River | NT |
| Melacca Swamp | NT |
| Shoal Bay | NT |
| Territory Wildlife Park / Berry Springs | NT |
| Territory Wildlife Park / Berry Springs | NT |
| Tree Point Conservation Area | NT |

## Invasive Species

[ Resource Information ]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

| Name | Status | Type of Presence |
|---|---|---|
| **Birds** | | |
| Acridotheres tristis<br>Common Myna, Indian Myna [387] | | Species or species habitat likely to occur within area |
| Columba livia<br>Rock Pigeon, Rock Dove, Domestic Pigeon [803] | | Species or species habitat likely to occur within area |
| Passer domesticus<br>House Sparrow [405] | | Species or species habitat likely to occur within area |
| Passer montanus<br>Eurasian Tree Sparrow [406] | | Species or species habitat likely to occur within area |
| Sturnus vulgaris<br>Common Starling [389] | | Species or species habitat likely to occur within area |
| **Frogs** | | |
| Rhinella marina<br>Cane Toad [83218] | | Species or species habitat known to occur within area |
| **Mammals** | | |
| Bos taurus<br>Domestic Cattle [16] | | Species or species habitat likely to occur within area |
| Bubalus bubalis<br>Water Buffalo, Swamp Buffalo [1] | | Species or species habitat likely to occur within area |
| Canis lupus familiaris<br>Domestic Dog [82654] | | Species or species habitat likely to occur within area |
| Equus asinus<br>Donkey, Ass [4] | | Species or species habitat likely to occur within area |

| Name | Status | Type of Presence |
|---|---|---|
| Equus caballus<br>Horse [5] | | Species or species habitat likely to occur within area |
| Felis catus<br>Cat, House Cat, Domestic Cat [19] | | Species or species habitat likely to occur within area |
| Mus musculus<br>House Mouse [120] | | Species or species habitat likely to occur within area |
| Rattus rattus<br>Black Rat, Ship Rat [84] | | Species or species habitat likely to occur within area |
| Sus scrofa<br>Pig [6] | | Species or species habitat likely to occur within area |
| **Plants** | | |
| Andropogon gayanus<br>Gamba Grass [66895] | | Species or species habitat likely to occur within area |
| Annona glabra<br>Pond Apple, Pond-apple Tree, Alligator Apple, Bullock's Heart, Cherimoya, Monkey Apple, Bobwood, Corkwood [6311] | | Species or species habitat may occur within area |
| Brachiaria mutica<br>Para Grass [5879] | | Species or species habitat likely to occur within area |
| Cabomba caroliniana<br>Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171] | | Species or species habitat likely to occur within area |
| Cenchrus ciliaris<br>Buffel-grass, Black Buffel-grass [20213] | | Species or species habitat may occur within area |
| Dolichandra unguis-cati<br>Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119] | | Species or species habitat likely to occur within area |
| Eichhornia crassipes<br>Water Hyacinth, Water Orchid, Nile Lily [13466] | | Species or species habitat likely to occur within area |
| Hymenachne amplexicaulis<br>Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754] | | Species or species habitat likely to occur within area |
| Jatropha gossypifolia<br>Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507] | | Species or species habitat likely to occur within area |
| Lantana camara<br>Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892] | | Species or species habitat likely to occur within area |
| Mimosa pigra<br>Mimosa, Giant Mimosa, Giant Sensitive Plant, ThornySensitive Plant, Black Mimosa, Catclaw Mimosa, Bashful Plant [11223] | | Species or species habitat likely to occur within area |
| Parkinsonia aculeata<br>Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301] | | Species or species habitat likely to occur within area |
| Pennisetum polystachyon<br>Mission Grass, Perennial Mission Grass, Missiongrass, Feathery Pennisetum, Feather | | Species or species habitat likely to occur |

| Name | Status | Type of Presence |
|---|---|---|
| Pennisetum, Thin Napier Grass, West Indian Pennisetum, Blue Buffel Grass [21194] | | within area |
| Sagittaria platyphylla | | |
| Delta Arrowhead, Arrowhead, Slender Arrowhead [68483] | | Species or species habitat likely to occur within area |
| Salvinia molesta | | |
| Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665] | | Species or species habitat likely to occur within area |
| Vachellia nilotica | | |
| Prickly Acacia, Blackthorn, Prickly Mimosa, Black Piquant, Babul [84351] | | Species or species habitat may occur within area |
| **Reptiles** | | |
| Hemidactylus frenatus | | |
| Asian House Gecko [1708] | | Species or species habitat likely to occur within area |
| Lepidodactylus lugubris | | |
| Mourning Gecko [1712] | | Species or species habitat likely to occur within area |
| Ramphotyphlops braminus | | |
| Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258] | | Species or species habitat known to occur within area |

## Nationally Important Wetlands [ Resource Information ]

| Name | State |
|---|---|
| Adelaide River Floodplain System | NT |
| Daly-Reynolds Floodplain-Estuary System | NT |
| Finniss Floodplain and Fog Bay Systems | NT |
| Mary Floodplain System | NT |
| Mount Bundey Training Area - Mary River Floodplain | NT |
| Port Darwin | NT |
| Shoal Bay - Micket Creek | NT |

# Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods.  Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc).  In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

# Coordinates

-12.71103 130.75848

# Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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# APPENDIX C THREATENED SPECIES LIKELIHOOD OF OCCURRENCE TABLE

| Name | Status | | Summary | Likelihood of Occurrence |
|---|---|---|---|---|
| | Cth | NT | | |
| **BIRDS** | | | | |
| **Red Knot**<br>*Calidris canutus* | EN | VU | **Habitat:** Coastal and estuarine with tidal mudflats. May roost during high tide on nearby beaches. May also be found at near-coastal swamps and lakes (apart from Red and Great Knot)<br>**Distribution:** Mostly widespread around the northern Australian coast, less common in the south, with few inland records. Eastern Curlew is uncommon across Australia while Asian Dowitcher is rare. Every year these species breed in the northern hemisphere in the summer, and migrate to Australia for the southern hemisphere summer. Some birds remain in Australia during the winter. Wilson et al. (2007) have shown that the two main Australian non-breeding regions belong to separate populations of Godwit. Subspecies *menzbieri* is generally present in north-western Australia and breed in north-eastern Russia, and subspecies *baueri* is generally present in south-eastern Australia and breed in northern and western Alaska (Wilson et al. 2007). It is thought that both subspecies probably migrate to the NT. Due to the difficulties of distinguishing between the two, they are treated within the NT as *Limosa lapponica* and listed collectively as Vulnerable (Ward 2012).<br><br>*Information summarised from Chatto (2003), DoE (2015) and Garnett et al. (2011)* | **NONE**<br>• No suitable coastal or estuarine tidal mudflats present within the project area. |
| **Curlew Sandpiper**<br>*Calidris ferruginea* | CR | VU | | |
| **Great Knot**<br>*Calidris tenuirostris* | CR | VU | | |
| **Greater Sand Plover**<br>*Charadrius leschenaultii* | VU | VU | | |
| **Lesser Sand Plover**<br>*Charadrius mongolus* | EN | VU | | |
| **Asian Dowitcher**<br>*Limnodromus semipalmatus* | - | VU | | |
| **Bar-tailed Godwit (Western Alaskan subspecies)**<br>*Limosa lapponica baueri* | VU | VU | | |
| **Bar-tailed Godwit (northern Siberian subspecies)**<br>*Limosa lapponica menzbieri* | CR | VU | | |
| **Eastern Curlew**<br>*Numenius madagascariensis* | CR | VU | | |
| | Geering, A., Agnew, L. and Harding, S. (2007). *Shorebirds of Australia*. CSIRO Publishing, Collingwood, Australia.<br>Garnett, S.T., Szabo, J.K. and Dutson, G. (2011). *The Action Plan for Australian Birds 2010*. CSIRO Publishing, Collingwood, Australia.<br>Chatto, R. (2003). *The distribution and status of shorebirds around the coast and coastal wetlands of the Northern Territory*. Technical Report 73, Parks and Wildlife Commission of the Northern Territory, Darwin. https://dtc.nt.gov.au/__data/assets/pdf_file/0008/279917/2003_shorebirds_rpt76.pdf . | | | |

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| | Garnett, S.T., Szabo, J.K. and Dutson, G. (2011). *The Action Plan for Australian Birds 2010*. CSIRO Publishing. Collingwood, Australia.<br>Geering, A., Agnew, L. and Harding, S. (2007). *Shorebirds of Australia*. CSIRO Publishing, Collingwood, Australia.<br>Marchant, S. and Higgins, P. (eds.) (1993). *Handbook of Australian, New Zealand and Antarctic Birds. Vol. 2 - Raptors to Lapwings*. Oxford University Press, Melbourne, Victoria<br>Wilson, J.R., Nebel, S. and Minton, C.D.T. (2007). Migration ecology and morphometrics of two Bar-tailed Godwit populations in Australia. *Emu*, Vol. 107, pp. 262–274.<br>Ward, S. (2012). *Threatened Species of the Northern Territory –Bar-tailed Godwit – Limosa lapponica*. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0008/373544/bar-tailed-godwit.pdf .<br>Chatto, R. (2003). *The distribution and status of shorebirds around the coast and coastal wetlands of the Northern Territory*. Technical Report 73, Parks and Wildlife Commission of the Northern Territory, Darwin. https://dtc.nt.gov.au/__data/assets/pdf_file/0008/279917/2003_shorebirds_rpt76.pdf .<br>Garnett, S.T., Szabo, J.K. and Dutson, G. (2011). *The Action Plan for Australian Birds 2010*. CSIRO Publishing. Collingwood, Australia.<br>Geering, A., Agnew, L. and Harding, S. (2007). *Shorebirds of Australia*. CSIRO Publishing, Collingwood, Australia. | | | |
| **White-throated Grasswren**<br>*Amytoris woodwardi* | VU | VU | **Habitat:** Confined to hummock grasslands, sometimes with open shrubland or woodland overstorey, mixed among dense boulder fields or sandstone pavements (Schodde 1982; Noske 1992) and escarpment drainage lines.<br>**Distribution**: NT only – patchily distributed from Nitmuluk National Park to western Arnhem Lank (Noske 1992).<br>**Within expert distribution:** No | **NONE**<br>• Project footprint is outside the species distribution.<br>• No preferred sandstone or escarpment habitat within project footprint. |
| | Noske, R. (1992). The status and ecology of the white-throated grass-wren Amytornis woodwardi. Emu, Vol. 92, pp. 39-51. Schodde, R. (1982). The fairy-wrens - A monograph of the Maluridae. Landsdowne Editions, Melbourne. | | | |
| **Yellow Chat (Alligator River subspecies)**<br>*Epthianura crocea tunneyi* | EN | EN | **Habitat:** Grassy floodplain depressions and channels, concentrating around refugial waterholes at the end of the dry season (Armstrong 2004).<br>**Distribution**: Top End of the NT, where restricted to a small number of sites in the floodplains from the Adelaide River to the East Alligator River (Woinarski & Armstrong 2006). | **NONE**<br>• Project footprint is outside the species range (floodplains from the Adelaide to East Alligator Rivers).<br>• No suitable glassy floodplain habitat |
| | Armstrong, M. (2004). *The yellow chat Epthianura crocea tunneyi in Kakadu National Park*. Report to Parks Australia (North), NT Department of Infrastructure Planning and Environment, Darwin.<br>Woinarski, J. and Armstrong, M. (2006). *Threatened Species of the Northern Territory - Yellow Chat (Alligator River subspecies) - Epthianura crocea tunneyi*. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0019/206344/yellow-chat.PDF .<br>Schodde, R. and Mason, I.J. (1999). *The Directory of Australian Birds: Passerines*. CSIRO Publishing, Melbourne. | | | |
| **Red Goshawk**<br>*Erythrotriorchis radiatus* | VU | VU | **Habitat:** Prefers tall, open Eucalypt forest and riparian areas. Nests in large trees, frequently the tallest and most massive in a tall stand, nest trees are invariably within 1 km of permanent water (Debus & Czechura 1988; Aumann & Baker-Gabb 1991). Rarely breeds in areas with fragmented native vegetation (Aumann & Baker-Gabb 1991; Czechura 2001). Home range of up to 200 km2 (Czechura & Hobson 2000).<br>**Distribution:** Solitary and secretive hawk that is sparsely distributed across much of northern Australia, from the Kimberley in WA to south-eastern Qld. Within this range, generally confined to taller forests characteristic of higher rainfall coastal and sub-coastal areas (Debus 1998), but there are some isolated records of wandering birds from central Australia (Woinarski 2006). | **LOW**<br>• Preferred habitat and nesting habitat within Project footprint.<br>• Closest records are >30 km from project footprint along significant waterways which are not found within Project footprint.<br>• Project footprint may be utilised for vagrant foraging only. |
| | Aumann, T. and Baker-Gabb, D. (1991). *A Management Plan for the Red Goshawk*. RAOU Report 75, Royal Australasian Ornithologists Union, Melbourne.<br>Czechura G.V. and Hobson R.G. (2000). *The Red Goshawk* Erythrotriorchis radiatus *in northern Queensland: status and distribution*. Report to Queensland Parks and Wildlife Service.<br>Czechura G.V. (2001). *The status and distribution of the Red Goshawk* Erythrotriorchis radiatus *on Cape York Peninsula, Queensland*. Unpublished report to Birds Australia. | | | |

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| | Debus, S. and Czechura, G. (1988). Field identification of the Red Goshawk *Erythrotriorchis radiatus. Australian Bird Watcher*, Vol. 12, pp. 154-159.<br>Debus, S. (1998). *The Birds of Prey of Australia.* Oxford University Press, Melbourne.<br>Woinarski, J. (2006). *Threatened Species of the Northern Territory - Red Goshawk - Erythrotriorchis radiatus*. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0018/206352/red-goshawk.pdf . | | | |
| **Gouldian Finch**<br>*Erythrura gouldiae* | EN | VU | **Habitat:** Prefers areas with an adequate supply of seed from annual and perennial grasses (especially Sorghum), a nearby source of surface water and – in the breeding season – unburnt, hollow-bearing Eucalyptus trees (especially E. tintinnans, E. brevifolia and E. leucophloia) (Tidemann 1996; O'Malley 2006).<br>**Distribution:** Patchily distributed across northern Australia from the Kimberley to north-central Qld (Dostine 1998; Franklin et al. 1999; Barrett et al. 2003; Franklin et al. 2005). In the NT, most known breeding populations occur in the Top End. Non-breeding birds disperse widely (Garnett et al. 2011), greatly increasing the possible range of this species. | **LOW**<br>• Suitable foraging habitat. However, no preferred species of nesting trees within the project footprint.<br>• Project footprint is well away from the nearest known breeding site of Yinberrie Hills (Pine Creek bioregion).<br>• Project footprint may be utilised for vagrant foraging only. |
| | Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003). *The New Atlas of Australian Birds*. Royal Australian Ornithologists Union, Melbourne, Victoria.<br>Dostine, P. (1998). *Gouldian Finch Recovery Plan Erythrura gouldiae*. Gouldian Finch Recovery Team and Parks & Wildlife Commission NT, Darwin.<br>Franklin, D.C., Burbidge, A.H. and Dostine, P.L. (1999). The harvest of wild birds for aviculture: an historical perspective on finch trapping in the Kimberley with special emphasis on the Gouldian Finch. *Australian Zoologist,* Vol. 31, pp. 92-109.<br>Franklin, D.C., Whitehead, P.J., Pardon, G., Matthews, J., McMahon, P. and McIntyre, D. (2005). Geographic patterns and correlates of the decline of granivorous birds in northern Australia. *Wildlife Research*, Vol. 32, pp. 399-408.<br>Garnett, S.T., Szabo, J.K. and Dutson, G. (2011). *The Action Plan for Australian Birds 2010*. CSIRO Publishing. Collingwood, Australia.<br>O'Malley, C. (2006). *National Recovery Plan for the Gouldian Finch (Erythrura gouldiae*). WWF-Australia, Sydney and Parks and Wildlife NT, Department of Natural Resources, Environment and the Arts, NT Government, Palmerston.<br>Tidemann, S.C. (1996). Causes of the decline of the Gouldian Finch *Erythrura gouldiae*. *Biological Conservation International*, Vol. 6, pp. 49-61. | | | |
| **Grey Falcon**<br>*Falco hypoleucos* | - | VU | **Habitat:** Occurs in areas of lightly-timbered lowland plains, typically on inland drainage systems, where the average annual rainfall is less than 500 mm (Ward 2012).<br>**Distribution:** Sparsely distributed through much of the arid and semi-arid areas of Australia but is recorded in all Australian mainland states and territories. In the NT, the majority of records are from the southern half, but there are records all the way up to Darwin (Ward 2012). | **LOW**<br>• Project footprint is in area of higher rainfall than preferred by the species.<br>• *Eucalyptus* open woodland within the project footprint is potential foraging habitat.<br>• Typical distribution is central Australia.<br>• Potential for vagrant foraging within project footprint. |
| | Ward, S. (2012). Threatened Species of the Northern Territory - Grey Falcon - Falco hypoleucos. Northern Territory Department of Environment and Natural Resources. [online] Available at:https://nt.gov.au/__data/assets/pdf_file/0020/206354/grey-falcon.pdf [Accessed 30 May 2017]. | | | |
| **Crested Shrike-tit (northern subspecies)**<br>*Falcunculus frontatus whitei* | VU | - | **Habitat:** Recorded in eight different woodland types in northern Australia, mainly those dominated by Eucalyptus miniata, E. tetrodonta or E. bleeseri (Robinson & Woinarski 1992). Nests have been found in the canopy of E. tectifica, C. grandifolia and C. latifolia at >12 m above the ground in open woodland habitat (Ward et al. 2009).<br>**Distribution:** North-western Australia from the Kimberley in WA, across the Top End of the NT to Borroloola (TSSC 2016). In the NT, recorded in very low densities in many isolated sub-populations (Garnett & Crowley 2000) between north-east Arnhem Land and semi-arid Victoria River District. Scarcity of records suggests | **LOW**<br>• Suitable woodland habitat dominates the project footprint.<br>• Project footprint is outside the expert distribution of the species<br>• Only one record from the Darwin Coastal bioregion: ~160 km south-east of the project footprint |

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| | | | that populations are at very low density (Woinarski 2004). Not known to have disappeared from any area where recorded historically (TSSC 2016). | |
| | Garnett, S.T. and Crowley, G.M. (2000). *The Action Plan for Australian Birds 2000*. Environment Australia and Birds Australia, Canberra, ACT.<br>Robinson, D. and Woinarski, J.C.Z. (1992). 'A review of records of the Northern Shrike-tit *Falcunculus frontatus whitei* in north-western Australia'. *South Australian Ornithologist*, Vol. 31, pp. 111-117.<br>Threatened Species Scientific Committee (2016). *Approved Conservation Advice for Falcunculus frontatus whitei - crested shrike-tit (northern)*. Canberra: Department of the Environment. In effect under the EPBC Act from 02-May-2016. Available at: http://www.environment.gov.au/biodiversity/threatened/species/pubs/26013-conservation-advice-05052016.pdf.<br>Ward, S.J., Berghout, M. & Baker, B. (2009). Notes on the form and habitat of nests of the Northern Shrike-tit. *Northern Territory Naturalist,* Vol. 21, pp. 54-60.<br>Woinarski, J.C.Z. (2004). *National multi-species Recovery Plan for the Partridge Pigeon [eastern subspecies] Geophaps smithii smithii; crested shrike-tit [northern (sub)-species] Falcunculus (frontatus) whitei; masked owl [north Australian mainland subspecies] Tyto novaehollandiae kimberli; and masked owl [Tiwi Islands subspecies] Tyto novaehollandiae melvillensis, 2004-2008*. NT Department of Infrastructure Planning and Environment, Darwin. | | | |
| **Christmas Frigatebird**<br>*Fregata andrewsi* | EN | - | **Habitat:** Inhabits tropical waters of the Indian Ocean. Nests in tall trees, also sometimes on the slope of the inland cliff or higher up on the terraces (Gibson-Hill 1947).<br>**Distribution**: Breeds only on Christmas Island. In non-breeding season, disperses mostly to south-east Asia and Indian Ocean (Marchant et al. 1990). The few NT records are of small numbers of birds seen in during the wet season over the Darwin coastline – usually during north-westerly winds (including McKean et al. 1975). | **NONE**<br>• Only NT records have been along the Darwin coastline, the associated habitat and range of which is not within the project footprint. |
| | Gibson-Hill, C.A. (1947). Notes on the birds of Christmas Island. Bulletin of the Raffles Museum, Vol. 18, pp.87-165.<br>Marchant, S. and Higgins, P.J. (eds.) (1990). Handbook of Australian, New Zealand and Antarctic Birds: Volume 1 - Ratites to Ducks. Oxford University Press, Melbourne, Victoria<br>McKean, J.L., Bartlett, M.C. and Perrins, C.M. (1975). New records from the Northern Territory. Australian BirdWatcher, Vol. 6, pp. 45-46. | | | |
| **Partridge Pigeon (eastern subspecies)**<br>*Geophaps smithii smithii* | VU | VU | **Habitat:** Open forests and woodlands with an understorey of grasses (Woinarski 2006). Prefers woodland dominated by Eucalyptus tetrodonta and E. miniata (Braithwaite 1985; Garnett et al. 2011; Higgins & Davies 1996). According to Fraser (2001), favour a structurally-patchy savanna understorey at a relatively intricate scale. In all seasons, prefer to feed in areas that have an open ground layer (e.g. following fire); however, more likely to nest where there is dense vegetation cover. Largely sedentary; however, can travel distances of 5 to 10 km in the wet season on search of food and water resources (Fraser 2001). Home ranges vary seasonally between 8 – 31 hectares Fraser (2001).<br>**Distribution:** Historically, across the Top End (from Kununurra in WA to Borroloola in the NT). Since early 20th century a severe range contraction from the western, eastern and southern parts of the former distribution (Higgins & Davies 1996; Woinarski et al. 2007). Currently, distribution is limited to sub-coastal NT from Yinberrie Hill in the south, Litchfield NP in the west and (western) Arnhem Land in the east (Garnett et al. 2011). | **HIGH**<br>• Suitable Eucalyptus woodland habitat dominates the project footprint.<br>• Project footprint is within the expert distribution for the species and there are nearby records from similar vegetation communities. |

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| | Braithwaite, R.W. (1985). *The Kakadu fauna survey: an ecological survey of Kakadu National Park*. Australian National Parks & Wildlife Service, Canberra.<br>Fraser, F. (2000). Species profile: Partridge Pigeon Geophaps smithii. *Northern Territory Naturalist* 16, 38-39.<br>Fraser, F., Lawson V., Morrison S., Christophersen P., McGregor S. and Rawlinson M. (2003). Fire management experiment for the declining partridge pigeon, Kakadu National Park. *Ecological Management and Restoration* 4, 94–102.<br>Garnett, S.T., Szabo, J.K. and Dutson, G. (2011). *The Action Plan for Australian Birds 2010*. Birds Australia, CSIRO Publishing, Melbourne.<br>Higgins, P.J. and Davies S.J.J.F. (eds) (1996). *Handbook of Australian, New Zealand and Antarctic Birds. Volume Three: Snipe to Pigeons*. Oxford University Press. Melbourne, Victoria.<br>Woinarski, J.C.Z. (2006). *Threatened Species of the Northern Territory - Partridge Pigeon (eastern subspecies) - Geophaps smithii*. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0003/206355/partridge-pigeon.pdf .<br>Woinarski, J., Pavey, C., Kerrigan, R., Cowie, I. and Ward, S. (Eds) (2007). *Lost from Our Landscape: Threatened Species of the Northern Territory*. Northern Territory Government, Darwin | | | |
| **Australian Painted Snipe**<br>*Rostratula (benghalensis) australis* | EN | VU | **Habitat:** Fringes of permanent and temporary wetlands, swamps and inundated grasslands (Taylor et al. 2013).<br>**Distribution:** Nomadic and scattered across Australia with no predictable occurrence (Rogers 2001), but could occur at any wetland or inundated grassland across its distribution, including nearly all of the NT and Qld (Garnett et al. 2011). | **LOW**<br>• No permanent habitat for the nomadic species within the project footprint, however, seasonal inundation may provide temporary habitat.<br>• Within the expert distribution of the species but species is nomadic and naturally rare.<br>• Very few records for the bioregion. |
| | Garnett, S.T., Szabo, J.K. and Dutson, G. (2011). *The Action Plan for Australian Birds 2010*. CSIRO Publishing. Collingwood, Australia.<br>Rogers, D. (2001). Painted Snipe. *Wingspan*, Vol. 11 (No. 4), pp. 6-7.<br>Taylor, R., Chatto, R. and Woinarski, J.C.Z. (2013). *Threatened Species of the Northern Territory - Australian pained snipe - Rostratula australis*. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0018/206361/australian-painted-snipe.pdf. | | | |
| **Masked Owl (northern subspecies)**<br>*Tyto novaehollandiae kimberli* | VU | VU | **Habitat:** Mainly in *Eucalyptus* tall open forests (especially those dominated by *Eucalyptus miniata* and *E. tetrodonta*), but also roosts in monsoon rainforests and forages in more open vegetation types, including grasslands (Woinarski & Ward 2012). Usually nests in tree hollows, within patches of closed forest (Garnett et al. 2011). Little else known about the subspecies, but the species in general is resident in pairs within a territory up to 3,000 hectares (Debus 2009). Nest in large hollows with an entrance more than 20 cm wide and that is greater than 10 m above the ground (Debus 2009). Breeding poorly known, but thought to occur between March and October (DEWHA 2010).<br>**Distribution:** Poorly known, with few records from across a broad range in northern Australia. In the NT, records from the Top End, Kakadu, Coburg Peninsula (majority of records) and south-west Gulf country (Woinarski & Ward 2012). | **MEDIUM**<br>• Suitable *Eucalyptus* woodland foraging habitat is present within project footprint.<br>• Tall Eucalyptus open forest habitat within the project footprint.<br>• Within the expert distribution of the species, although no nearby records. |
| | Garnett, S.T., Szabo, J.K. and Dutson, G. (2011). The Action Plan for Australian Birds 2010. CSIRO Publishing. Collingwood, Australia.<br>Woinarski, J.C.Z. and Ward, S. (2012). *Threatened Species of the Northern Territory - Masked Owl (north Australian mainland subspecies) - Tyto novaehollandiae kimberli.* Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/word_doc/0008/373553/masked-owl-mainland-top-end.docx. | | | |
| **MAMMALS (TERRESTRIAL)** | | | | |
| **Fawn Antechinus** | VU | EN | **Habitat**: Mostly in open forests and woodlands dominated by *Eucalyptus miniata* and/or *E. tetrodonta*, particularly where these forests have a relatively dense | **LOW**<br>• Potential *Eucalyptus* woodland habitat |

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| *Antechinus bellus* | | | shrubby understorey (Friend 1985; Friend & Taylor 1985). Declines in areas with frequent intense fires (Corbett et al. 2003) but not necessarily common in areas where fire has been excluded for long periods (>20 years; Woinarski et al. 2004). Breeding occurs mid-June to late August, after which a synchronous male die-off occurs (TSSC 2015).<br>**Distribution:** Restricted to the Top End of the NT (Watson & Calaby 2008), with one record from Melville Island. Recent surveys have failed to record it across central and eastern Arnhem Land (TSSC 2015). | exists within the project footprint, however, the lack of a dense shrubby understorey and high fire frequency reduce habitat suitability.<br>• The project footprint is within the expert distribution, however, there are no records near the project footprint.<br>• Significant range contraction in the past few decades. |
| | Corbett L. K., Andersen, A.N. and Muller, W.J. (2003). Terrestrial vertebrates. In: Andersen, A.N., Cook, G.D. and Williams, R.J. (eds.). Fire in Tropical Savannas: The Kapalga Experiment. Springer-Verlag, New York: pp. 126–152.<br>Friend, G.R. and Taylor, J.A. (1985). Habitat preferences of small mammals in tropical open-forest of the Northern Territory. Australian Journal of Ecology, Vol. 10, pp. 173-185.<br>Friend, G.R. (1985). Ecological studies of a population of Antechinus bellus (Marsupalia: Dasyuridae) in tropical Australia. Australian Wildlife Research, Vol. 12 (No. 2), pp. 151-162.<br>Threatened Species Scientific Committee (2015). Approved Conservation Advice for Antechinus bellus – Fawn Antechinus. Canberra: Department of the Environment. In effect under the EPBC Act from 03-Dec-2015. Available at: http://www.environment.gov.au/biodiversity/threatened/species/pubs/344-conservation-advice-2015123.pdf.<br>Watson, M.L. and Calaby, J.H. (2008). Fawn Antechinus: Antechinus bellus. In: Van Dyck, S. and Strahan, R. (eds.). The Mammals of Australia: 3rd Edition. Reed New Holland, Sydney.<br>Woinarski, J.C.Z., Risler, J. and Kean, L. (2004). The response of vegetation and vertebrate fauna to 23 years of fire exclusion in a tropical Eucalyptus open forest, Northern Territory, Australia. Austral Ecology, Vol. 29, pp. 156–176. | | | | |
| **Brush-tailed Rabbit-Rat**<br>*Conilurus penicillatus* | VU | EN | **Habitat:** Largely restricted to mixed *Eucalypt* open forest and woodland, or on dunes with *Casuarina* – seeming to prefer habitats that are not burnt annually, that have an understorey of predominantly perennial grasses and a sparse-to-moderate middle storey (Firth et al. 2006; Firth 2007; Kemper & Firth 2008).<br>**Distribution:** Formerly widespread across northern Australia, but has declined extensively from Qld and lower rainfall areas of the Kimberley in WA and the Top End in the NT. No recent records from much of the historically-recorded NT range between near the mouth of Victoria River (in the west) and Sir Edward Pellew island group (in east). Most recently known from Cobourg Peninsula, Tiwi Islands, Groote Eylandt and a small area within Kakadu National Park (Woinarski & Hill 2012). | **NONE**<br>• Suitable *Eucalyptus* forest and woodland habitat exists within the project footprint, however, the lack of a dense shrubby understorey and high fire frequency reduce habitat suitability.<br>• The project footprint is within the expert distribution, however, there are no records near the project footprint and species is considered locally extinct. |
| | Firth, R.S.C. (2007). *Ecology and conservation status of the brush-tailed rabbit-rat Conilurus penicillatus*. PhD thesis, Charles Darwin University, Darwin, Northern Territory.<br>Firth, R.S.C., Woinarski, J.C.Z. and Noske, R.A. (2006). Home range and den characteristics of the brush-tailed rabbit-rat *Conilurus penicillatus* in the monsoonal tropics of the Northern Territory, Australia. *Wildlife Research*, Vol. 33, pp. 397-408.<br>Kemper, C.M. and Firth, R.S.C. (2008). Brush-tailed Rabbit-rat. In: Van Dyck, S. and Strahan, R. (eds). *The Mammals of Australia*. Reed New Holland, Chatswood, NSW.<br>Woinarski, J.C.Z. and Hill, B. (2012). *Threatened Species of the Northern Territory - Brush-tailed rabbit-rat, Brush-tailed tree-rat - Conilurus penicillatus*. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0016/205504/brush-tailed-rabbit-rat.pdf . | | | |
| **Northern Quoll**<br>*Dasyurus hallucatus* | EN | CR | **Habitat:** Wide range of habitats, but since the arrival of Cane Toads generally restricted to the most suitable habitats which are rocky upland areas with numerous crevices and rock piles (Van Dam et al. 2002). Prime habitat in the NT consists of rocky sandstone escarpments and outliers (Braithwaite & Griffiths 1994). Home range varies from 35 to 100 ha (Oakwood 2002). Breeding occurs in May and June, with male die-off occurring shortly afterwards (Oakwood 2000).<br>**Distribution:** Historically occurred in the NT from Borroloola in the south-east as far west as the NT/WA border (Woinarski et al. 2007), and extends into the | **MEDIUM**<br>• The project footprint is within the expert distribution, however, the species has experienced significant range contraction since Cane Toad invasion.<br>• There is Eucalyptus habitat within the project footprint; however, there are no preferred rocky habitat areas. |

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| | | | Kimberley and Pilbara regions of WA. Dramatic range contraction and population crash associated with Cane Toad invasion. Now occurs across northern Australia in five regional populations – including the Top End in the NT. | |
| | Braithwaite, R.W. and Griffiths, A.D. (1994). Demographic variation and range contraction in the Northern Quoll, *Dasyurus hallucatus* (Marsupialia: Dasyuridae). *Wildlife Research,* Vol. 21, pp. 203-218.<br>Oakwood, M. (2000). Reproduction and demography of the northern quoll, *Dasyurus hallucatus*, in the lowland savanna of northern Australia. *Australian Journal of Zoology*. 48:519-539.<br>Oakwood, M. (2002). Spatial and social organization of a carnivorous marsupial, *Dasyurus hallucatus*. *Journal of Zoology*, London. 257:237-248.<br>Van Dam, R.A., Walden, D.J. and Begg, G.W. (2002). *A preliminary risk assessment of cane toads in Kakadu National Park*. Supervising Scientist Report 164, Darwin, Northern Territory.<br>Woinarski, J.C.Z., Rankmore, B.R., Fisher, A. and Milne, D. (2007). *The natural occurrence of northern quolls Dasyurus hallucatus on islands of the Northern Territory: assessment of refuges from the threat posed by cane toads Bufo marinus.* Report to Natural Heritage Trust. | | | |
| **Arnhem Leaf-nosed Bat**<br>*Hipposideros inornatus* | EN | VU | **Habitat:** Caves or abandoned mine sites in cool draughty areas, close to water (Churchill 1998; Corbett & Richards 2002). Reported as foraging in riparian areas and in Eucalypt tall open forests (Woinarski & Milne 2015).<br>**Distribution:** Restricted to the NT and only known to occur on the western Arnhem Land sandstone massif (Deaf Adder Gorge and upper South Alligator River area) and from one site – Tolmer Falls – in Litchfield National Park (McKean & Hertog 1979) where population appears to be disappearing (Woinarski & Milne 2015). | **NONE**<br>• Distribution restricted to western Arnhem Land and Tolmer Falls well outside the project footprint and there are no nearby records. |
| | Churchill, S. (1998). Australian Bats. Reed New Holland, Sydney.<br>Corbett, L. and Richards, G. (2002). Bat survey: Gunlom land trust area. Report to Parks Australia North, EWL Sciences, Darwin.<br>McKean, J.L. and Hertog, A.L. (1979). Extension of range in the horseshoe bat. Northern Territory Naturalist, Vol. 1, p. 5.<br>Woinarski, D. and Milne, D. (2015). Threatened Species of the Northern Territory – Arnhem Leaf-nosed Bat – Hipposideros inornata. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0018/205524/arnhem-leaf-nosed-bat.pdf. | | | |
| **Ghost Bat**<br>*Macroderma gigas* | VU | - | **Habitat:** Ranging from the arid Pilbara of WA to tropical savanna woodlands and north Qld. rainforests (TSSC 2016). Permanent roost sites are generally deep natural caves or disused mines (TSSC 2016).<br>Move between a number of caves seasonally or as dictated by weather conditions, and require a range of cave sites (Hutson et al. 2001). Most breeding sites are caves with multiple entrances (TSSC 2016).<br>**Distribution:** Geographically-disjunct colonies occur in the Pilbara and Kimberley in WA, NT north of approximately 17° latitude (including Elcho Island and Groote Eylandt), the Gulf of Carpentaria, eastern Qld from Cape York to near Rockhampton, and western Qld (including Riversleigh and Camooweal districts) (TSSC 2016). Distribution likely influenced by the availability of suitable caves and mines for roost sites (Ward & Milne 2016). Only 14 breeding sites known (Worthington Wilmer 2012). Disperse widely when not breeding (TSSC 2016). In arid Australia, including southern NT until the early 1960's (Ward & Milne 2016). | **LOW**<br>• No deep cave/abandoned mine habitat for permanent roost sites within the project footprint.<br>• Woodland is potential foraging habitat. |
| | Hutson, A. M., Mickleburgh, S. P. & Racey, P. A. (2001) Microchiropteran Bats - Global Status Survey and Conservation Action Plan. IUCN/SSC Chiroptera Specialist Group, Gland, Switzerland and Cambridge, U.K.<br>Milne, D. and Ward, S. (2016). Threatened Species of the Northern Territory – Ghost Bat - Macroderma gigas. Northern Territory Department of Environment and Natural Resource. https://nt.gov.au/__data/assets/pdf_file/0010/376138/ghost-bat.pdf.<br>Threatened Species Scientific Committee (2016). Approved Conservation Advice for Macroderma gigas (ghost bat). Canberra: Department of the Environment. Available at:http://www.environment.gov.au/biodiversity/threatened/species/pubs/174-conservation-advice-05052016.pdf . | | | |

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| | Worthington Wilmer, J. (2012). Ghost Bat Macroderma gigas. In: Curtis et al. (eds.). Queensland's Threatened Animals. CSIRO, Canberra: pp. 382-383. | | | |
| **Black-footed Tree-rat (Kimberley and mainland NT subspecies)**<br>*Mesembriomys gouldii gouldii* | EN | VU | **Habitat:** Woodlands and open forests with large trees and a moderately diverse mid-storey in near-coastal areas. Generally, require fruit and seed resources including Pandanus fruits, and fruiting trees and shrubs (Rankmore 2006). Shelters in tree hollows and occasionally Pandanus (Hill 2012). Thought to be more prevalent in woodlands with infrequent and low intensity fires (Price et al. 2005).<br>**Distribution:** Top End of NT, Kimberley region of WA and Cape York Peninsula south to Townsville in Qld. (Hill 2012). Has remained relatively abundant in the Darwin rural area and there are some recent records from Gunn Point (Price et al. 2005), the Lee Point Area and Middle Arm. | **HIGH**<br>• Suitable open forest and diverse near-coastal habitat within the project footprint.<br>• Within the expert distribution of the species.<br>• Recent record ~15 km east of project footprint. |
| | Hill, B. (2012). Threatened Species of the Northern Territory- Black-footed Tree-rat - Mesembriomys gouldii. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0018/205515/black-footet-tree-rat.pdf.<br>Price, O., Rankmore, B., Milne, D.J., Brock, C., Tynan, C., Kean, L. and Roger, L. (2005). Regional patterns of mammal abundance and their relationships to landscape variables in eucalypt woodlands near Darwin, northern Australia. Wildlife Research, Vol. 32, pp. 435-446.<br>Rankmore, B.R. 2006. Impacts of Habitat Fragmentation on the Vertebrate Fauna of the Tropical Savannas of Northern Australia; with Special Reference to Medium-sized Mammals. PhD Thesis, Charles Darwin University, Darwin. | | | |
| **Golden-backed Tree-rat**<br>*Mesembriomys macrurus* | VU | CR | **Habitat:** In the NT, little known of the ecology apart that all three records were from riverine vegetation. In the Kimberley, known to occur in open Eucalyptus forests with tussock grass understorey, rainforest patches, sandstone screes, beaches, and black soil plains (Woinarski et al. 2012).<br>**Distribution**: Historically, known to have occurred in three localities in the NT (Parker 1973) with no new records in the last 30 years. In 1993, reportedly spotted in Kakadu National Park; however, further surveys of suitable habitats in the NT failed to locate the species (Lee 1995). Now only known to occur in some areas of the north-western Kimberley and associated offshore islands (Palmer et al. 2003). | **NONE**<br>• Presumed regionally extinct in the NT |
| | ee, A.K. (1995). The Action Plan for Australian Rodents. Australian Nature Conservation Agency, Endangered Species Program, Canberra.<br>Palmer, C., Taylor, R. & Burbidge, A. (2003). Recovery plan for the Golden Bandicoot Isoodon auratus and golden-backed tree-rat Mesembriomys macrurus 2004-2009. Northern Territory Department of<br>Infrastructure Planning and Environment, Darwin.<br>Parker, S.A. (1973). An annotated checklist of the native land mammals of the Northern Territory. Records of the South Australian Museum, Vol. 16, pp. 1-57.<br>Woinarski, J.C.Z., Palmer, C. & Hill, B. (2012). Threatened Species of the Northern Territory - Golden-backed tree-rat - Mesembriomys macrurus. Northern Territory Department of Environment and Natural Resources. [online] Available at: https://nt.gov.au/__data/assets/pdf_file/0006/205476/golden-backed-tree-rat.pdf [Accessed 20 April 2017] | | | |
| **Nabarlek (Top End subspecies)**<br>*Petrogale concinna canescens* | CR | EN | **Habitat:** Isolated and rocky areas consisting of both sandstone and granite escarpments (Churchill 1997; Telfer et al. 2008). Shelters in caves and crevices during the day (Churchill 1997) and may move from these to forage in adjacent flat areas (Sanson et al. 1985).<br>**Distribution:** Restricted to the Top End of the NT in scattered populations from sandstone cliffs bordering the Arafura Swamp (Arnhem Land) in the east, to the Daly River catchment in the west (Ward & Woinarski 2012). | **NONE**<br>• There is no suitable sandstone or granite escarpment habitat within the project footprint.<br>• The project footprint is within the expert distribution, Historic record is ~40 km south-west of project footprint. |
| | Churchill, S. (1997). Habitat use, distribution and conservation status of the Nabarlek, Petrogale concinna, and sympatric rock-dwelling mammals, in the Northern Territory. Australian Mammalogy, Vol. 19, pp. 297-308.<br>Sanson, G.D., Nelson, J. and Fell, P. (1985). Ecology of Peradorcas concinna in Arnhem Land in a wet and a dry season. Proceedings of the Ecological Society of Australia, Vol. 13, pp. 65-72. | | | |

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| | Telfer, W.R., Griffiths, A.D. and Bowman, D.M.J.S. (2008). The habitat requirements of four sympatric rock-dwelling macropods of the Australian monsoon tropics. Austral Ecology, Vol. 33, pp. 1033-1044.<br>Ward, S. and Woinarski, J. (2012). Threatened Species of the Northern Territory - Nabarlek - Petrogale concinna. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0017/205523/nabarlek.pdf . | | | |
| **Northern Brush-tailed Phascogale**<br>*Phascogale pirata* | VU | EN | **Habitat:** No detailed studies, but ecology is probably similar to that reported for phascogales in southern Australia (Rhind 1998). Most records are from tall open forests dominated by Eucalyptus miniata and E. tetrodonta (Rhind et al. 2008). Brush-tailed Phascogales are primarily arboreal and seldom feed on the ground.<br>**Distribution:** Probably occurs naturally in low densities (Woinarski et al. 2014). Very few records exist; reported from West Island, east Arnhem Land, Coburg Peninsula, Kakadu, Litchfield and the Tiwi Islands. In the last 10 years only recorded from Kakadu, Coburg Peninsula and the Tiwi Islands, despite many extensive wildlife surveys across regions of the Top End during that time (Woinarski et al. 2014). | **LOW**<br>• Range contraction to Arnhem Land (on the mainland) means unlikely to occur in the area.<br>• Woodland and forest habitat on site is marginal for the species, which prefers taller forest. |
| | Rhind, S.G. (1998). Ecology of the brush-tailed phascogale in jarrah forest of south-western Australia. PhD thesis, Murdoch University, Perth, Western Australia.<br>Rhind, S.G., Woinarski, J. and Aplin, K.P. (2008). Brush-tailed Phascogale. In: Van Dyck, S. and Strahan, R. (eds). The Mammals of Australia. Reed New Holland, Chatswood, NSW.<br>Woinarski, J., Burbidge, A. and Harrison, P. (2014). The Action Plan for Australian Mammals 2012. CSIRO Publishing: pp. 125-127. | | | |
| **Bare-rumped Sheath tail Bat**<br>*Saccolaimus saccolaimus (nudicluniatus)* | VU | - | **Habitat:** In the NT, specimens have been collected from Pandanus woodland fringing the sedge lands of the South Alligator River and Eucalypt tall open forests (Friend & Braithwaite 1986; Churchill 1998) with more recent records from Howard Springs (Milne et al 2009). Most records occur within near-coastal habitats with one recent exception (Jasper Gorge) 150 km inland (Woinarski et al. 2014).<br>**Distribution:** Widely distributed from India through south-east Asia to the Solomon Islands including north-eastern Qld and the NT. The north-eastern Australian population is described as the subspecies S. s. nudicluniatus, although it is not clear whether this should be applied to NT populations (Milne & Woinarski 2006). | **HIGH**<br>• *Eucalyptus* woodland within the project footprint is potential habitat for the species, although, there is limited monsoonal and riparian habitat.<br>• The project footprint is within the expert distribution of the species.<br>• Closest record ~35 km south-east of project footprint. |
| | Churchill, S. (1998). Australian Bats. Reed New Holland, Sydney.<br>Friend, G.R. and Braithwaite, R.W. (1986). Bat fauna of Kakadu National Park, Northern Territory. Australian Mammalogy, Vol. 9, pp. 43-52.<br>Milne, D.J., Jackling, F.C., Sidhu, M., and Appleton, B.R. (2009). Shedding new light on old species identifications: morphological and genetic evidence suggest a need for conservation status review of the critically endangered bat, Saccolaimus saccolaimus. Wildlife Research36: 496–508.<br>Milne, D. and Woinarski, J. (2006). Threatened Species of the Northern Territory - Bare-rumped Sheathtail Bat - Saccolaimus saccolaimus. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0007/376117/bare-rumped-sheathtail-bat.pdf .<br>Woinarski, J., Burbidge, A. and Harrison, P. (2014). The Action Plan for Australian Mammals 2012. CSIRO Publishing: pp. 511-514. | | | |
| **Pale Field-rat**<br>*Rattus tunneyi* | - | VU | **Habitat:** Historically occurred in a wide range of habitats, but now primarily in dense vegetation along creeks (Aplin et al. 2008).<br>**Distribution:** Higher rainfall areas of northern Australia, extending from Kimberley in WA to south-eastern Qld, including the Top End of the NT (Braithwaite & Griffiths 1996). | **MEDIUM**<br>• Core dense riparian habitat is limited within the project footprint<br>• The project footprint is within the extent of occurrence of the species.<br>• Closest record is ~18 km south-east of the project footprint |
| | Aplin, K., Braithwaite, R. and Baverstock, P. (2008). Pale Field-rat: Rattus tunneyi. In: Van Dyck, S. and Strahan, R. (eds.). The Mammals of | | | |

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| | Australia (3rd Edition). Reed New Holland, Sydney, NSW.<br>Braithwaite, R. and Griffiths, A. (1996). The paradox of Rattus tunneyi: endangerment of a native pest. Wildlife Research, Vol. 23, pp. 1-21. | | | |
| **False Water Rat**<br>*Xeromys myoides* | VU | - | **Habitat**: Utilises both intertidal and freshwater habitats, with most records from mangrove forests, saltmarsh, sedgelands, clay pans and freshwater Melaleuca wetlands. In the NT, few records in the Darwin Coastal bioregion (DoE 2017).<br>**Distribution:** Three regions of coastal Australia: the NT, central south Qld and south-east Qld (DoE 2017). In the NT, known only from coastal Top End with ten records at six sites – South Alligator River in 1903, Daly River floodplain in 1972, two sites on the Tomkinson River in 1975, Melville Island in 1975 and Glyde River floodplain in 1998 and 1999 ( Cole & Woinarski 2002, Woinarski 2006). | **LOW**<br>• Suitable intertidal water associated vegetation habitat within the project footprint.<br>• Closest record is ~65 km south-east of the project footprint. |
| | Cole, J. and Woinarksi, J. (2002). Field Guide to the Rodents and Dasyurids of the Northern Territory. Surrey Beatty & Sons, Chpping Norton, NSW.<br>Department of the Environment (2017). Xeromys myoides - Water Mouse, False Water Rat, Yirrkoo. Species Profile and Threats Database, Department of the Environment, Canberra. Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=66 .<br>Woinarski, J.C.Z. (2006). Threatened Species of the Northern Territory - False water-rat, Water mouse - Xeromys myoides. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0008/376136/false-water-rat.pdf . | | | |
| **Arnhem Rock-rat**<br>*Zyzomys maini* | VU | VU | **Habitat:** Rugged sandstone environments, typically where here are many caves, crevices or boulders. Occupies environments in association with monsoonal rainforest, typically those areas which are floristically-rich and provide the fleshy fruits and seeds that form its principal food item (Begg et al. 1980).<br>**Distribution**: Endemic to the sandstone massif of western Arnhem Land in the NT (Woinarski 2004).<br>Commonly found throughout parts of Kakadu National Park and Warddeken Indigenous protected area (Woinarski et al. 2014). | **NONE**<br>• Endemic to sandstone massif of western Arnhem Land.<br>• No preferred habitat within project footprint |
| | Begg, R.J. and Dunlop, C.R. (1980). Security eating, and diet in the large rock-rat, Zyzomys woodwardi (Rodentia: Muridae). Australian Wildlife Research, Vol. 7, pp. 63-70.<br>Woinarski, J., Burbidge, A. & Harrison, P. (2014). The Action Plan for Australian Mammals 2012. CSIRO Publishing: pp. 652-654.<br>Woinarski, J.C.Z. (2004). Threatened plants and animals in Kakadu National Park: a review and recommendations for management. Darwin, Northern Territory DIPE. | | | |
| **REPTILES (TERRESTRIAL)** | | | | |
| **Plains Death Adder**<br>*Acanthophis hawkei* | VU | VU | **Habitat:** Floodplains in the Top End and cracking soil plains inland (Webb et al. 2002).<br>**Distribution:** Habitat mapping suggests the potential geographic range extends from western Qld, across the sub-coastal north of the NT to the north-eastern Kimberley of WA. Fragmented populations occur in the Mitchell Grass Downs of western Qld, the Barkly Tablelands on the NT/Qld border and east of Darwin (Fogg Dam) in the NT (TSSC 2012; Wuster et al. 2005). Susceptible to ingesting toxic Cane Toads (Phillips et al. 2009). | **NONE**<br>• No suitable cracking clay habitat within the project footprint.<br>• No nearby records of the species. |
| | Phillips, B.L., Greenlees, M.J., Brown, G.P. and Shine R (2010). Predator behaviour and morphology mediates the impact of an invasive species: cane toads and death adders in Australia. Animal Conservation, Vol. 13, pp. 53-59.<br>Webb, J.K., Christian, K.A. and Fisher, P. (2002). Fast growth and early maturation in a viviparous sit-and-wait predator, the northern death adder (Acanthophis praelongus) from tropical Australia. Journal of Herpetology, Vol. 36, no. 3, pp. 505-509.<br>Wuster, W., Dumbrell, A.J., Hay, C., Pook, C.E., Williams, D.J. and Fry, B.G. (2005). Snakes across the Strait: trans-Torresian phylogeographic relationships in three genera of Australasian | | | |

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| | snakes (Serpentes: Elapidae: Acanthophis, Oxyuranus, and Pseudechis). Molecular Phylogenetics and Evolution, Vol. 34. pp. 1-14.<br>Threatened Species Scientific Committee (2015). Approved Conservation Advice – Acanthophis hawkei – Plains Death Adder. Canberra: Department of the Environment. http://www.environment.gov.au/biodiversity/threatened/species/pubs/83821-conservation-advice.pdf . | | | |
| **Arnhem Land Skink**<br>*Bellatorias obiri* | EN | EN | **Habitat:** Prefers sandstone outcrops, typically with extensive fissures and cave systems (Sadlier 1990).<br>**Distribution:** Restricted to the Western Arnhem Land plateau and outliers (e.g. Jabiluka), where it is patchily distributed (Armstrong & Dudley 2004). Nearest record in Darwin Coastal bioregion: Greater than 100 km from project footprint. | **NONE**<br>• Confined to western Arnhem Land Plateau. |
| | Armstrong, M. and Dudley, A. (2004). The Arnhem Land Egernia Egernia obiri in Kakadu National Park. Report to Parks Australia North, NT Department of Infrastructure Planning and Environment, Darwin.<br>Sadlier, R.A. (1990). A new species of scincid lizard from western Arnhem Land, Northern Territory. The Beagle, Vol. 7, pp. 29-33. | | | |
| **Yellow-snouted Gecko**<br>*Lucasium occultum* | EN | VU | **Habitat:** Prefers areas with well-developed leaf litter and grasses (King et al. 1982; Johansen 2006) in open forests dominated by *Eucalyptus miniata* and *E. tetrodonta*. Commonly found in sandy red-loam substrates. Has been recorded in areas consisting of moderate to sparse Gamba grass (Beggs et al. 2012).<br>**Distribution:** Endemic to the NT with known populations from north-west of Kakadu National Park and Wildman Reserve (King et al. 1982). | **NONE**<br>• Restricted to Kakadu and Wildman Reserve. |
| | Beggs, K., Armstrong, M., Woinarski, J. and Ward, S. (2012). Threatened Species of the Northern Territory - Yellow-Snouted Gecko - Lucasium occultum. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0007/206458/yellow-snouted-gecko.pdf .<br>Johansen, T. (2006). The yellow-snouted gecko (Diplodactylus occultus), a little known endemic species of northern Australia. Report to NT Department of Natural Resources Environment and the Arts.<br>King, M., Braithwaite, R.W. and Wombey, J.C. (1982). A new species of Diplodactylus (Reptillia: Gekkonidae) from the Alligator Rivers region - Northern Territory. Transactions of the Royal Society of South Australia, Vol. 106, pp. 15-18. | | | |
| **Mertens' Water Monitor**<br>*Varanus mertensi* | - | VU | **Habitat:** Semi-aquatic, occupying edges of freshwater watercourses and lagoons, but seldom seen far from water (Christian 2004).<br>**Distribution:** Across far northern Australia from the western Cape York Peninsula in Qld to the Kimberley in WA (Christian 2004). Widespread in the NT, occupying all of the Top End river systems (Ward et al.2006). | **MEDIUM**<br>• There may be suitable habitat in the minor drainage lines within the project footprint. However, these are ephemeral, tidal for some of their length, and may not contain pools that are adequate to support this species during the dry season.<br>• Closest record is ~21 km east of project footprint. |
| | Christian, K. (2004). Varanus mertensi. In: Pianka et al. (eds.). Varanoid lizards of the world. Indiana University Press, Bloomington, Indianapolis.<br>Ward, S., Woinarski, J., Griffiths, T. and McKay, L. (2006). Threatened Species of the Northern Territory - Mertens Water Monitor - Varanus mertensi. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0018/206460/mertens-water-monitor.pdf [Accessed 30 May 2017]. | | | |
| **Mitchell's Water Monitor**<br>*Varanus mitchelli* | - | VU | **Habitat**: Semi-aquatic and arboreal, inhabiting margins of freshwater watercourses, swamps and lagoons (Ward 2012).<br>**Distribution**: Top End of the NT and Kimberley in WA (Schultz & Doody 2004). In the NT, recorded in most catchments flowing into the Timor Sea, Arafura Sea and the Gulf of Carpentaria (Ward 2012). | **MEDIUM**<br>• There may be suitable habitat in the minor drainage lines within the project footprint. However, these are ephemeral, tidal for some of their length, and may not contain pools that are adequate to support this species during the dry season. |

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| | Doody, J.S., Green, B., Rhind, D., Castellano, C., Sims, R. and Robinson, T. (2009). Population-level declines in Australian predators caused by an invasive species. Animal Conservation, Vol. 12, pp. 46-53.<br>Schultz, T. and Doody, S. (2004). Varanus mitchelli. In: Pianka et al. (eds.). Varanoid lizards of the world. Indiana University Press, Bloomington, Indianapolis.<br>Ward, S. (2012). Threatened Species of the Northern Territory - Mitchell's Water Monitor - Varanus mitchelli. Northern Territory Department of Environment and Natural Resources. [online] Available at:https://nt.gov.au/__data/assets/pdf_file/0019/206461/mitchells-water-monitor.pdf [Accessed 30 May 2017]. | | | |
| **Floodplain Monitor**<br>*Varanus panoptes* | - | VU | **Habitat:** Broad range of habitats from coastal beaches to savannah woodlands (Christian 2004). Also common throughout floodplains grasslands and a variety of native woodlands (Ward et al. 2012).<br>**Distribution:** Across northern Australia from the Kimberley in WA to Cape York Peninsula, and southwards through most of Qld. In the NT, recorded across most of the Top End and the Gulf Region (Christian 2004). Experienced significant declines due to cane toad poisoning (Doody et al. 2009). | **MEDIUM**<br>• Woodland within the project footprint is suitable habitat for the species.<br>• Significant decline within the region reduces the likelihood of occurrence.<br>• Closest record is ~20 km east and north of project footprint |
| | Christian, K. (2004). Varanus panoptes. In: Pianka et al. (eds). Varanoid lizards of the world. Indiana University Press, Bloomington, Indianapolis.<br>Doody, J.S., Green, B., Rhind, D., Castellano, C., Sims, R. and Robinson, T. (2009). Population-level declines in Australian predators caused by an invasive species. Animal Conservation, Vol. 12, pp. 46-53.<br>Ward, S., Woinarski, J., Griffiths, T. & McKay, L. (2012). Threatened Species of the Northern Territory - Yellow Spotted Monitor, Northern Sand Goanna, Floodplain Monitor - Varanus panoptes. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0006/206466/floodplain-monitor.pdf [Accessed 30 May 2017]. | | | |
| **REPTILES (MARINE)** | | | | |
| **Loggerhead Turtle**<br>*Caretta caretta* | EN | VU | **Habitat:** Pelagic in tropical, sub-tropical and temperate waters. Nests mainly on sub-tropical sandy beaches (Marquez 1990).<br>**Distribution:** Global, including the Australian coast (DoE 2017) where nesting is concentrated in southern Qld and from Shark Bay to the North West Cape in WA (DoE 2017). No breeding known to occur in the NT, but records in NT waters (Taylor et al. 2006). | **NONE**<br>• No nesting habitat within the project footprint.<br>• Potentially-suitable foraging habitat for juveniles within estuarine part of the project footprint. |
| | Department of Environment (2017). Caretta caretta - Loggerhead Turtle. Species Profile and Threats Database, Department of the Environment, Australian Government, Canberra. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1763 .<br>Marquez, R. (1990). FAO Species Catalogue: Sea Turtles of the World. An annotated and illustrated catalogue of the sea turtle species known to date. Rome: Food and Agriculture Organisation of United Nations. FAO Fisheries Synopsis, Vol. 125 (No. 11), pp. 81.<br>Taylor, R., Chatto, R. and Woinarski, J. (2006). Threatened Species of the Northern Territory - Loggerhead Turtle - Caretta caretta. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0019/206452/loggerhead-turtle-vu.pdf . | | | |
| **Green Turtle**<br>*Chelonia mydas* | VU | - | **Habitat:** Pelagic (until adulthood) in tropical and subtropical waters, then shallow benthic foraging habitats containing seagrass beds or algae mats (DoE 2017). In the NT, nesting mainly on wide beaches backed by large dune systems (Chatto 1998).<br>**Distribution:** Global. Nests, forages and migrates across tropical northern Australia, with main breeding sites being the Great Barrier Reef of Qld, the north-west shelf of WA, Wellesley Island group in the southern Gulf of Carpentaria and the Top End coast (DoE 2017). Many nesting sites in the NT, mostly from the western end of Melville Island to near NT/Qld border (Chatto 1998). | **NONE**<br>• No nesting habitat within the project footprint.<br>• Potentially-suitable foraging habitat for juveniles within estuarine part of the project footprint. |

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| | Chatto, R. (1998). A preliminary overview of the locations of marine turtle nesting in the Northern Territory. In: Kennett et al. 9eds.). Marine turtle conservation and management in northern Australia. Northern Territory University, Darwin: pp. 33-40.<br>Department of Environment (2017). Chelonia mydas - Green Turtle. Species Profile and Threats Database, Commonwealth Department Environment, Canberra. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1765 . | | | |
| **Leatherback Turtle**<br>*Dermochelys coriacea* | EN | CR | **Habitat:** Pelagic in tropical, subtropical and temperate oceanic waters (DoE 2017).<br>**Distribution:** Global, including the northern and eastern seaboards of Australia (DoE 2017). No major nesting recorded in Australia. In the NT, only a few records in the waters off northern Arnhem Land and the Gulf of Carpentaria (Taylor et al. 2013). | **NONE**<br>• No pelagic or nesting habitat within the project footprint. |
| | Department of Environment (2017). Dermochelys coriacea - Leatherback Turtle, Leathery Turtle, Luth. Species Profile and Threats Database, Commonwealth Department of the Environment, Canberra. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1768 .<br>Taylor, R., Chatto, R., Whiting, S. and Ward, S. (2013). Threatened Species of the Northern Territory - Leatherback Turtle - Dermochelys coriacea. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0010/206398/leatherback-turtle.pdf . | | | |
| **Hawksbill Turtle**<br>*Eretmochelys imbricata* | VU | VU | **Habitat:** Pelagic (until adulthood) in tropical, subtropical and waters, then tropical tidal and sub-tidal coral and rocky reef habitats (less frequently, within seagrass habitats) (DoE 2017). In the NT, most nesting occurs on islands rather than mainland beaches (Taylor et al. 2012).<br>**Distribution:** Global. In the NT, principal nesting sites are concentrated around north-eastern Arnhem Land and Groote Eylandt (Chatto 1998). | **NONE**<br>• No nesting habitat within the project footprint.<br>• Potentially-suitable foraging habitat for juveniles within estuarine part of the project footprint. |
| | Chatto, R. (1998). A preliminary overview of the locations of marine turtle nesting in the Northern Territory. In: Kennett et al. (eds.). Marine turtle conservation and management in northern Australia. Northern Territory University, Darwin: pp. 33-40<br>Department of the Environment (2017). Eretmochelys imbricate – Hawksbill Turtle. Species Profile and Threats Database, Department of the Environment, Canberra. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1766.<br>Taylor, R., Chatto, R., Woinarski, J., Whiting, S. and Ward, S. (2012). Threatened Species of the Northern Territory – Hawksbill Turtle - Eretmochelys imbricata. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0003/206454/hawksbill-turtle.pdf . | | | |
| **Olive Ridley Turtle**<br>*Lepidochelys olivacea* | EN | VU | **Habitat:** Tropical and subtropical waters, preferring shallow protected waters (DoE 2017). In the NT, breeds at a wide range of sites on island and, less commonly, mainland beaches (Chatto 1998).<br>**Distribution:** Global. In the NT, second most widespread nesting species (after Flatbacks) (Chatto & Baker 2008). Vast majority of the nesting population recorded from Melville Island to Groote Eylandt (Chatto 1998). | **NONE**<br>• No nesting habitat within the project footprint.<br>• Potentially-suitable foraging habitat for juveniles within estuarine part of the project footprint. |
| | Chatto, R. and Baker, B. (2008). The distribution and status of marine turtle nesting in the Northern Territory. Technical Report 77/2008. Department of Natural Resources, Environment, the Arts and Sport, Parks and Wildlife Service, Palmerston.<br>Chatto, R. (1998). A preliminary overview of the locations of marine turtle nesting in the Northern Territory. In Kennett et al. (eds.). Marine turtle conservation and management in northern Australia. Northern Territory University, Darwin: pp. 33-40.<br>Department of the Environment (2017). Lepidochelys olivacea - Olive Ridley Turtle, Pacific Ridley Turtle. Species Profile and Threats Database. Department of the Environment, Canberra. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1767 . | | | |
| **Flatback Turtle**<br>*Natator depressus* | VU | - | **Habitat**: Prefers shallow, soft-bottomed seabed habitats away from reefs (DoE 2017). In the NT, nests on a wide variety of beach types on the coast and on offshore island (Chatto & Baker 2008)<br>**Distribution:** Northern Australia and New Guinea, with all known breeding sites occurring in Australia (DoE 2017). In the NT, the most widely spread marine turtle | **NONE**<br>• No nesting habitat within the project footprint.<br>• Potentially-suitable foraging habitat for juveniles within estuarine part of the |

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| | | | species, nesting on portions of the entire coastline (Chatto & Baker 2008). | project footprint. |
| | Chatto, R. and Baker, B. (2008). The distribution and status of marine turtle nesting in the Northern Territory. Technical Report 77/2008. Department of Natural Resources, Environment, the Arts and Sport, Parks and Wildlife Service, Palmerston. [online] Available at:https://dtc.nt.gov.au/__data/assets/pdf_file/0006/279915/marine_turtle_nesting.pdf .<br>Department of the Environment (2017). Natator depressus - Flatback Turtle. Species Profile and Threats Database. Commonwealth Department of the Environment, Canberra. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=59257 .<br>Taylor, R., Chatto, R. and Woinarski, J. (2006). Threatened Species of the Northern Territory - Flatback Turtle - Natator depressus. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0008/376172/flatback-turtle.pdf . | | | |
| **FISH** | | | | |
| **Northern River Shark**<br>*Glyphis garricki* | EN | EN | **Habitat:** Little is known of the ecology, probably restricted to shallow, brackish reaches of large rivers (Ward & Larson 2012).<br>**Distribution:** In Australia, there are few records, including in the NT from the Adelaide, East and South Alligator River systems. Also known from the Kimberley coast and King Sound in WA (Thorburn & Morgan 2004; Compagno et al. 2008). NT distribution does not extend into the Gulf of Carpentaria. | **NONE**<br>• No large river to provide suitable habitat within project footprint. |
| | Compagno, L.J.V., White, W.T. and Last, P.R. (2008). Glyphis garricki sp. nov., a new species of river shark (Carcharhiniformes: Carcharhinidae) from northern Australia and Papua New Guinea, with a redescription of Glyphis glyphis (Müller & Henle, 1839). In: Last et al. (eds.). Descriptions of New Australian Chondrichthyans. CSIRO Marine and Atmospheric Research Paper, 022: pp. 203-226.<br>Thorburn, D.C. and Morgan, D.L. (2004). The northern river shark, Glyphis sp. C (Carcharhinae) discovered in Western Australia. Zootaxa, Vol. 685, pp. 1-8.<br>Ward, S. and Larson, H. (2012). Threatened Species of the Northern Territory – Northern River Shark – Glyphis garricki. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0005/206384/northernr-river-shark.pdf . | | | |
| **Speartooth Shark**<br>*Glyphis glyphis* | CR | VU | **Habitat:** Tropical freshwater and marine environments (Bradshaw et al. 2008). May be restricted to low salinity environments such as freshwater or brackish areas of rivers (DoE 2017).<br>**Distribution**: Papua New Guinea and Northern Australia. Considered to be very rare in Australia as few specimens have been collected (Cavanagh et al. 2003). Three distinct geographical locations in the NT and northern Qld (DoE 2017). In the NT, recorded in the Alligator River region across to Adelaide River, and the Bizant River (Ward and Larson 2012). | **NONE**<br>• No suitable marine and freshwater estuarine habitat within project footprint.<br>• Outside of known NT range. |
| | Bradshaw, C.J.A., Fitzpatrick, B.M., Steinberg, C.C., Brook, B.W. and Meekan, M.G. (2008). Decline in whale shark size and abundance at Ningaloo Reef over the past decade: the world's largest fish is getting smaller. Biological Conservation, Vol. 141, pp. 1894–1905.<br>Cavanagh, R., Kyne, P., Fowler, S., Musick, J. and Bennett, M. (eds.) (2003). The Conservation Status of Australian Chondrichthyans. Report of the IUCN Shark Specialist Group Australia and Oceania Red List Workshop. The University of Queensland, School of Biomedical Sciences, Brisbane, Australia.<br>Department of the Environment (2017). Glyphis glyphis - Speartooth Shark. Species Profile and Threats Database, Department of the Environment, Canberra. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=82453 .<br>Ward, S. and Larson, H. (2012). Threatened Species of the Northern Territory - Speartooth Shark - Glyphis glyphis. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0009/206388/speartooth-shark.pdf . | | | |
| **Lorentz Grunter**<br>*Pingalla lorentzi* | - | VU | **Habitat:** Small and large pools with rock and sand substrates, usually in open unshaded sections of streams and in water temperatures between 25°C and 30°C (Allen et al. 2002).<br>**Distribution:** Rare in Australia, more widespread in PNG. In the NT only known from the Finniss River near Rum Jungle (Stirrat et al. 2006). | **NONE**<br>• Restricted to the Finniss River, which is outside the project footprint. |
| | Allen, G.R., Midgley, S.H. and Allen, M. (2002). Field Guide to Freshwater Fishes of Australia. Western Australian Museum, Perth. | | | |

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| | Stirrat, S., Woinarski, J.C.Z. and Larson, H. (2006). Threatened Species of the Northern Territory – Lorentz Grunter - Pingalla lorentzi. Northern Territory Department of Environment and Natural Resources.<br>https://nt.gov.au/__data/assets/pdf_file/0020/206390/lorentz-grunter.pdf [Accessed 26 April 2017]. | | | |
| **Dwarf Sawfish**<br>*Pristis clavata* | VU | VU | **Habitat:** Tropical marine and estuarine habitats, entering estuarine or fresh waters to breed during the wet season and moving into marine waters following the wet season (Peverell 2005).<br>**Distribution:** Indonesia, South-East Asia and northern Australia (Cavanagh et al. 2003). In the NT, known to occur around Darwin (including Buffalo Creek and Rapid Creek), in Kakadu National Park (Alligator River), Keep River and Victoria River (Thorburn et al. 2003). | **NONE**<br>• No suitable marine and freshwater estuarine habitat within project footprint. |
| | Cavanagh, R., Kyne, P., Fowler, S., Musick, J. and Bennett, M. (eds.) (2003). The Conservation Status of Australian Chondrichthyans. Report of the IUCN Shark Specialist Group Australia and Oceania Red List Workshop. The University of Queensland, School of Biomedical Sciences, Brisbane, Australia.<br>Peverell, S.C. (2005). Distribution of sawfishes (Pristidae) in the Queensland Gulf of Carpentaria, Australia, with notes on their ecology. Environmental Biology of Fishes, Vol. 73, pp. 391-402.<br>Thorburn, D.C., Peverell, S., Stevens, S., Last, J.D. and Rowland, A.J. (2003). Status of freshwater and estuarine elasmobranchs in Northern Australia. Report to Natural Heritage Trust, Canberra. | | | |
| **Freshwater or Largetooth Sawfish**<br>*Pristis pristis* | VU | VU | **Habitat:** Tropical marine and estuarine habitats, entering estuarine or fresh waters to breed during the wet season and moving into marine waters following the wet season (Peverell 2005). Of the four Pristis species reported to occur in Australia, is the one most often associated with freshwater, and has been recorded several hundred kilometres upstream (Thorburn et al. 2003).<br>**Distribution:** Circumtropical, with distinct populations in the eastern Atlantic, western Atlantic, eastern Pacific and Indo-West Pacific – including northern Australia (TSSC 2014). In the NT, reported in Adelaide, Victoria, Daly, East and South Alligator, Goomadeer, Roper, McArthur, Wearyan and Robinson Rivers (TSSC 2014). May potentially occur in all large rivers of northern Australia from the Fitzroy River, WA, to the western side of Cape York Peninsula, Qld (DoE 2018). | **NONE**<br>• No suitable marine and freshwater estuarine habitat within project footprint. |
| | Department of the Environment (DoE) (2018). Pristis pristis in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: http://www.environment.gov.au/sprat..<br>Peverell, S.C. (2005). Distribution of sawfishes (Pristidae) in the Queensland Gulf of Carpentaria, Australia, with notes on their ecology. Environmental Biology of Fishes, Vol. 73, pp. 391-402.<br>Threatened Species Scientific Committee (2014). Approved Conservation Advice - Pristis pristis (largetooth sawfish). Canberra: Department of the Environment. In effect under the EPBC Act from 11-April-2014. http://www.environment.gov.au/biodiversity/threatened/species/pubs/60756-conservation-advice.pdf . | | | |
| **Green Sawfish**<br>*Pristis zijsron* | VU | VU | **Habitat:** Tropical waters – including marine inshore waters, river mouths, estuaries and lagoons – but not freshwater (Thorburn et al. 2003). Enters estuarine to breed during the wet season and moves back into marine waters following the wet season (Peverell 2005).<br>**Distribution:** Northern Australia, South-East Asia and the Indian Ocean (Cavenagh et al. 2003). Most frequently encountered of the sawfish species in Australian waters (Last & Stevens 1994). Most commonly known from the Gulf of Carpentaria (Stevens et al. 2005). In the NT specimens have only been collected from Buffalo Creek in Darwin (Stirrat et al. 2006). | **NONE**<br>• No suitable marine and freshwater estuarine habitat within project footprint. |
| | Cavanagh, R., Kyne, P., Fowler, S., Musick, J. and Bennett, M. (eds.) (2003). The Conservation Status of Australian Chondrichthyans. Report of the IUCN Shark Specialist Group Australia | | | |

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| | and Oceania Red List Workshop. The University of Queensland, School of Biomedical Sciences, Brisbane, Australia.<br>Last, P.R. and Stevens, J.D. (1994). Sharks and Rays of Australia. CSIRO, Melbourne.<br>Peverell, S.C. (2005). Distribution of sawfishes (Pristidae) in the Queensland Gulf of Carpentaria, Australia, with notes on their ecology. Environmental Biology of Fishes, Vol. 73, pp. 391-402<br>Stirrat, S., Larson, H. and Woinarski, J. (2006). Threatened Species of the Northern Territory - Green Sawfish - Pristis zijsron. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0006/206394/green-sawfish.pdf .<br>Thorburn, D.C., Peverell, S., Stevens, S., Last, J.D. and Rowland, A.J. (2003). Status of freshwater and estuarine elasmobranchs in Northern Australia. Report to Natural Heritage Trust, Canberra. | | | |
| **AMPHIBIANS** | | | | |
| **Howard Springs Toadlet**<br>*Uperoleia daviesae* | - | VU | **Habitat:** Very little is known; however, appears to be confined to sandsheet heathland. Suitable habitat consists of short vegetation and sandy substrates which become inundated during the wet season (Ward et al. 2012).<br>**Distribution**: Endemic to the NT. Confined to sandsheet heathlands in the Howard and Elizabeth River catchments (Ward et al. 2012). | **NONE**<br>• No suitable sandsheet heath habitat within the project footprint. |
| | Ward, S., Young, S. and Hill, B. (2012). Threatened Species of the Northern Territory - Howard River Toadlet – Uperoleia daviesae. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0003/205527/howard-river-toadlet.PDF [Accessed 30 May 2017]. | | | |
| **INVERTEBRATES** | | | | |
| **Atlas Moth**<br>*Attacus wardi* | - | VU | **Habitat:** Coastal monsoon vine forest, where the larval stages feed on the plant Croton habrophyllus at the edges of the forest (Lane et al. 2010).<br>**Distribution:** On mainland NT, it is confined to three locations; Darwin, Black Point on the Coburg, and Dundee Beach Peninsula (Braby & Nielsen 2011). Also records from Lesuer Island in WA (Braby & Nielsen 2011). | **NONE**<br>• No suitable coastal monsoon vine forest within project footprint. |
| | Braby, M.F. and Nielsen, J. (2011). Review of the conservation status of the Atlas Moth, Attacus wardi Rothschild, 1910 (Lepidoptera: Saturniidae) from Australia. Journal of Insect Conservation, Vol. 15, pp. 603-608.<br>Lane, D., Martin, G. and Weir, R.P. (2010). The life history of Attacus wardi Rothschild (Lepidoptera: Saturniidae) from the Northern Territory, Australia. Australian Entomology, Vol. 37, pp. 115-127. | | | |
| **FLORA** | | | | |
| **a shrub**<br>*Atalaya brevialata* | CR | - | **Habitat:** Restricted to foot-slope sites with more open vegetation on deeper, coarser sandy soils, mostly along a specific, distinct geological boundary (Cowie 2014).<br>**Distribution**: Endemic to the NT; found south of Darwin, near Elizabeth River at Virginia, and its tributary – Amy's Creek (Cowie 2014). Few targeted survey and there is uncertainty as to the taxonomic distinctness of the species. Extent of occurrence is 7.6 $km^2$, with a high degree of confidence as it occurs within one of the most heavily-surveyed areas in the NT (Cowie 2014). | **NONE**<br>• Restricted to a small range which is outside the project footprint.<br>• There is a high confidence of the species' range given the level of surveys. |
| | Cowie, I. (2014). Threatened Species of the Northern Territory - Atalaya brevialata. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0008/376262/atalaya-brevialata.pdf . | | | |
| **a shrub**<br>*Clausena excavata* | CR | CR | **Habitat:** Collected from two small monsoonal vine thickets situated on limestone (karst) geology. One population was found in outcropping limestone and the other on the border of a sink hole (Westaway & Cowie 2012). | **NONE**<br>• Project footprint is outside the species range (outcropping limestone on Tipperary |

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| | | | **Distribution:** Thought to be endemic to the NT – highly restricted and known only from a small area on Tipperary Station, 5 km north-west of Mt Burrell in the Daly Basin bioregion (Westaway & Cowie 2012). | Station, NT) |
| | Westaway, J. and Cowie, I. (2012). Threatened Species of the Northern Territory - Clausena sp. Tipperary. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0004/208426/clausena-tipperary.pdf. | | | |
| ***a herb***<br>*Cleome insolata* | - | VU | **Habitat:** Inundated sedge land growing on silty loam with coverage of laterite gravels in close proximity to a river catchment (Short 2010).<br>**Distribution:** Endemic to the NT, known from a population located near Humpty Doo and three populations in Lloyd Creek in the Darwin rural area (Westaway & Cowie 2012; EcOz records). A species specific survey has not been carried out (Westaway & Cowie 2012). | **NONE**<br>• Highly restricted range which is outside the project footprint. |
| | Short, P.S. (2010). New species of Cleome L. (Cleomaceae) from the Northern Territory, Australia. The Beagle, Records of the Museum and Art Galleries of the Northern Territory, 2010, Vol. 26, pp. 1–12. https://dtc.nt.gov.au/__data/assets/pdf_file/0011/254954/Short.pdf.<br>Westaway, J. and Cowie, I. (2012). Threatened Species of the Northern Territory - Cleome insolata. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0006/208428/cleome-insolata.pdf. | | | |
| **an orchid**<br>*Crepidium marsupichila* | - | VU | **Habitat:** Prefers protected shady areas and moist soils rich in leaf litter along the margins of monsoon rainforest and littoral rainforest (Kerrigan & Cowie 2006).<br>**Distribution:** An Australian endemic with known populations from north-eastern Qld and the NT. In the NT, only known from one locality, Gunn Point (Kerrigan & Cowie 2006). Limited amount of recent survey in the area, though extensive surveys in the 1980's of rainforest areas failed to find the species (Kerrigan & Cowie 2006). | **NONE**<br>• Highly restricted range well outside the project footprint.<br>• No monsoon rainforest or littoral rainforest habitat within the project footprint. |
| | Kerrigan, R. and Cowie, I. (2006). Threatened Species of the Northern Territory - Malaxis marsupichila. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0007/208690/malaxis-marsupichila.pdf. | | | |
| **Darwin Cycad**<br>*Cycas armstrongii* | - | VU | Habitat: Open grassy woodland where adequate drainage appears to be a limiting factor (Kerrigan et al.<br>2006). Prime habitat has deep loamy soil (Liddle 2009).<br>Distribution: Restricted to the Top End of the NT – from Gunn Point to Hayes Creek, west to within 50km of the coastline and east to the Wildman River catchment (Kerrigan et al. 2006). Also on the Tiwi Islands and Cobourg Peninsula. | **LOW**<br>• Cycad species on the Cox Peninsula is typically *Cycas maconochiei*.<br>• Previous field surveys confirmed cycad present in project footprint was not *Cycas armstrongii*. |
| | Kerrigan, R., Cowie, I. and Liddle, D. (2006). *Threatened Species of the Northern Territory - Cycas armstrongii*. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0017/208430/cycas-armstrongii.pdf.<br>Liddle, D.T. (2009). Management Program for Cycads in the Northern Territory of Australia 2009-2014. Northern Territory Department of Natural Resources, Environment, the Arts and Sport, Darwin. http://www.territorystories.nt.gov.au/jspui/bitstream/10070/265358/1/Management%20program%20for%20cycads%20in%20the%20Northern%20Territory%20of%20Australia%202009%20to%202014.pdf. | | | |
| **a ground orchid**<br>*Dienia montana* | - | VU | **Habitat:** Wet (spring-fed) rainforest (Kerrigan et al. 2013).<br>**Distribution**: Northern Qld, and one population in the NT, near Munmarlary in Kakadu National Park. A targeted search in 2003 failed to record any plants at this locality (Kerrigan et al. 2013). | **NONE**<br>• Highly restricted range (in Kakadu)<br>• No monsoon rainforest or littoral rainforest habitat within the project footprint. |
| | Kerrigan, R., Cowie, I. and Ward S. (2013). Threatened Species of the Northern Territory - Dienia montana. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0007/208474/dienia-montana-malaxis-latifolia.pdf. | | | |

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| **a sedge**<br>*Endiandra limnophila* | VU | - | **Habitat:** Margins of seasonal swamps and watercourses with Melaleuca, Eucalyptus and Corymbia species and grasses (Cowie & Kerrigan 2006).<br>**Distribution:** In the NT, known from Wingate Mountains near Port Keats and Nitmiluk National Park near Katherine (TSSC 2008). | **NONE**<br>• Highly restricted range and no records near the project footprint. |
| | Cowie, I. and Kerrigan, R. (2006). Threatened Species of the Northern Territory - Eleocharis retroflexa. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0010/376264/eleocharis-retroflexa.pdf.<br>Threatened Species Scientific Committee (2008). Commonwealth Conservation Advice on Eleocharis retroflexa. Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/23672-conservation-advice.pdf. | | | |
| **Narrow-leaf Climbing Pandan**<br>*Freycinetia excelsa* | - | VU | **Habitat:** Wet lowland rainforest and spring-fed rainforests in sandstone gullies (Kerrigan & Cowie 2006).<br>**Distribution:** Known from Papua New Guinea, coastal Qld, and in the NT from seven locations between Bathurst Island and the Arafura Swamp (Kerrigan & Cowie 2006). | **NONE**<br>• No suitable rainforest within project footprint. |
| | Kerrigan, R. and Cowie, I. (2006). Threatened Species of the Northern Territory - Freycinetia excelsa. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0018/208440/freycinetia-excelsa.pdf. | | | |
| **a herb**<br>*Goodenia quadrifida* | VU | - | **Habitat:** Ecology not well known, however, one population was recorded growing in grassland, whilst another grows on the upper parts of estuarine floodplains on poorly drained soils (Cowie & Kerrigan 2006).<br>**Distribution:** Endemic to the Top End of the NT. Known from the Marrakai Crossing area on the Adelaide River and Hardies Creek (Cowie & Kerrigan 2006). | **NONE**<br>• Highly restricted range which is well away of the project footprint. |
| | Cowie, I. and Kerrigan, R. (2006). Threatened Species of the Northern Territory - Goodenia quadrifida. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0006/376269/goodenia-quadrifida.pdf. | | | |
| **a ground orchid**<br>*Habenaria rumphii* | - | EN | **Habitat:** In the NT, collected on sand plains adjacent to spring-fed rainforests (Kerrigan & Cowie 2006).<br>**Distribution:** Known from the northern parts of Australia, Papua New Guinea, and South-East Asia. In the NT, only known from a single locality, the Howard River sand plain (upper Howard River catchment) (Kerrigan & Cowie 2006) despite considerable survey effort in potentially-suitable habitat. | **NONE**<br>• No suitable sand plains habitat within the project footprint.<br>• Single known occurrence well outside project footprint. |
| | Kerrigan, R. and Cowie, I. (2006). Threatened species of the Northern Territory - Habenaria rumphii. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0004/208444/habenaria-rumphii.pdf. | | | |
| **a shrub**<br>*Helicteres macrothrix* | EN | EN | **Habitat:** Woodland dominated by *Eucalyptus tectifica, E. tetrodonta* and *E. miniata* on sandy loam and rocky siltstone slopes or granitic rocks (Cowie et al. 2012). Absent from the laterite country predominant in the region (DoE 2017).<br>**Distribution:** Restricted to the Top End of the NT where only three populations known – Mt Bundey, Batchelor/Glenluckie Creek and Lake Bennett (DoE 2017). While it is possible that extensive targeted searches may uncover additional subpopulations, there is a high degree of confidence in the broader distributional data (Cowie et al. 2012). | **LOW**<br>• Drainage areas within the project footprint are ephemeral and only marginal habitat.<br>• Not within expert distribution. |
| | Cowie, I. and Westaway, J. (2012). Threatened species of the Northern Territory - Stylidium ensatum. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0009/208494/stylidium-ensatum.pdf. | | | |

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| | Holmes, J., Bisa, D., Hill, A. and Crase, B. (2007). A Guide to Threatened, Near Threatened and Data Deficient Plants in the Litchfield Shire of the Northern Territory. WWF-Australia, Darwin.<br>Threatened Species Scientific Committee. 2016. Conservation Advice. Stylidium ensatum. Department of the Environment, Canberra. | | | |
| **a shrub**<br>*Hibiscus brennanii* | VU | VU | **Habitat:** Sandstone cliffs, in gullies and on broken sandstone (Kerrigan & Cowie 2006).<br>**Distribution**: Endemic to the NT, with restricted population in the Mt Brockman area to the west of Arnhem Land (Kerrigan & Cowie 2006). Considered adequately surveyed (Kerrigan & Cowie 2006). | **NONE**<br>• No suitable sandstone cliff habitat within the project footprint. |
| | Kerrigan, R. and Cowie, I. (2006). Threatened Species of the Northern Territory - Hibiscus brennanii. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0003/208452/hibiscus-brennanii.pdf. | | | |
| **Luisia Orchid**<br>*Luisia corrugata* | - | VU | **Habitat:** An epiphyte that commonly grows on trees with scaly bark and prefers the areas of bright light (non-shaded area). Within the NT, collected from the margins of monsoon rainforests (Kerrigan & Cowie 2012).<br>**Distribution:** Appears to be endemic to the NT with known populations from Melville Island and the mainland (Bankers Jungle and Crocodile Creek in Black Jungle Conservation reserve) (Kerrigan & Cowie 2012). It is likely that that the existing collections accurately reflect the abundance and distribution of this species (Kerrigan & Cowie 2012). | **NONE**<br>• Highly restricted range (that is considered accurate) outside project footprint.<br>• Core habitat of monsoon rainforest margins not present within project footprint. |
| | Kerrigan, R. and Cowie, I. (2012). Threatened Species of the Northern Territory - Luisia corrugata. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0005/208472/luisia-corrugata.pdf. | | | |
| **Arrow-leaf Monochoria**<br>*Monochoria hastata* | - | VU | **Habitat:** Grows in floating mat vegetation in permanent to near-permanent back-swamps, drainage channels and billabongs (Kerrigan & Cowie 2006).<br>**Distribution:** In Australia, only found in the NT on the floodplains of the Finniss, Reynolds and Wildman Rivers (Kerrigan & Cowie 2006). There is a negative collection bias associated with the swampy habitat in which this species occurs. However, extensive coverage of floodplains in the Kakadu region detected this species at only one location in that region (Wildman River). Furthermore, it is considered that the extensive surveys of the Top End floodplain communities (Wilson et al. 1991) during the 1990s would have detected this species more often had it been more common or widespread (Kerrigan & Cowie 2006). | **NONE**<br>• No permanent freshwater habitat within the project footprint.<br>• Outside of known distribution. |
| | Kerrigan, R. and Cowie, I. (2006). Threatened Species of the Northern Territory - Monochoria hastata. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0003/208479/monochoria-hastata.pdf.<br>Wilson, B.A., Brocklehurst, P.S. and Whitehead, P.J. (1991). Classification, distribution and environmental relationships of coastal floodplain vegetation, Northern Territory, Australia. Technical Report 91/2. Conservation Commission of the Northern Territory, Darwin. | | | |
| **Darwin Palm**<br>*Ptychosperma macarthurii* | - | EN | **Habitat:** Dense rainforests fed from lowland springs at the edges of tropical riverine floodplains. Common in deep organic loamy clay substrates without humus development (Liddle et al. 2006).<br>**Distribution:** Within the NT, known from eight locations on the western margin of the Adelaide River<br>Floodplain (Liddle et al. 2006). Survey effort is not documented. | **NONE**<br>• No suitable dense rainforest habitat within the project footprint. |
| | Holmes, J., Bisa, D., Hill, A. and Crase, B. (2007). *A Guide to the Threatened, Near Threatened and Data Deficient Plants in the Litchfield Shire of the Northern Territory*. WWF-Australia, Darwin. | | | |

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|---|---|---|---|---|
| | Liddle, D.T., Brook, B., Matthews, J., Taylor, S.M. and Caley, P. (2006). Threat and response: A decade of decline in a regionally endangered rainforest palm affected by fire and introduced animals. *Biological Conservation*, Vol. 132, pp. 362-375. | | | |
| **Trigger plant**<br>*Stylidium ensatum* | EN | EN | **Habitat**: Margins of drainage areas in damp heavy clay or peaty soil (Cowie & Westaway 2012).<br>**Distribution:** Known from three localities in Darwin – Shoal Bay, Girraween Rd, Hayes Creek. Other historical collections recorded; however, the exact locality for these collections is unknown. Not collected since 1974 (Cowie & Westaway 2012). No additional subpopulations have been located despite several flora and biodiversity surveys in the Darwin region over the last ten years (but no systematic survey of potentially suitable habitat at an appropriate time of year). NT Herbarium has conducted surveys in potential suitable habitat on the Cox Peninsula without detecting the species, however, herbarium mapping indicates the presence of suitable habitat within the project footprint (Green & Cuff 2016) | **MEDIUM**<br>• Drainage areas within the project footprint are ephemeral and only marginal habitat.<br>• Project footprint is outside the expert distribution and there are no nearby records.<br>• Closest record is ~35 km north-east of the project footprint. |
| | Cowie, I. and Westaway, J. (2012). Threatened species of the Northern Territory - Stylidium ensatum. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0009/208494/stylidium-ensatum.pdf.<br>Green, C. & Cuff, N. (2016). Threatened species distribution in the Greater Darwin Region – Stylidium ensatum. Department of Land Resources Management, Northern Territory Government. | | | |
| **a herb**<br>*Typhonium praetermissum* | - | VU | **Habitat:** Open woodland including relatively unshaded areas in red brown clay and shallow or gravelly lateritic soil (Cowie & Westaway 2012). Surveys have recorded the species in four land units; 3b, 3c, 2a1 and 1c (Green & Cuff 2016). NT Herbarium mapping indicates there is suitable habitat near the project footprint.<br>**Distribution:** Endemic to the NT. Previous recorded at six locations in the Darwin/Litchfield area – Virginia, Karama, the Palmerston escarpment, Mandorah and Humpty Doo (Cowie & Westaway 2012).<br>Two new sub-populations recorded in Lloyd Creek (EcOz records). Herbarium mapping includes the project footprint within the extent of occurrence (Green & Cuff 2016). | **HIGH**<br>• Open woodland areas in 2a1 land unit within project footprint is potential habitat.<br>• The project footprint is within the extent of occurrence of the species; however, the closest record is 10 km west.<br>• There is modelled high and moderate likelihood habitat within the project footprint. |
| | Cowie, I. and Westaway, J. (2012). Threatened species of the Northern Territory - Typhonium praetermissum. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0017/208502/typhonium-praetermissum.pdf<br>Green, C. & Cuff, N. (2016). Threatened species distribution in the Greater Darwin Region – Typhonium praetermissum. Department of Land Resources Management, Northern Territory Government. | | | |
| **a herb**<br>*Typhonium taylori* | EN | EN | **Habitat:** Seasonally-saturated sandy substrate in nutrient-deficient grass/sedge land (Kerrigan & Cowie 2006).<br>**Distribution:** Endemic to the NT, with the only known population from the edge of the Howard River floodplain (Kerrigan & Cowie 2006). Targeted survey for this species in the Howard River Floodplain as part of a biodiversity assessment survey (Cowie 2002) did not relocate or uncover any additional populations of this species. Considered adequately surveyed, based on the strong survey effort in the area and the high profile of this genus amongst collectors. While more populations may exist, the paucity of collections of this species is considered to accurately reflect its very restricted distribution and abundance (Kerrigan & Cowie 2006). | **NONE**<br>• Only known population on the Howard River floodplain which is well away from project footprint.<br>• No suitable habitat |
| | Cowie, I. D. (2002). Preliminary report on a survey of Utricularia (Lentibulariaceae) in the Howard River – Shoal Bay area. NT Department of Infrastructure Planning and Environment, | | | |

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|---|---|---|---|---|
| | Darwin.<br>Kerrigan, R. and Cowie, I. (2006). Threatened species of the Northern Territory - Typhonium taylori. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0019/208504/typhonium-taylori.pdf | | | |
| **a bladderwort**<br>*Utricularia dunstaniae* | - | VU | **Habitat***:* Wet sand, often in shallow water, in paperbark (*Melaleuca nervosa*) woodland or Feather-flower (*Verticordia*) shrub land. Occurs in slightly wetter micro-habitats than other sympatric *Utricularia* species, frequently where water is percolating from the ground (Kerrigan & Cowie 2012).<br>**Distribution:** Endemic to Australia, known from WA and the NT – where known from nine locations. Locations near Darwin are Noonamah, Howard Springs and the Howard River floodplain. Other subpopulations on the Cobourg Peninsula, near Murgenella and near Finniss River (Kerrigan & Cowie 2012). As apparently suitable habitat within the extent of occurrence remains unsurveyed, it is likely that additional, undiscovered subpopulations exist (Kerrigan & Cowie 2012). | **NONE**<br>• No suitable wet sand/inundated habitat within the project footprint.<br>• Project footprint outside the extent of occurrence for the species. |
| | Kerrigan, R. and Cowie, I. (2012). Threatened Species of the Northern Territory - Utricularia dunstaniae. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0020/208505/utricularia-dunstaniae.pdf | | | |
| **a bladderwort**<br>*Utricularia singeriana* | - | VU | **Habitat:** Margins of wet sandy flats and swamps with short grasses and sedges (Kerrigan & Cowie 2012).<br>**Distribution**: Endemic to the NT with known populations from five locations between Darwin and Katherine – the nearest Darwin being Finn Rd in Weddell. Other sites are the Edith River area, near the Finniss River, and the Marrawal Plateau east of Pine Creek. Port Darwin population (early 1900's record) no longer in existence (Kerrigan & Cowie 2012). As much apparently suitable habitat within the extent of occurrence remains unsurveyed, it is likely that additional undiscovered sub-populations exist (Kerrigan & Cowie 2012). | **NONE**<br>• No suitable wet sandy flat or swamp habitat within project footprint<br>• Project footprint is on the edge of the extent of occurrence. |
| | Kerrigan, R. and Cowie, I. (2012). Threatened Species of the Northern Territory - Utricularia singeriana. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0003/208506/utricularia-singeriana.pdf | | | |
| **a ground orchid**<br>*Zeuxine oblonga* | - | VU | **Habitat:** Grows in clusters in dark and moist situations on the rainforests floor or in wet peaty areas near streams (Jones 1988).<br>**Distribution**: Qld, NSW and in the NT, where known from five widely-spaced locations south and southwest of Darwin, from Keep River near the WA border to south-west of Adelaide River (Liddle et al. 1994). Not collected since 1992, despite efforts to relocate the Keep River population in 2000 and 2001 (Kerrigan & Cowie 2006). There is a negative collection bias associated with this species due to its ephemeral nature. | **NONE**<br>• No suitable rainforest habitat within the project footprint.<br>• Project footprint well outside extent of occurrence of the species. |
| | Jones, D.L. (1988). Native Orchids of Australia. Reed, Sydney.<br>Kerrigan, R. and Cowie, I. (2006). Threatened Species of the Northern Territory – Zeuxine oblonga. Northern Territory Department of Environment and Natural Resources. https://nt.gov.au/__data/assets/pdf_file/0008/208691/zeuxine-oblonga.pdf<br>Liddle, D.T., Russell-Smith, J., Brock, J., Leach, G.J. and Connors, G.T. (1994). Atlas of the vascular rainforest plants of the Northern Territory. Flora of Australia Supplementary Series No. 3, Australian Biological Resources Study, Canberra. | | | |

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# Appendix E. Mangrove and riparian study

# Appendix E Groundwater

GROUNDWATER ENTERPRISES

# BP33 Pumping Test Report

September 2021

PREPARED FOR Core Lithium Pty Ltd

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# 1 Introduction

Core Lithium (Core) are planning an underground mining operation at the BP33 deposit located 30 km south-east of Darwin on exploration leases EL30015 and EL29698. The BP33 deposit is situated approximately 5km south-east of Grants Lithium prospect. The environmental assessment report (NTEPA, 2019) for an open cut lithium mine at the Grants deposit was completed in June, 2019.

The water supply for the lithium project will be largely sourced from the dewatering of mine workings (Grants Pit and BP33 box cut and underground), with potable water and any additional water requirements sourced from an existing surface water storage, Observation Hill Dam, located 1500 m north-east of the BP33 deposit. However, Core are assessing the potential to augment surface water supplies with groundwater from around the BP33 site. A series of monitoring bores were installed at BP33 in late 2020 to establish baseline groundwater conditions prior to the mine development. Four of the investigation bores recorded airlift yields of 1.5 – 3.5 L/s with the remainder producing yields of less than 0.5 L/s. Since instalment, all bores have been monitored monthly for groundwater level and quality. Slug testing was undertaken as part of the drilling completion report (Groundwater Enterprises, 2020), however, there is limited information on the broader hydraulic characteristics of the aquifer around BP33.

A works program consisting of a series of short duration pumping tests has been completed to investigate the groundwater availability across the BP33 site. This document reports on the pumping test results and analysis, and provides an assessment of groundwater supply potential around the BP33 site.

## 1.1 Project Background

The proposed mining activities at BP33 involve the construction of a box cut to remove the weathered zone from the Burrell Creek Formation. The box-cut will be excavated to a depth of approximately 60 m. A 400 m long decline stemming from the base of the box-cut will allow access to the spodumene deposit located beneath the previously worked open pit. The deposit will be mined using sub-level retreat mining to an estimated depth of 320 m (Orewin, 2019). The mined ore will be trucked to the Grants processing facility and there will be no requirement for tailings storage at the BP33 site. There will be a waste rock dump at the BP33 site comprised of the oxide waste from the box-cut, which will be pushed back into the box-cut on completion of mining. Both the box cut and the underground mine will require de-watering. Water sourced from de-watering activities will be largely reused for dust suppression at the mine site.

## 1.2 Scope

The BP33 groundwater availability investigation has the following scope:

- Undertake a 24-hour duration pumping test on deep bore BPG4d located adjacent to the exist BP33 pit-lake.
- Undertake three shorter duration (8-hours) pumping tests on the higher yielding monitoring bores (BPG1, BPG5i, BPG6) around the BP33 site.
- Analyse the pumping test data to estimate the groundwater supply potential of each test bore.
- Estimate the potential volume that could be extracted by dewatering the existing BP33 pit-lake
- Undertake a broader desktop assessment of the groundwater supply potential of aquifers underlying Core's surrounding mining and exploration leases.

# 2 Pumping Test Overview

## 2.1 Site Hydrogeology

The Burrell Creek Formation (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 6 L/s during drilling) have been recorded where bores intersect 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 – 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, unweathered rock.

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 late 2020 (Groundwater Enterprises, 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 pit/proposed mine workings and the drainage line to the east. These results and subsequent groundwater monitoring suggest groundwater within the alluvial deposits is largely ephemeral or is restricted to small areas in very close proximity to the drainage lines.

## 2.2 Bore Details

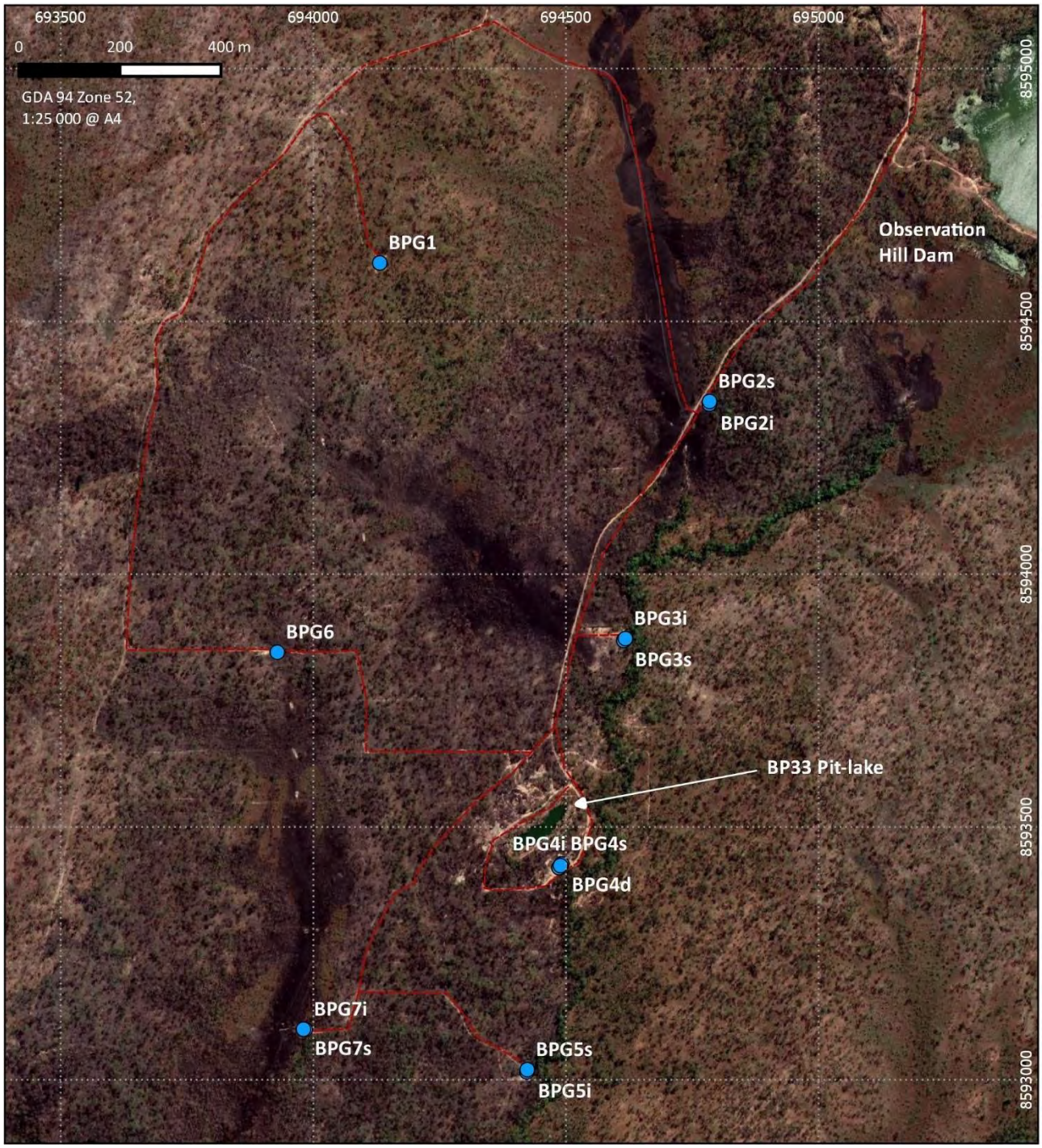
Thirteen monitoring bores have been installed around the BP33 site. Bore construction details are provided in Table 2-1. The bores highlighted in bold are those that were pumped during the aquifer testing program. A bore location map is provided in Figure 2-1.

**Table 2-1 BP33 Bore Details. Test bores shown in bold.**

| SITE ID | AQUIFER TYPE | BORE DEPTH (mBLG)* | SCREENED INTERVAL (mBGL) | CASING DIAMETER (mm) | AIRLIFT YIELD (L/S) ^ | STANDING WATER LEVEL (12-05-21) (mTOC)$^{\Delta}$ |
|---|---|---|---|---|---|---|
| **BPG1** | **Fractured/weathered BCF with pegmatite** | **36** | **29 – 35** | **100** | **1.5** | **2.8** |
| BPG2i | Fractured/weathered BCF with quartz veins | 28.3 | 22.3 – 28.3 | 100 | 0.4 | 0.78 |
| BPG2s | Alluvial Sediments (Silty sand with laterite band) | 3.5 | 2.5 – 3.5 | 100 | Seepage | 0.97 |
| BPG3i | Fresh BCF | 48.75 | 41.8 – 48.8 | 100 | 0.1 | 1.86 |
| BPG3s | Alluvial Sediments | 4.5 | 3.5 – 4.5 | 100 | Dry | 4.13 |
| **BP4d** | **Fractured Fresh BCF** | **109** | **47 – 109#** | **150** | **2.6** | **0.90** |
| BPG4i | Weathered BCF | 35.4 | 28.4 – 34.4 | 100 | Seepage | 1.24 |
| BPG4s | Weathered BFC | 8 | 5 – 8 | 50 | Seepage | 1.6 |
| **BPG5i** | **Fractured Fresh BCF** | **57.3** | **49.3 – 55.3** | **100** | **3** | **1.52** |
| BPG5s | Weathered BCF | 8 | 5 – 8 | 100 | Seepage | 1.96 |
| **BPG6** | **Fractured Fresh BCF** | **73** | **66 – 72** | **100** | **1.5** | **7.53** |
| BPG7i | Fractured Fresh BCF | 53.2 | 46.2 – 52.2 | 100 | 0.5 | 1.03 |
| BPG7s | Weathered BCF | 7 | 4 – 7 | 100 | Seepage | 1.48 |

NOTES:
* metres below ground level
^ Airlift yields are final constructed yield
# Open hole form 47 – 109 m
$^{\Delta}$ metres below top of casing

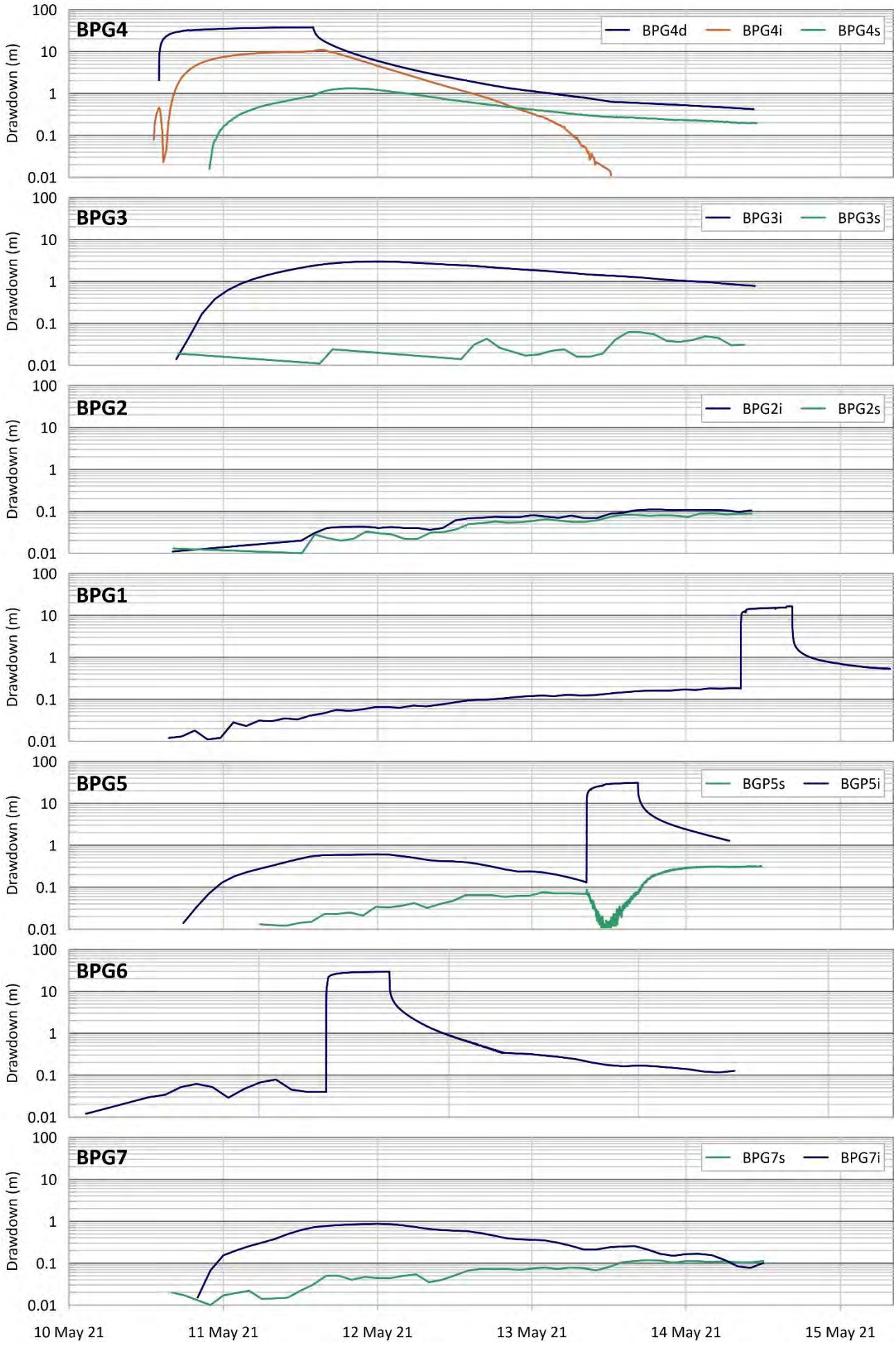
**Figure 2-1 BP33 Bore Locations**




## 2.3 Program Summary

The pumping test program was completed by McMinn Bore Services and involved a 24-hour constant rate test completed on BPG4d followed by 8-hour constant rate tests completed on bores BPG1, BPG5i and BPG6. The tests were undertaken using electric submersible pumps, either a Grundfos SP17-7 (BPG4d) or a Grundfos SQ5-70 (BPG1, BPG5i, BPG6). Flow rates were recorded manually using a mechanical flow meter and were periodically verified by measuring the discharge rate using a 20 L bucket. Drawdown was measured using pressure loggers, Insitu Rugged Trolls in the observation bores and a HOBO water level logger in the test bore. Manual water level measurements were collected using an OTT water level tape. Drawdown observed in the monitoring bores is presented in Figure 2-2 for the full test period. The discharge water was monitored for field parameters (temperature, Electrical Conductivity (EC) and pH) using a TPS WP-81 Water Quality meter. Results are tabulated in Appendix A. EC and pH were field calibrated against standard solutions for a precision of ±1 % and ±0.01 units respectively. Temperature measurements have an instrument precision of ±0.4°C.

**Figure 2-2 Drawdown in BP33 bores over test program**



# 3 Pumping Test Analysis

## 3.1 BPG4d 24-hour Constant Rate Test

The BPG4 site is located adjacent to the BP33 orebody and existing open, water filled pit. The site comprises a nest of three bores, targeting the fresh Burrell Creek Formation at a total drilled depth of 109m but encountering a significant water bearing fracture at 50-54 m, an intermediate depth bore (BPG4i) in weathered Burrell Creek Formation at 35.4 m total depth, and a shallow bore (BPG4s) at the top of the Burrell Creek Formation. The shallow bores did not encounter free water during drilling. The deep bore (BPG4d) had a final airlift yield of 2.6 L/s, but yields of roughly 5.5 L/s were measured shortly after water was struck. A slug test could not be successfully performed on BPG4d due to the large casing diameter. Slug tests on BPG4i and BPG4s resolved hydraulic conductivities of 0.007 m/day and 0.02 m/day respectively.

A 24-hour constant rate test was performed on BPG4d commencing on 10 May 2021. The average pumping rate during the test was 3.7 L/s but the rate ranged from 3.5 L/s to 4.9 L/s due to the dropping head above the pump and the effect of this on the performance of the electric submersible pump. The test was initially started at roughly 6 L/s, but after roughly one hour of pumping it was realised that the rate would not be sustained for the duration of the test. There were some minor (<=0.1 L/s) step changes in the pumping rates due to the pumping contractor making adjustments to try and maintain a constant pumping rate. These rate adjustments rendered the use of derivatives for identification of flow regimes unavailable.

Water levels were monitored in all bores across the site (Figure 2-2). Responses to the pumping were observed in the nested bores at the BPG4 site, BPG5i (Figure 3-1), BPG3i, BPG7i, BPG1 and potentially BPG6, although the magnitude of drawdown in the latter two bores was insufficient to analyse with any degree of confidence. BPG4i and BPG4s both responded, with delays, to the pumping.

The BPG4d test was analysed in Aqtesolv, in the following manner:

- A Theis (1935) type curve was fitted to the BPG5i drawdown to calculate a storage coefficient for the test. The BPG5i derivative was diagnostic of a leaky aquifer, however the test stopped before the full effect of the leakage was observed. A good fit (of the Theis curve) was obtained to the early- to mid-time data (Figure 3-2), resolving a storativity of 0.0003, which is indicative of semi-confined aquifer, or an aquifer of relatively low storage. The bulk transmissivity between the test bore and BPG5i was 30 $m^2$/day.
- The pumping bore (BPG4d) data could not be matched with a Theis (1935) type curve regardless of whether aquifer boundaries were included or not. The Gringarten-Witherspoon (1972) solution for a vertical fracture was used which enabled a good fit to the data except for the late time recovery data (Figure 3-3). The storage parameter used was not changed from the BPG5i response. The water level recovered much quicker than the type-curve, suggesting that there may be a nearby constant head boundary, such as the BP33 pit lake.
- BPG4i and BPG4s both responded to the pumping. Attempts were made to analyse the data, but no analytical solution could be found that would enable a reasonable match to either of the responses. An attempt to analyse the data in a multiple-aquifer analytical model (MLU for Windows) was also unsuccessful as there was an unresolvable interplay between increasing the vertical hydraulic conductivity of the overburden and decreasing the horizontal hydraulic conductivity of the pumped layer to induce drawdown. The bores are likely to be connected via a convoluted fracture network that cannot be resolved with simple analytical solutions. The recovery responses in BPG4i and BPG4s also indicate connection to a constant head boundary.

**Figure 3-1 BPG4d constant rate test drawdown – all bores with clear pumping response**

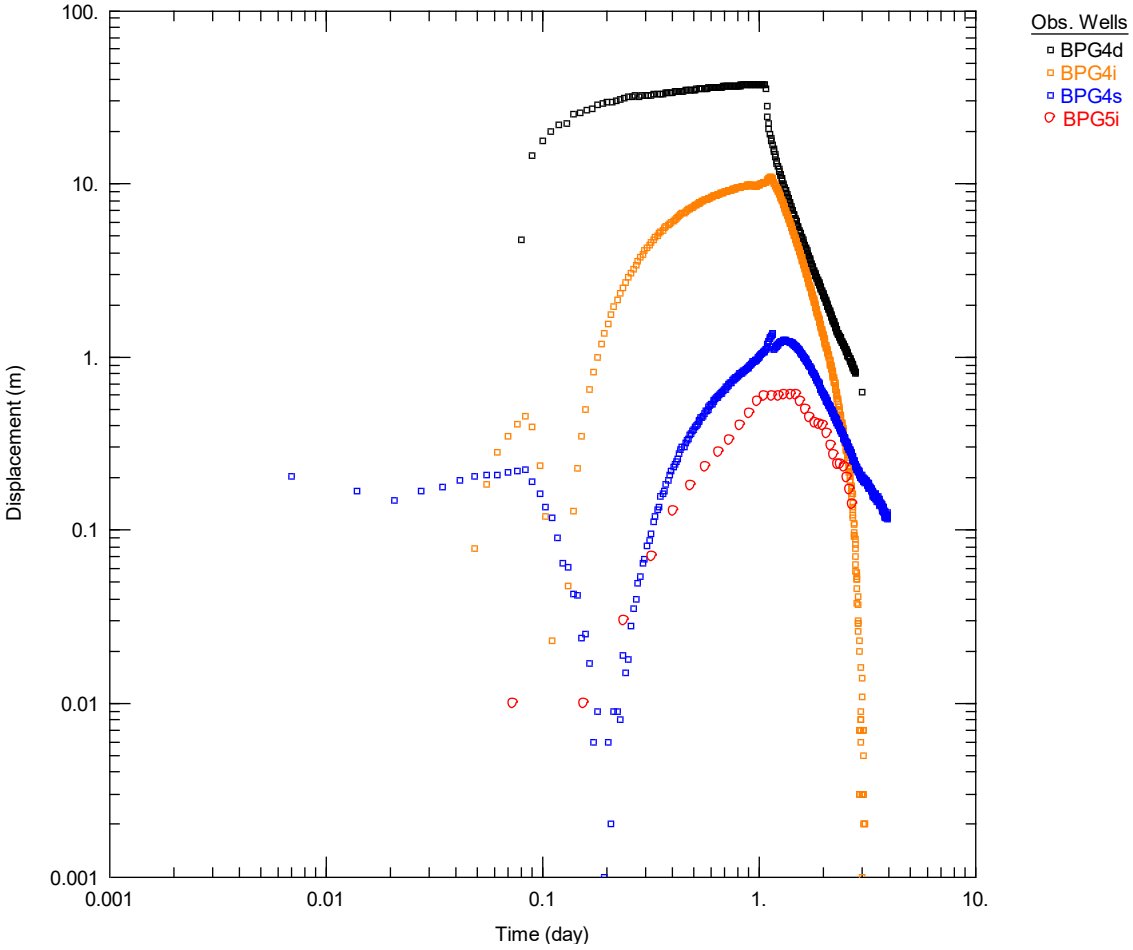



**Figure 3-2 BPG4d constant rate test analysis for BPG5i. Drawdown (blue) and derivative (red).**

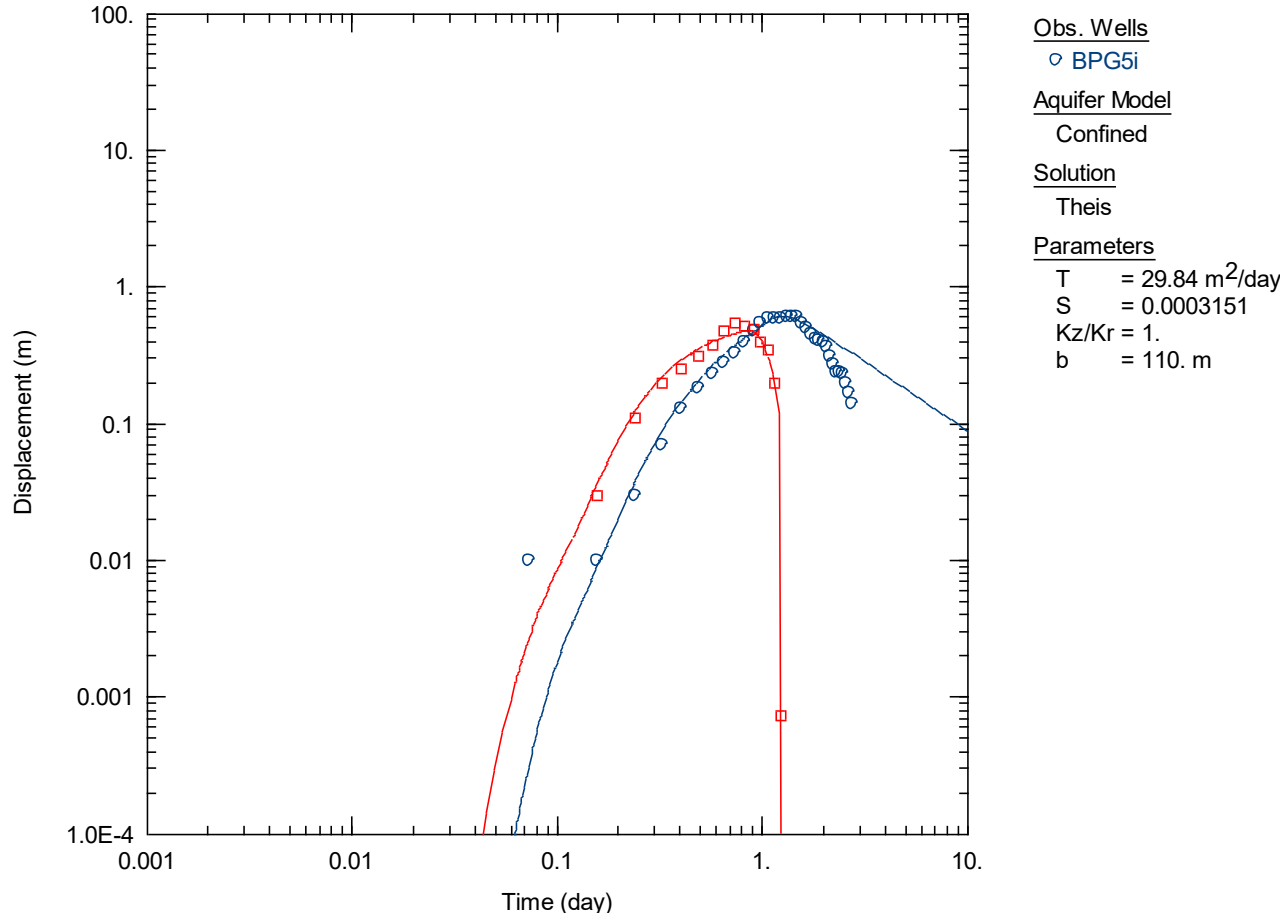
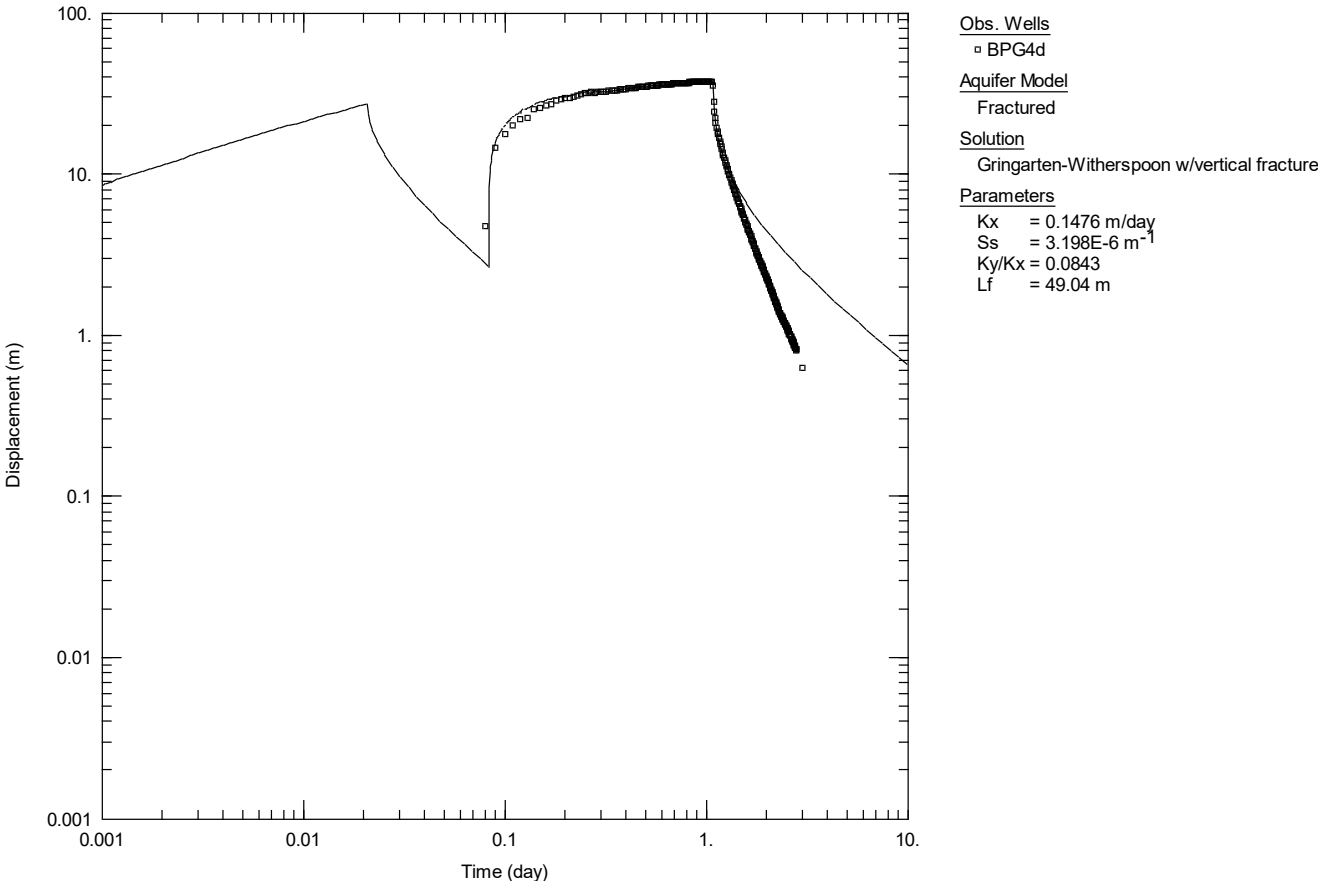


**Figure 3-3 BPG4d constant rate test analysis for pumping bore**




## 3.2 BPG1 8-hour Constant Rate Test

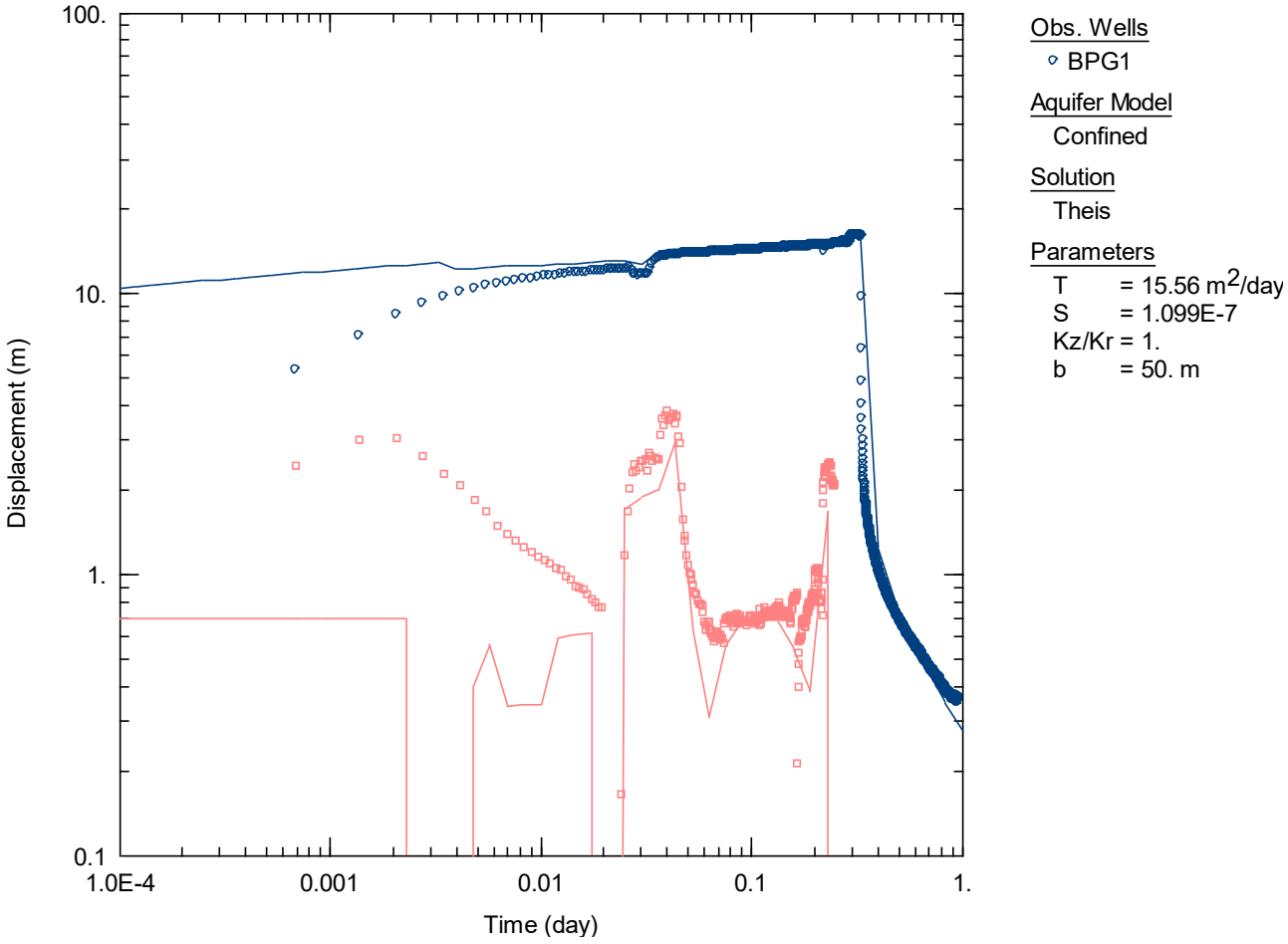
BPG1 is the northernmost bore location at the BP33 site, and is located at the northern end of the proposed box cut, in an outcrop of fresh Burrell Creek Formation. BPG1 was drilled to 37 m and was constructed across a fracture zone in the contact between the pegmatite and sandstone. It is likely that only the pegmatite is the water bearing zone based on the water cut being associated with fractured vein quartz. The bore produced a final airlift yield of 1.6 L/s, and the slug tests performed on the bore resolved a hydraulic conductivity of 1.8 m/day.

An 8-hour constant rate test was performed on BPG1 on 14 May 2021 at an average rate of 1.54 L/s. The drawdown at the end of the test was 16.1 m. The pumping rate showed a decline typical of an electric submersible pump with dropping head, and there were some minor step-changes in rate (<0.1 L/s) when the pumping contractor made adjustments to try and maintain a constant rate in the first three hours. At five hours, there was an unexplained increase in pumping rate to 1.6 L/s.

Figure 3-4 presents the test data in Aqtesolv and includes the drawdown data, a Theis (1935) type-curve adjusted for variations in pumping rate and the derivative (Bourdet with 0.3 smoothing). Because of the slight variations in pumping rate during the test, there is no clear period of infinite acting radial flow to which the type curve and derivative can be fitted to obtain the aquifer transmissivity. The curve has been preferentially fitted to the late time data which most closely approximates infinite acting radial flow, and the recovery data. This results in a calculated transmissivity of 15.6 $m^2$/day, which corresponds to an effective aquifer thickness of 8.7 m based on the hydraulic conductivity from the slug test. The discrepancy between the type curve and the data in early time data is due to the pumping of wellbore storage, which is not incorporated into the Theis (1935) solution.

The relatively good fit to of the type curve to the data through the periods of rate change suggests that well losses are immaterial at the rates at which the bore was tested.

**Figure 3-4 BPG1 constant rate test (average 1.54 L/s) drawdown (blue) and derivative (red)**




## 3.3 Bore BPG5i

BPG5 is the southernmost bore site in the investigation area and is located adjacent to the creek. There are two bores present at the site. The deeper bore, BPG5i, constructed in fractured fresh Burrell Creek Formation to a total depth of 57.3 m, produced 3 L/s as a final airlift yield. The slug tests performed on the bore resolved a hydraulic conductivity of 1.3 m/day. The shallow bore was constructed in heavily weathered Burrell Creek Formation at a total depth of 8m. It did not produce a measurable airlift yield and the slug test resolved a hydraulic conductivity of 0.04 m/day.

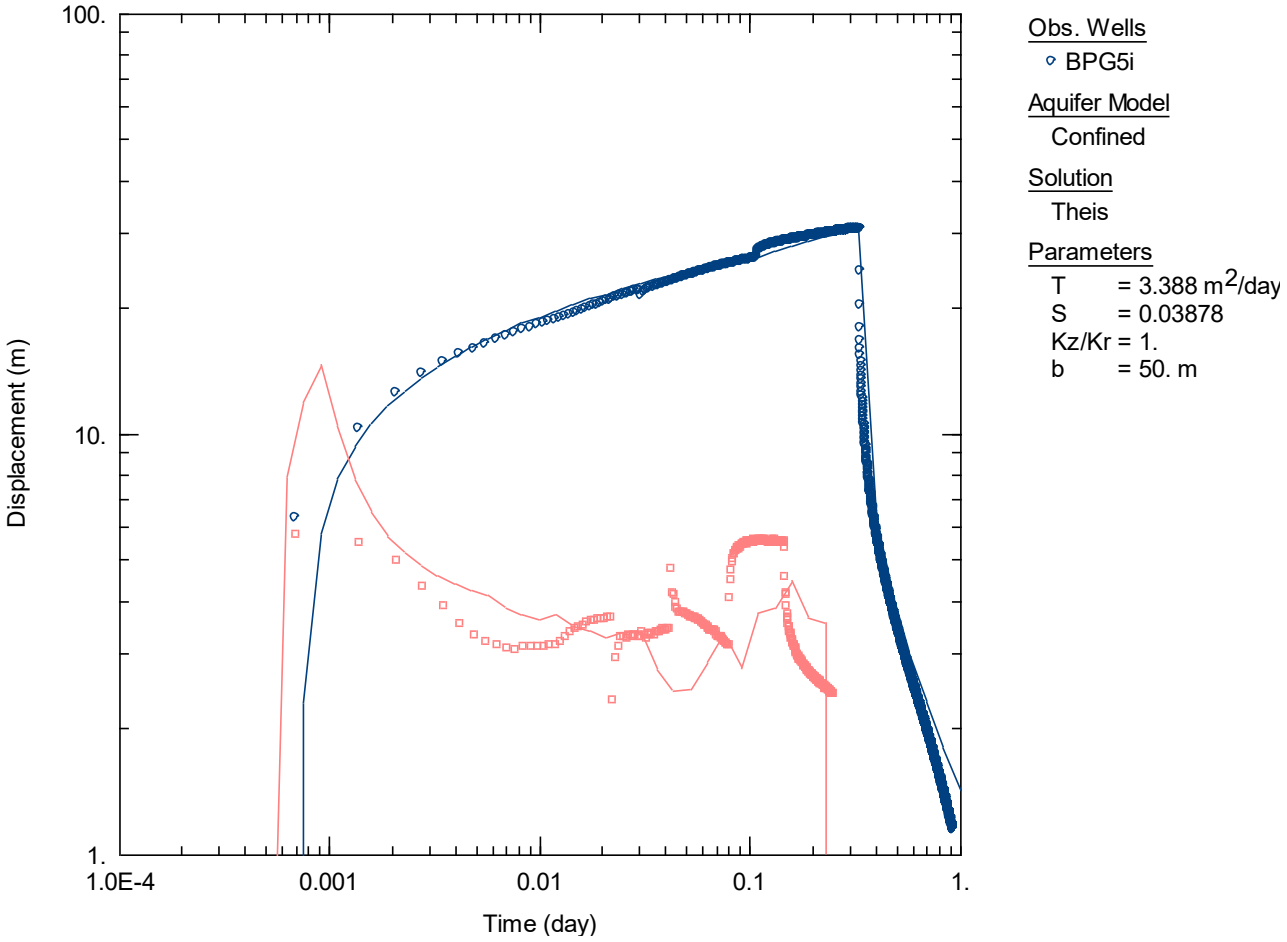
An 8-hour constant rate test was performed on BPG5i on 15 May 2021 at an average rate of 1.73 L/s which resulted in a maximum drawdown at the end of the test of 30.9 m. While the pumping rate showed a decline typical of an electric submersible pump with dropping head, there were some minor step-changes in rate (<0.05 L/s) in the first three hours. At 3 hours, there was an unexplained increase in pumping rate to 1.72 L/s, which then remained constant for the remainder of the test.

Figure 3-5 presents the test data in Aqtesolv and includes the drawdown data, a Theis (1935) type-curve adjusted for variations in pumping rate and the derivative (Bourdet with 0.3 smoothing). Because of the slight variations in pumping rate during the test, there is no clear period of infinite acting radial flow to which the type curve and derivative can be fitted to obtain the aquifer transmissivity. However, the overall fit of the type-curve to the data throughout the duration of the test indicates a general conformance to the assumptions of the Theis (1935) solution. The fitted curve results in a transmissivity of 3.4 $m^2$/day, which corresponds to an effective aquifer thickness of 2.6 m based on the hydraulic conductivity from the slug test.

While BPG5s was monitored during the test, the water level rose by 0.3 m in the early time of the test. The increase in water level due to pumping is commonly referred to as the reverse water level fluctuation (e.g. Kim and Parizek, 1997). The effect is caused by the relatively quicker change in the mechanical stress within the aquitard (in which BPG5s is screened) compared with the propagation of pressure drawdown through the aquitard. The analysis of this effect requires a coupled hydraulic-geomechanical model, which is outside

the scope of this assessment and is unlikely to be of any practical value. The response, however, does qualitatively confirm the extremely low hydraulic conductivity of non-fractured material.

**Figure 3-5 BPG5i constant rate test (average 1.73 L/s) drawdown (blue) and derivative (red)**




## 3.4 Bore BPG6

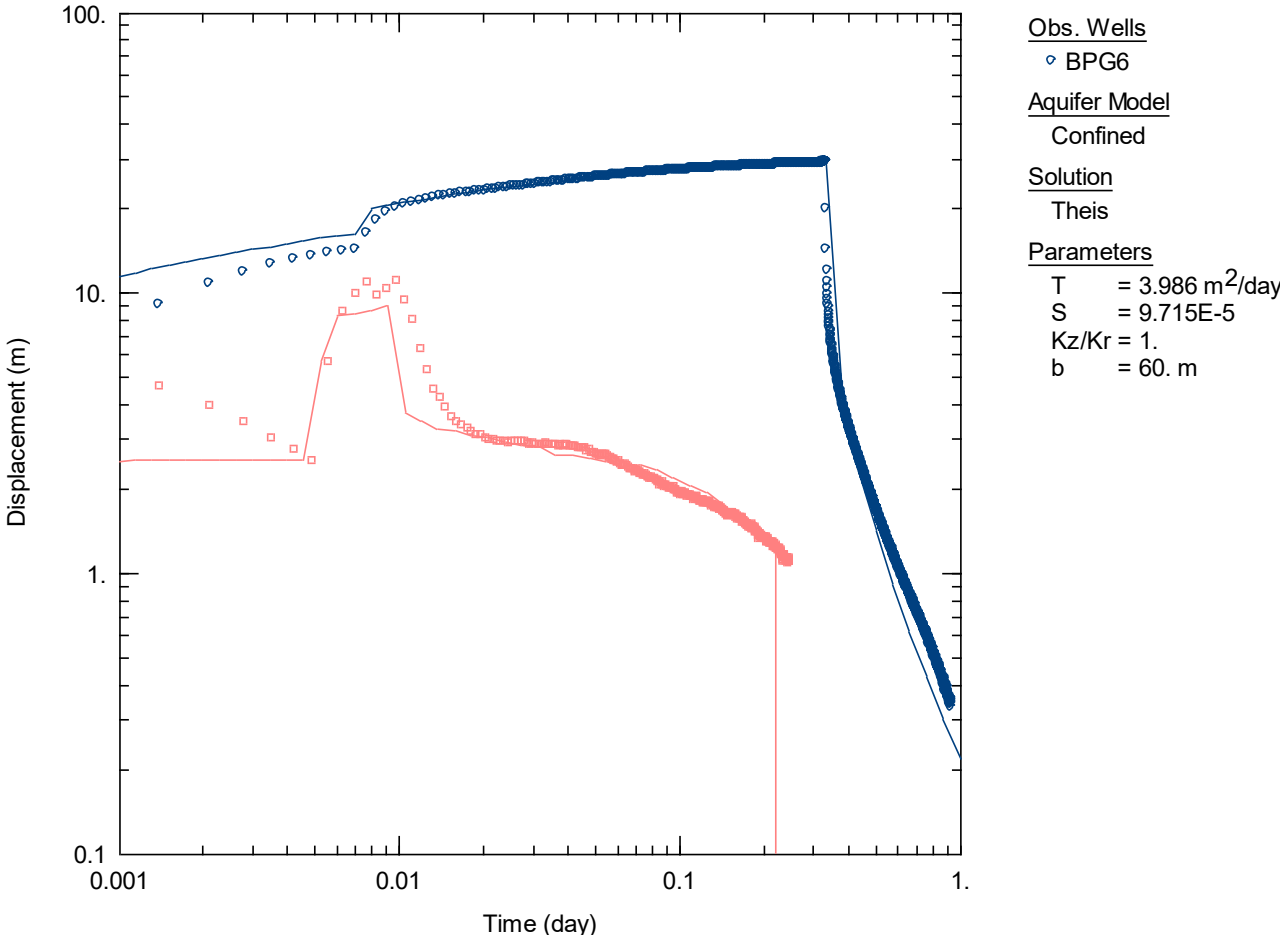
BPG6 is located in the central domain of the site in the vicinity of the proposed box cut. On drilling, it produced final airlift yield of 1.5 L/s from a quartz-filled fracture zone within fresh siltstone encountered at 70-71 mbgl. The slug tests performed on the bore resolved a hydraulic conductivity of 2.4 m/day.

An 8-hour constant rate test was performed on the bore on 12 May 2021 at an average rate of 1.72 L/s. The test was a started at a rate of approximately 1.5 L/s which was increased to 1.9 L/s after 10 minutes. The pumping rate progressively declined during the test as the head on the electric submersible pump declined with increasing drawdown. Upon cessation of the pumping period, 29.4 m of drawdown had been realised.

Figure 3-6 presents the test data in Aqtesolv and includes the derivative (Bourdet with 0.3 smoothing). The derivative is indicative of a response showing wellbore storage in early time (up to 0.02 days), followed by a short period of infinite acting radial flow, and then a declining trend which is diagnostic of an infinite linear constant head boundary. The inclusion of a constant head boundary at 80 m resulted in a good fit of the Theis (1935) type curve to the data, providing a calculated transmissivity of 4 $m^2$/day. This corresponds to an effective aquifer thickness of 1.7 m based on the hydraulic conductivity obtained from the slug test. The constant head boundary likely reflects the connection of the cone of depression to a wider fracture network.

The relatively poor fit to the lower rate early time data is likely due to the period of pumping wellbore storage, which is not incorporated into the Theis (1935) solution assumptions. The similarity between the change in the type curve and the change in the test data at the rate step-change indicates that the bore does not experience significant well losses at the test rates.

**Figure 3-6 BPG6 constant rate test (average 1.72 L/s) drawdown (blue) and derivative (red)**



# 4 Groundwater Availability

The pumping test analysis has been used to provide an estimate of the maximum potential rates at which the BP33 bores could be pumped. The analysis does not consider interference from pumping multiple bores or the impact of dewatering once mining activities commence at BP33. It should be noted that due to the variable nature of the fractured rock aquifer these are the maximum theoretical pumping rates. After prolonged periods of groundwater production (weeks to years) pumping rates are expected to decline due a combination of reasons including:

- A reduction in the available drawdown due to interference from pumping multiple bores.
- A decrease in the effective transmissivity around individual production bores as additional aquifer boundaries are intersected. This is particularly likely given the heterogeneous nature of the fractured rock aquifer.
- A potential decrease in the efficiency of the pumping bores due to scale build up and/or clogging of screens. Groundwater from the BCF typically has high concentrations of iron and manganese, which are associated with clogging and fouling issues.

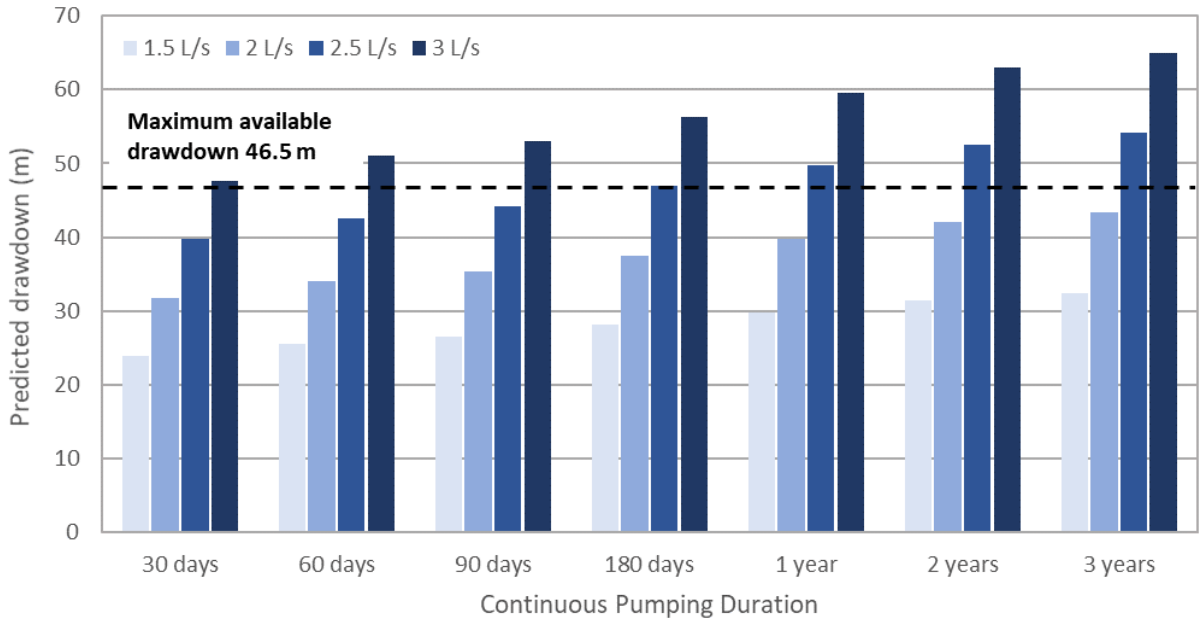
Monitoring of flow rates and production bores water levels is recommended to improve the reliability and predictability of the water source if groundwater is used to augment the mine water supply.

## 4.1 BPG4d

Aqtesolv was used to estimate drawdown over time for various pumping rates using the matched parameters from the Gringarten-Witherspoon (1972) solution (Section 3.1). The predicted drawdowns are presented in Figure 4-1. Note that these have the same selected time intervals as the rate analyses from the other bores (Figure 4-2 to 4-5) but the output is slightly different.

A maximum available drawdown of 46.5m is assumed as this is the depth of the fractured interval below the standing water level. While the bore is 109 m deep, if the pump is set below the fractured interval, the aquifer will effectively be dewatered significantly reducing the overall volume of water that could be extracted. The predictions suggest that 2.5 L/s to 3 L/s may be achievable for the short term (<30 days), but over the longer term the sustainable pumping rate is estimated to be in the order of 2 L/s. This assumes no dewatering of the orebody or dewatering of the pit which are likely to reduce the available drawdown as mining activities progress.

**Figure 4-1 Maximum estimated pumping rate for BP4d**

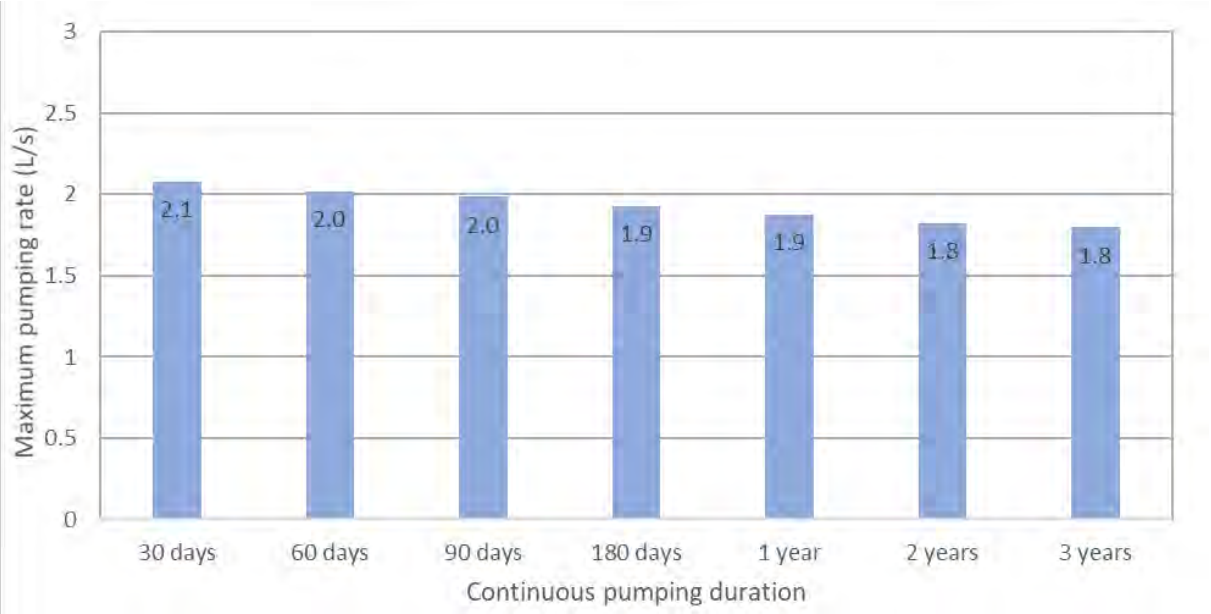


## 4.2 BPG1

The Aqtesolv analysis for BPG1 (transmissivity of 15.6 $m^2$/day) was transferred to an excel spreadsheet model with the Theis (1935) solution to predict drawdown at different pumping rates and hence to estimate the maximum potential rate of continuous pumping. A maximum available drawdown of 21.1 m was assumed. This reflects the equivalent of the standing water level at time of drilling to the top of the screened interval. The time of drilling water level was recorded at the end of the dry season when groundwater levels are typically at their deepest. Selecting this time period accommodates for seasonal groundwater level variation within the analysis.

The results of the analysis are presented in Figure 4-2. The analysis suggests that rates of roughly 1.8 L/s may be achievable from BPG1 for longer durations of continuous pumping.

**Figure 4-2 Maximum estimated pumping rate for BPG1**

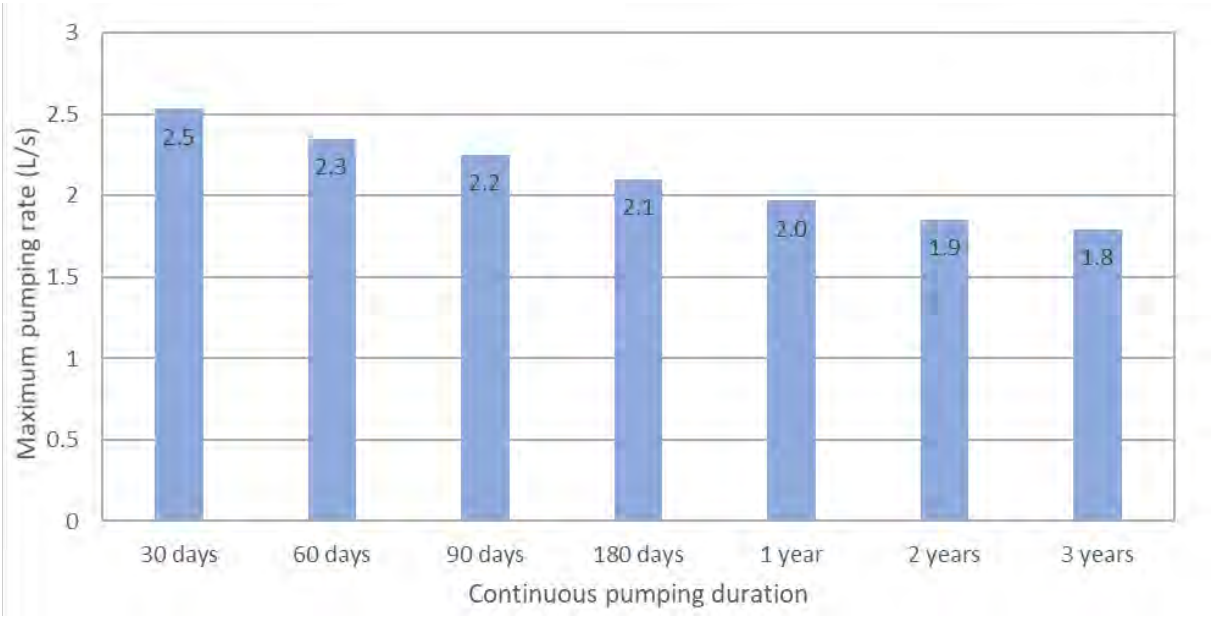



## 4.3 BPG5i

The Aqtesolv analysis for BPG5i (transmissivity of 3.4 $m^2$/day) was transferred to an excel spreadsheet model with the Theis (1935) solution to predict drawdown at different pumping rates and hence to estimate the maximum potential rate of continuous pumping. A maximum available drawdown of 44.5 m was assumed, which is the equivalent of the standing water level at time of drilling to the top of the screened interval.

Figure 4-3 presents the results of this analysis, which suggests that rates of roughly 2 L/s may be achievable for one year of pumping, but 1.8 L/s for longer durations.

**Figure 4-3 Maximum estimated pumping rate for BPG5i**

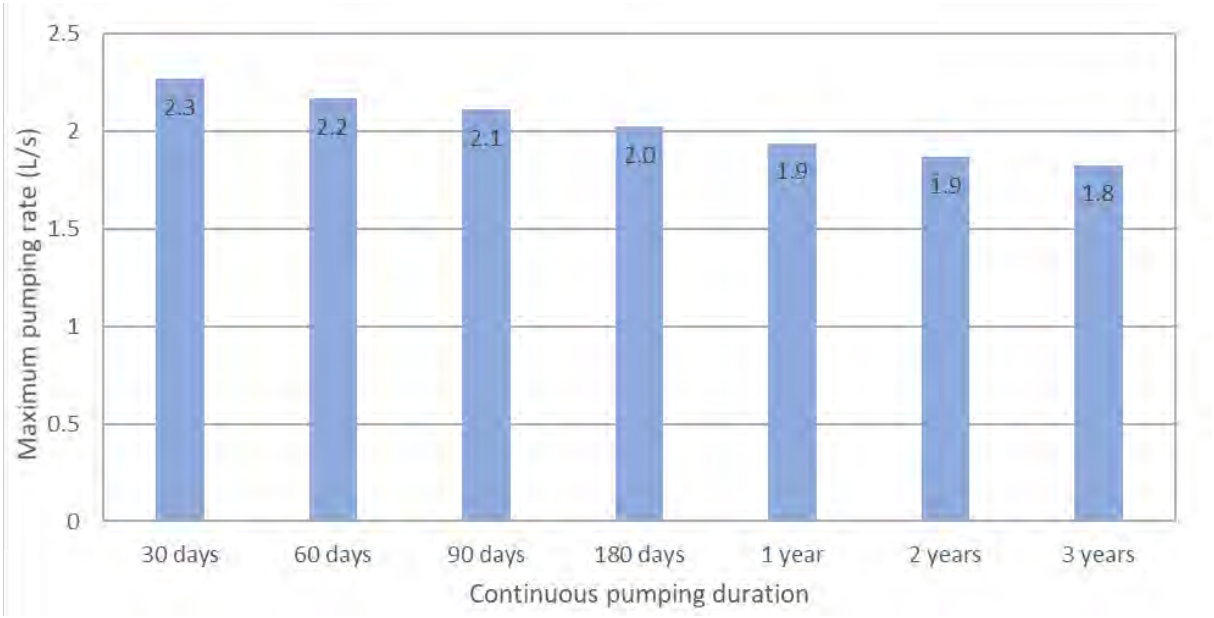



## 4.4 BPG6

The Aqtesolv analysis for BPG6 (transmissivity of 4 $m^2$/day) was transferred to an excel spreadsheet model with the Theis (1935) solution to predict drawdown at different pumping rates and hence to estimate the maximum potential rate of continuous pumping. A maximum available drawdown of 58m was assumed, which is based on the difference between the standing water level at time of drilling and the top of the screened interval.

Two scenarios were investigated, a conventional radial flow analysis and a second scenario that included an image well to simulate a constant head boundary. With the image well, the analysis resolved a maximum pumping rate of 3.3 L/s. This however assumes that there is a reservoir of infinite volume connected to the bore, which is unrealistic in a fractured rock environment. By excluding the constant head boundary, the maximum pumping rate is in the order of 2 L/s for less than 1 year, and 1.8 L/s for more than one year. The output of the analysis is presented in Figure 4-4.

**Figure 4-4 Maximum estimated pumping rate for BPG6**



## 4.5 Groundwater inflow to the BP33 Pit-lake

An existing pit void is present at the BP33 deposit, which is a legacy of shallow mining undertaken in the late 1990s. The pit void has dimensions of approximately 130 m x 30 m. The depth of the excavation is not known, however, the pegmatite resource at BP33 was revised in 1996 just prior to mining, with an estimated depth of 40 m. This assessment assumes the pit was excavated to 40 m below surface.

A pit-lake has formed in the void left from mining activities. The elevation of the water level in the pit-lake and the surrounding monitoring bores is very similar (see CloudGMS, 2021), suggesting the pit-lake is connected to the surrounding aquifer system. The following assessment has been completed to estimate the potential groundwater resource that could be pumped by using the pit-lake as a water supply.

**METHOD**

An analytical modelling approach has been used to estimate groundwater inflow into the BP33 pit-lake and assess its potential as a water supply for the project. Analytical models involve the solving of basic mathematical equations for flow of water through a porous medium and because of their relative simplicity have a range of inherent assumptions. Common to most analytical groundwater flow solutions, these include: the aquifer being homogeneous, isotropic and of infinite lateral extent with steady state and laminar flow conditions. Numerous analytical solutions exist in the literature for estimating inflows into excavations. Each solution has additional specific assumptions, limitations and data requirements, which can result in significantly different estimates of inflows.

For this assessment, several different analytical solutions have been employed to provide a range of groundwater inflow estimates. The solutions applied are listed in Table 4-1. All of the solutions implemented are steady state and assume that the dimensions of BP33 pit-lake do not vary with depth (i.e. are consistent with the dimensions exposed at the surface). Inflow rates are estimated from the current pit lake level, approximately 5 m below the ground surface to an assumed pit-lake depth of 40m, giving a saturated aquifer thickness of 35 m.

A key input to the solutions is the hydraulic conductivity of the aquifer surrounding and underling the pit-lake. The hydraulic conductivity of the weathered Burrell Creek Formation (BCF) at BP33 is estimated at between 0.003 – 0.08 m/day (Groundwater Enterprises, 2020). The hydraulic conductivity of the underlying fractured BCF is notably higher ranging from 0.3 – 2.6 m/day (Groundwater Enterprises, 2020). While, the higher yielding bores around BP33 are constructed in the fractured BCF, the BP33 pit appears to be excavated largely in unfractured, weathered BCF. Inflow scenarios have been run for two hydraulic conductivity values:

- 0.03 m/day, which represents the geometric mean from all slug tests completed at the site in weathered, unfractured BCF and;
- 0.1 m/day, a higher end K estimate that assumes the pit may intersect some fracture zones within the BCF. While the top 40 m of the BCF is typically weathered several bores across the site (BPG2, BPG1) have intersected the fractured BCF aquifer at depths shallower than 40 m. If the pit intersects fractured aquifer zones the average hydraulic conductivity in the pit walls will be higher than the expected K range for unfractured, weathered BCF.

Some solutions (e.g. Marinelli and Nicolli, 2000) rely on recharge as a key input to the analytical equations. This assessment adopts an average recharge rate of 100 mm/year, which is consistent with the value adopted in the numerical model developed for the site (CloudGMS, 2021). A summary of all input parameters and values adopted for the pit inflow modelling is presented in Table 4-2.

**Table 4-1 Analytical solutions used in this assessment**

| Solution | References | Aquifer type | Solution Number |
|---|---|---|---|
| Flow into sides and corners of a rectangular excavation | Hazel (2009) | Confined/ unconfined | 1 |
| Inflow from walls and base of pit. Requires an estimate of recharge | Marinelli and Nicolli (2000) | Unconfined | 3 |
| Excavation treated as a wellbore of equivalent area | Hazel (2009) | Confined/ unconfined | 2 |
| | Singh and Atkins (1985) | Confined | 4 |
| | Singh and Atkins (1985) | Unconfined | 5 |
| | Vandersluis et al (1995) | Unconfined | 6 |
| | Powers et. al. (2007) | Confined/ unconfined | 7 |
| Flow into the base of a circular excavation | Forcheimer (1914) in Neville (2017) | Confined | 8 |
| | Hvorslev (1951) in Neville (2017) | Confined/ unconfined | 9 |

**Table 4-2 Input parameters**

| Input parameter | Units | Data source | Input Value |
|---|---|---|---|
| **Pit** | | | |
| Pit length | m | Measured from aerial photograph | 130 |
| Pit width | m | Measured from aerial photograph | 30 |
| Elevation of base of pit | m | Assumed – it is estimated the pit lake 40 m deep | 0 |
| Saturated thickness at pit wall | m | Calculated from pit base and pit lake water level | 35 |
| **Heads** | | | |
| Initial potentiometric head (pre-mining) | m | Estimated from potentiometric surface | 35 |
| Potentiometric head during pumping | m | Direct input into calculation | 0 |
| Radius of influence | m | Calculated (Bear, 1979) | 235 – 429 |
| **Aquifer** | | | |
| Aquifer thickness | m | Calculated | NA |
| Hydraulic conductivity (Kh) - horizontal | m/day | Based on range from slug testing completed on site bores. Low K scenario of 0.03 m/day is the geometric mean of test results for the weathered BCF. The high K scenario 0.1 m/day assumes some contribution from higher K fracture zones. | 0.03 – 0.1 |
| Hydraulic conductivity (Kv) - vertical | m/day | Assumed to equivalent to Kh. Aquifer testing shows response in both lateral and vertically nested bores. The BCF is heavily folded and bedding is close to vertical across the BP33 site. | 0.03 – 0.1 |
| Recharge Flux | m/day | Equivalent rate of 100 mm/year, consistent with numerical model inputs from the BP33 groundwater model. | 0.00027 |
| Storage coefficient | - | On-site pumping test analysis based on drawdown response from BPG5i during 24-hour test on BPG4d. | 3.00E-04 |

**RESULTS**

The pit inflow model outputs are presented in Figure 4-5 (low K scenario) and Figure 4-6 (high K scenario). As the pit inflows are heavily influenced by the pit depth, which is an unknown, results have been presented as modelled groundwater inflow versus the relative pit-lake level.

Assuming a pit depth of 40 m the estimated groundwater inflow ranges from 40 to 200 $m^3$/day (0.5 – 2.3 L/s) under the low K scenario and 100 – 650 $m^3$/day (1.3 – 7.5 L/s) under the high K scenario. The volume of water currently in the pit-lake is estimated at 137,000 $m^3$ assuming a void depth of 40 m. For context, groundwater inflow into the proposed box-cut at BP33 from the numerical model (CloudGMS, 2021) is estimated to range from 4 – 28 L/s over the life of the project. Noting that groundwater inflow into the box-cut is expected to be larger relative to the pit-lake due to a significantly greater surface area and deeper excavation depth (60-70 m below surface). Inflow estimates to the BP33 pit-lake could be refined by pumping the pit-lake while monitoring flow rates and water levels in the lake and adjacent bores.

**Figure 4-5 Groundwater inflow into pit-lake under low K scenario (for solution no. see Table 4-1)**

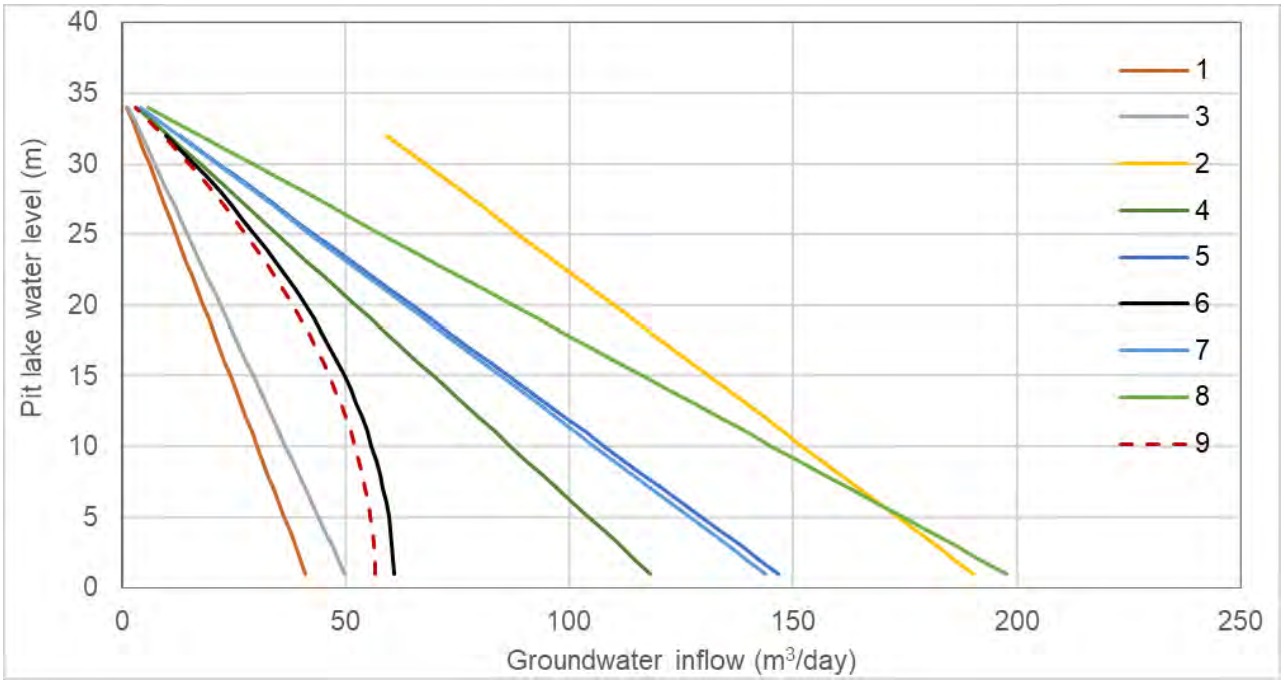
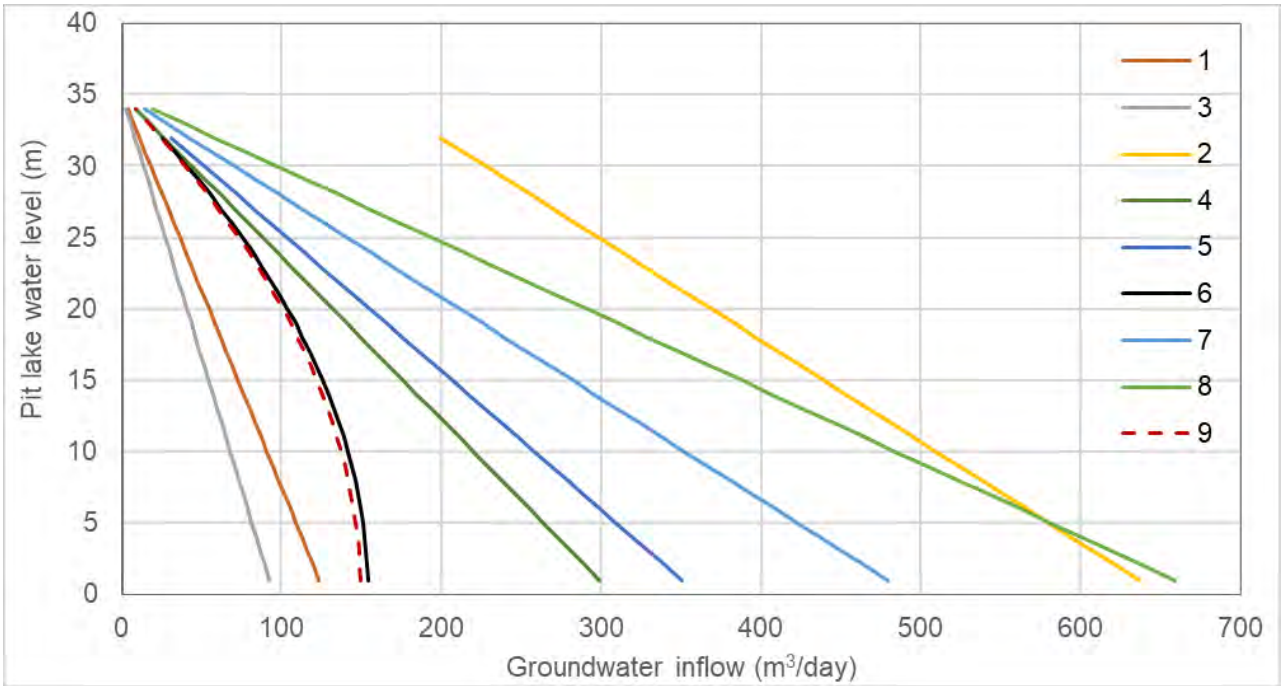



**Figure 4-6 Groundwater inflow into pit-lake under high K scenario (for solution no. see Table 4-1)**



## 4.6 Bore yield/pit-lake inflows relative to groundwater inflows from numerical model

The groundwater availability from individual bores (<2 L/s) and inflows into existing pit-lake at BP33 (0.5 - 7.5 L/s) is small relative to dewatering predictions from the numerical model (CloudGMS, 2021). The model predicts the following peak groundwater inflows for the BP33 mine elements: box-cut (28 L/s), decline (34 L/s) and underground mine workings (45 L/s). The contrast in groundwater inflows between bores/the shallow existing pit-lake and the full mine workings is due to several factors including the size and depth of the workings. One of the main reasons the box-cut and in particular the BP33 mine are expected to produce larger volumes of groundwater is their size. Individual bores are only open to a small area of the formation. The aquifer is not very transmissive so the volume of water entering into the bores is relatively low. As the box-cut/underground mine will be open to a much larger cross section of the aquifer, even with low transmissivity/storage there is potential to intercept larger volumes of groundwater.

The predicted inflows from the numerical model are also dependent on the assumed storativity/specific yield of the aquifer. The bore yield/pit-lake inflow predictions assume a storage co-efficient based on the pumping test results, in which the system is semi-confined. The numerical model assumes the system will be dewatered becoming unconfined and models the storage as a specific yield. This modelled specific yield has been refined by calibrating to the water level monitoring data, however, the specific yield is very difficult to constrain without stressing the aquifer over longer time periods (months to years). The only practical way to do this, particularly in fractured rock aquifers, is through the mine dewatering process. To this end monitoring of dewatering volumes and groundwater levels will be critical to refine the accuracy of model predictions as the mine activities progress.

# 5 Groundwater resources within Core mineral leases

In addition to the mining leases at BP33 and Grants, Core Lithium holds seven mineral exploration leases to the south of BP33. Overlaying these tenements with the interpreted geology from the Litchfield North Special (Goldberg et al, 2010) reveals that the majority of the lease area is located over the Burrell Creek Formation (Figure 5-1). The western-most lease is situated over the Welltree Metamorphics and a small area of the Two Sisters Granite. The eastern edge of lease EL31271 overlies rocks of the South Alligator Group, including small areas of Gerowie Tuff, and Wildman Siltstone.

The groundwater potential beneath the tenements is shown in Figure 5-2 based on regional mapping from Tickell (2009). Airlift yields recorded at the time of drilling from registered groundwater bores have been superimposed over the aquifer mapping. Groundwater resources beneath Core Lithium tenements are mapped as local scale aquifers in fractured and weathered rocks with typical bore yields of 0.5 - 2.5 L/s. A small area in the south-west where the tenements overlie the Two Sisters Granite and Welltree Metamorphics has a smaller expected yield range of 0.05 - 0.5 L/s.

The main aquifer class (0.5 – 2.5 L/s) is largely coincident with the extent of the Burrell Creek Formation. Drilling at Grants and BP33 provides guidance on the expected groundwater potential from the Burrell Creek Formation. It is a marginal fractured rock aquifer with typical bore yields of less than 0.5 L/s. Higher yields occur where bores intersect fracture zones or bands of quartz veining. At BP33 around 60% of drilling sites encountered bore yields in the BCF of 1.5 L/s or greater, while yields in the remaining sites were less than 0.2 L/s. At the Grant's site the occurrence of high yielding bores is lower with only 20% of bore sites recording yields greater than 1 L/s.

There are approximately 180 bores constructed in the BCF around Core Lithium's tenements. Reported bore yields range from 0 – 12 L/s with an average yield of 2.4 L/s and a median yield of 1.5 L/s. Around 10% of bores report yields in excess of 5 L/s. These higher yielding bores likely intersect zones where faulting or folding has enhanced the degree of fracturing and aquifer permeability. While large airlift yields are not uncommonly observed during drilling, experience suggests that these rates are rarely sustained when the bores in the BCF are pumped for an extended period. This is illustrated by the borefields that supply Adelaide River and Pine Creek, both of which are constructed in structural zones of enhanced fracturing within the BCF. Airlift yields of up to 10 L/s were recorded when these supply bores were drilled, however, long-term pumping rates rarely exceed 1 - 2 L/s. Both towns rely on multiple borefields with a large number of pumping bores (up to 10) to meet a water requirement of less than 10 L/s. As a consequence of the local scale of fractured rock aquifers within the BCF groundwater resources from this unit are typically only suited to small scale water supply (i.e. stock and domestic).

The eastern edge of exploration lease EL31271 overlies units of the South Alligator Group and the Wildman Siltstone. The Darwin 1:250 000 Hydrogeology Map (Tickell, 2018) maps these formations as having a marginally greater yield potential (1 – 3 L/s) than the Burrell Creek Formation. However, these formations are still considered to have relatively poor water supply potential relative to the high yielding dolomite aquifers found at Berry Springs and in the Darwin Rural Area. The South Alligator Group and Wildman Siltstone are largely comprised of fine-grained rocks (siltstone, shale, tuff). Similar to the Burrell Creek Formation, higher yielding bores in the South Alligator Group/Wildman Siltstone are dependent on intersecting fracture zones.

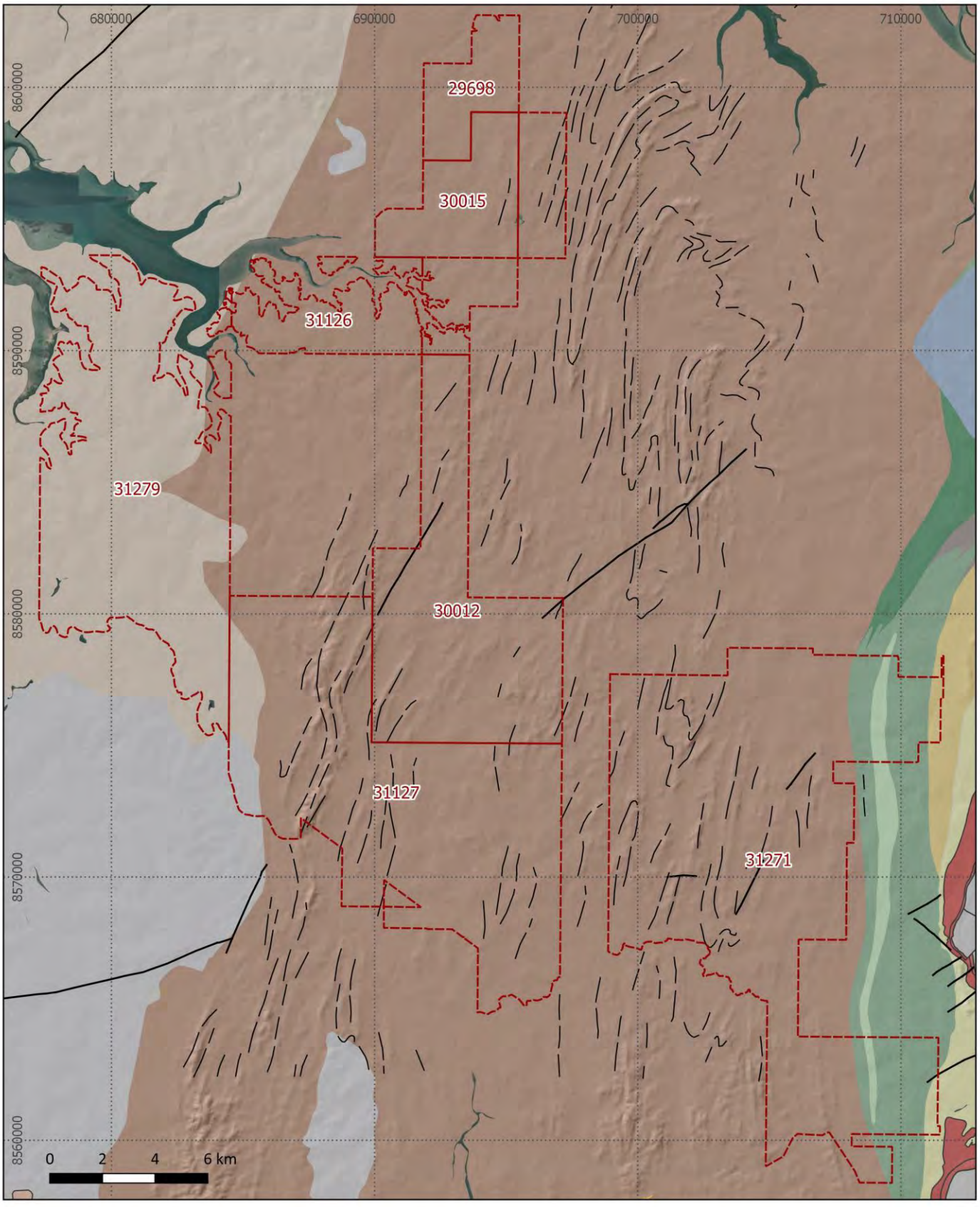



Figure 5-1 Interpreted Geology Beneath Core Lithium Leases

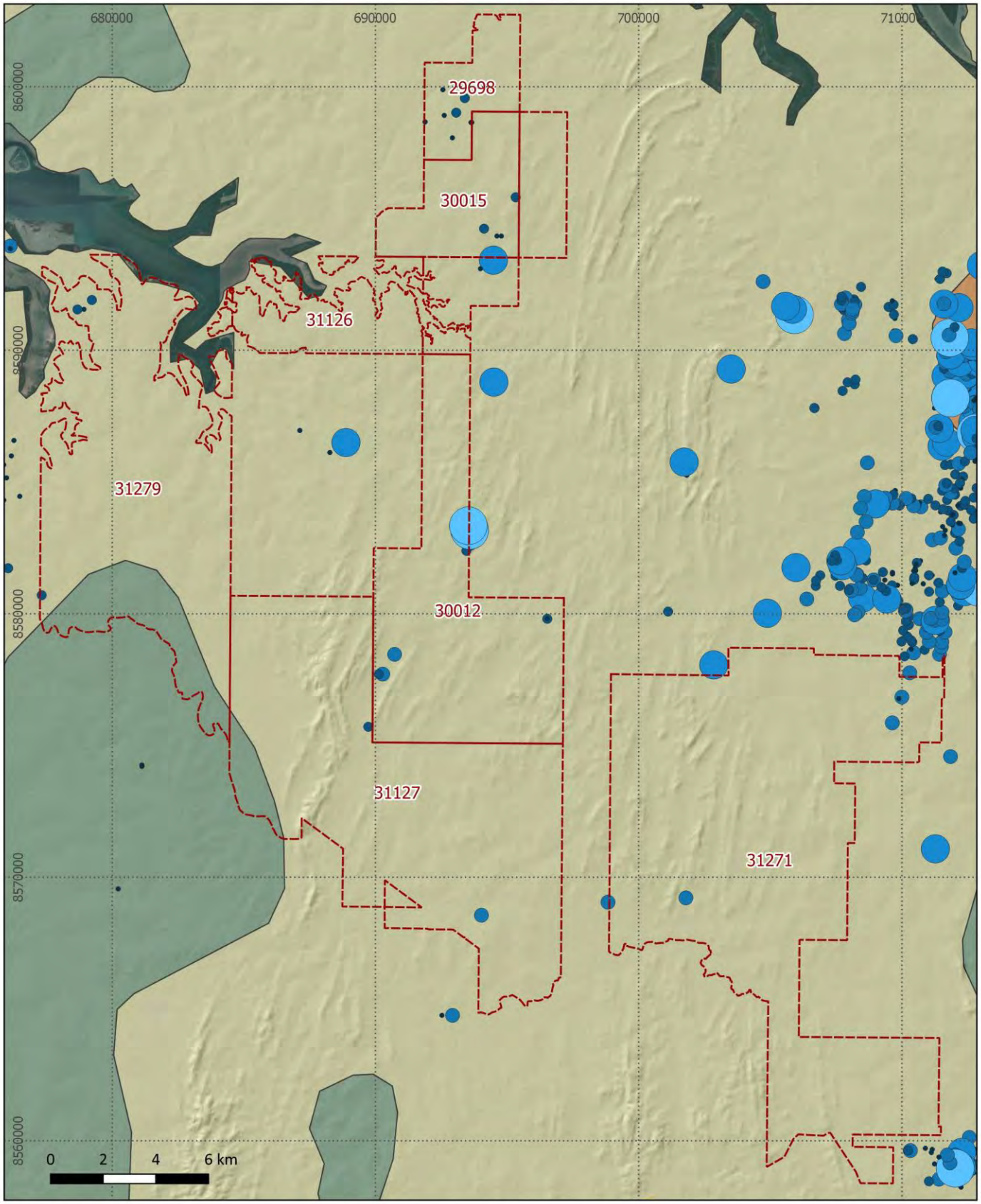


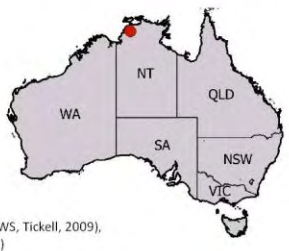

Figure 5-2 Regional Aquifer Map and Airlift Yields

NT AQUIFERS 1:2M

- Fractured and Weathered Rocks. Typical bore yield: 0.05 - 0.5 L/s
- Fractured and Weathered Rocks. Typical bore yield: 0.5 - 2.5 L/s
- Fractured and Karstic Rocks. Typical bore yield: 5 - 50 L/s
- Core Lithium Tenements

- 0 - 0.5 L/s
- 0.5 - 2 L/s
- 2 - 5 L/s
- 5 - 10 L/s
- > 10 L/s

N




DATA SOURCES
NT Aquifers 1:2M Scale (DEPWS, Tickell, 2009),
Bore Yields (DEPWS, NRMaps)

# 6 Conclusions

This report makes the following conclusions regarding the groundwater supply potential of the existing observation bores at BP33, the pit-lake and the groundwater system beneath Core Lithium's mineral leases:

- Analysis of pumping tests undertaken on four monitoring bores around BP33 estimates maximum pumping rates of between 1.8 and 2 L/s per bore. Due to the variable nature of the fractured rock aquifer confidence in the rate predictions will decrease over longer pumping durations. With sustained pumping it is expected that bore rates will decline due to a combination of bore interference, the intersection of aquifer boundaries and decreased bore efficiency.
- A series of analytical models were used to estimate groundwater inflows into the BP33 pit-lake. Model results estimate groundwater inflow into the BP33 pit void will range between 0.5 – 7.5 L/s assuming the pit is dewatered to a depth of 40 m. The volume of water currently stored within the pit-lake is estimated at 137 ML.
- There is limited potential for groundwater supply beneath Core Lithium's wider mineral leases. A large proportion of the lease area is located over the Burrell Creek Formation. Similar groundwater conditions can be expected as those observed from drilling at Grants and BP33 with typical bore yields ranging from 0.5 - 2.5 L/s. Around 10% of registered bores drilled in the Burrell Creek Formation around the tenements record airlift yields in excess of 5 L/s. However, these short-term estimates are not typically representative of the longer-term aquifer yield in the Burrell Creek Formation. The eastern edge of the tenement area intersects formations of the South Alligator Group and Wildman Siltstone. Aquifers within these formations are slightly more prospective than the Burrell Creek Formation but are still largely suited to small scale groundwater supply with a typical bore yields of less than 3 L/s.

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# Appendix A Water Quality Field Parameters

**Table A-1 Field parameters monitored from discharge water on BPG4D**

| Time Elapsed | Electrical Conductivity (µS/cm) | pH | Temperature (°C) |
|---|---|---|---|
| 20 | 242 | 7.1 | 33.5 |
| 60 | 251 | 6.28 | 30.4 |
| 140 | 255 | 6.96 | 30.3 |
| 200 | 254 | 7.04 | 28.9 |
| 400 | 248 | 7.03 | 28.5 |
| 760 | 240 | 7.26 | 28.7 |
| 1160 | 263 | 7.16 | 26.5 |
| 1260 | 240 | 7.2 | 30.8 |
| 1440 | 247 | 6.94 | 29.6 |

**Table A-2 Field parameters monitored from discharge water on BPG6**

| Time Elapsed | Electrical Conductivity (µS/cm) | pH | Temperature (°C) |
|---|---|---|---|
| 50 | 212 | 6.9 | 29.8 |
| 100 | 214 | 7.2 | 30.1 |
| 120 | 212 | 6.9 | 29.8 |
| 180 | 216 | 7.03 | 29.5 |
| 360 | 210 | 7.09 | 30 |

**Table A-3 Field parameters monitored from discharge water on BPG5i**

| Time Elapsed | Electrical Conductivity (µS/cm) | pH | Temperature (°C) |
|---|---|---|---|
| 10 | 198 | 6.67 | 28.3 |
| 50 | 193 | 6.65 | 28.4 |
| 90 | 189 | 6.6 | 29.2 |
| 120 | 196 | 6.64 | 27.1 |
| 150 | 198 | 6.72 | 26.6 |
| 240 | 185 | 6.66 | 29.7 |
| 360 | 185 | 6.61 | 29.2 |
| 480 | 182 | 6.62 | 29.5 |

**Table A-4 Field parameters monitored from discharge water on BPG1**

| Time Elapsed | Electrical Conductivity (µS/cm) | pH | Temperature (°C) |
|---|---|---|---|
| 15 | 79 | 5.9 | 26.9 |
| 70 | 50 | 5.45 | 29.3 |
| 100 | 50 | 5.4 | 28.7 |
| 150 | 51 | 5.37 | 28.5 |
| 240 | 51 | 5.36 | 28.1 |

GROUNDWATER ENTERPRISES

# BP33 Groundwater Investigation Report

November 2020

PREPARED FOR Core Lithium Pty Ltd

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# 1 Introduction

Core Lithium are scoping an underground mining operation at their BP33 deposit located 30 km south-east of Darwin on exploration leases EL30015 and EL29698. The BP33 deposit is situated approximately 5km south-east of Grants Lithium prospect. The environmental assessment report (NTEPA, 2019) for an open cut lithium mine at the Grants deposit was completed in June, 2019.

Core Lithium commissioned a desktop groundwater study of the BP33 prospect in October 2019 (GE, 2019). The study recommended the installation of a series of nested bore to investigate groundwater conditions around BP33 and to establish a monitoring network for the collection of baseline water level and quality data for the mine approval process. This document forms a field completion report from the site groundwater investigation.

## 1.1 Project Description

The proposed mining activities at BP33 involve the construction of a box cut to remove the weathered zone from the Burrell Creek Formation. The box cut will be excavated to a depth of approximately 60 m. A 400 m long decline stemming from the base of the box cut will allow access to the spodumene deposit located beneath the previously worked open pit. The deposit will be mined using sub-level retreat mining to an estimated depth of 320 m (Orewin, 2019). The mined ore will be trucked to the Grants processing facility and there will be no requirement for tailings storage at the BP33 site. There will be a waste rock dump at the BP33 site comprised of the oxide waste from the box cut, which will be pushed back into the box cut on completion of mining. Both the box cut and the underground mine will require de-watering. Water sourced from de-watering activities will be pumped to Observation Hill Dam (OHD), which is being recommissioned as a water supply for ore processing at the Grants site.

## 1.2 Scope

The field completion report has the following scope:

- Report on findings from the investigation program drilling including documenting groundwater observations, field water quality, bore construction and bore completion details.
- Document hydraulic testing of investigation bores including methods, results and analysis.
- Provide monitoring recommendations to enable the collection of a baseline water quality and water level data set.

# 2 Site Characterisation

The following section is sourced from the BP33 desktop groundwater study (GE, 2019).

## 2.1 Topography and Drainage

The regional topography surrounding BP33 is largely subdued and flat lying. Locally BP33 is situated in a subtle valley with a south to south-west orientation. Higher elevations (40 mAHD) occur to the north-east around Observation Hill Dam (OHD). The land surface falls away from this area to the south-west with the lowest lying areas (10 maHD) found along drainage lines running into Bynoe Harbour.

BP33 is located in the Finniss River drainage basin and falls within the Bynoe Harbour catchment. There are no permanent water courses in the immediate vicinity of BP33. The area is drained by a number of small unnamed ephemeral water courses which rise in the higher elevations to the north-west of BP33 and drain south-west into the Charlotte River and ultimately Bynoe Harbour. BP33 is located on the western edge of a small drainage line connects OHD to the Charlotte River. Both OHD and the BP33 pit lake contain surface water that typically persists through the dry season. While OHD is fed by a drainage line, BP33 is not connected to any channels and the water present in the pit is likely to represent a groundwater discharge feature. The generalised topography and drainage around BP33 are shown in Figure 2-1.

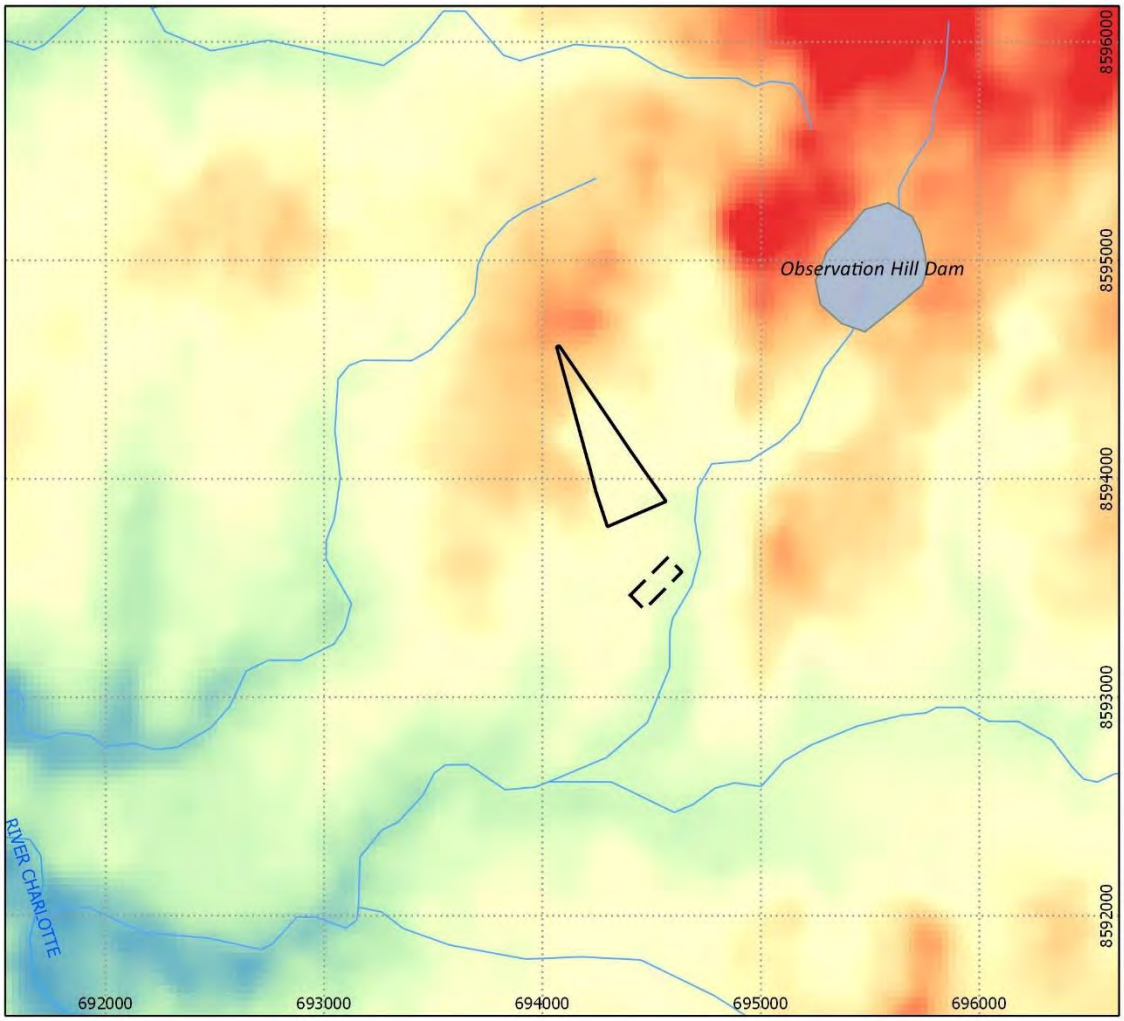



**Figure 2-1 BP33 Topography and Drainage**

N

**Topography (mAHD)**
- 0
- 20
- 42

**Proposed BP33 mine workings**
- Approx. extent of box cut
- Approx. extent of underground workings
- Surface water drainage network (250 K)

0 500 1000 m

GDA 94 Zone 52, 1:30 000 @ A4

## 2.2 Geology

Regionally, BP33 is located in the north-west of the Pine Creek Geosyncline, a thick sequence of Proterozoic metasediments that overlies Archean basement rocks and underwent extensive folding and uplift around 1800 million years ago. After a long hiatus during which significant weathering and erosion occurred a drape of flat bedded Cretaceous and Cainozoic sedimentary formations were deposited over the Proterozoic rocks.

The lithium prospect at BP33 is hosted in a pegmatite, which is one of a swarm of complex zoned rare element pegmatites forming the 55km long by 10km wide West Arm–Mt Finniss pegmatite belt. The Finniss pegmatites are intruded into the early Proterozoic Burrell Creek Formation which is distributed along the northwest margin of the Pine Creek Geosyncline. The BP33 pegmatite is north-east trending and steeply dipping, it is approximately 75 m long with a width of between 25 – 40 m (Frater, 2005). From exploration drilling the top of the BP33 pegmatite ranges in depth from 30 – 180 m below surface, with an average depth of 90 m.

The Burrell Creek Formation is comprised of shale, siltstone, sandstone and strongly foliated phyllite with lenses of quartz pebble conglomerate. The Burrell Creek Formation is extensively weathered at surface where it often forms a laterite horizon. The underlying shale and phyllite is typically heavily weathered and decomposed into mottled clay. Exploration drilling at BP33 indicates the weathered zone in the Burrell Creek is on average 60 m thick with the upper 30 m typically showing extensive weathering and the bottom 30 m showing moderate to slight weathering.

Where the Burrell Creek Formation is not exposed at surface it subcrops beneath a thin veneer of Tertiary and Quaternary aged sediments. These include alluvial deposits (Qa) along the drainage lines as well as colluvium and laterite formed by in-situ weathering of the Burrell Creek Formation. The colluvium (Cz) comprises ferruginous clayey, sandy and gravelly soils. Both the colluvium and laterite deposits are typically less than 4 m in thickness (Pietsch, 1986).

The alluvial deposits centre around active drainage lines and can extend up to several kilometres in length and up to 200-300 m in width (Frater, 2005). They are typically less than 4 m in thickness but can exceed 6 m in the southern sections of the Booths drainage (Mollemans and Hatcher, 1988) - Booths is the drainage line running south from Observation Hill dam to the immediate east of BP33. Mollemans and Hatcher (1988) describes the following three sedimentary layers in alluvial deposits around BP33/Observation Hill area:

- A-layer: Less than 0.5 m thick and may contain a thin band of pebbles (5–10 mm diameter) at its base. It is essentially un-mineralised and is capped by an organic clay layer.
- B-layer. A minor gravel layer up to 1 m thick, directly overlying the C-layer or separated from it by thin bands of clayey sand.
- C-layer. This earliest layer consists of basal clayey sand or gravel up to 2.5 m thick, containing sub-angular quartz and siltstone clasts up to 200 mm in length.

Mollemans and Hatcher (1988) note that in some areas the alluvial deposits have been completely reworked with black soil, and that the bedrock under the main alluvial channel is typically heavily weathered.

## 2.3 Hydrogeology

**BURRELL CREEK FORMATION**

The Burrell Creek Formation forms the principal aquifer across 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 lack of primary porosity and open fracturing within the formation. Higher yields (2 L/s) can occur where drilling intersects fracture zones or bands of quartz veining. Groundwater is typically intersected at the base of the weathering zone/transition into fresh Burrell Creek Formation. At the Grant's deposit 5 km to the north-east groundwater investigation bores intersected the upper groundwater zone in the Burrell Creek Formation between 50 and 60 m below ground level. Limited information is available at BP33, however, anecdotal observations from mineral drilling suggests holes intersect groundwater between 60 and 80 m depth. The Burrell Creek Formation is largely fine grained and characteristically weathers to clay. Where heavily weathered the Burrell Creek Formation is less permeable as open fractures are less prevalent where the formation is decomposed to clay.

Groundwater flow directions within the Burrell Creek Formation are likely to reflect the topographic gradient with groundwater moving from higher groundwater elevations in the north-east around OHD to lower elevations around Bynoe Harbour south-west of BP33. The pit lake at BP33 appears to operate as a groundwater discharge feature, the loss of water from the lake through evaporation may create a local groundwater gradient in the surrounding aquifer toward the pit lake.

**ALLUVIAL AQUIFER**

There is limited information on the groundwater characteristics of the alluvial deposits as no bores have been constructed in this unit at BP33. Auger drilling and costeaning undertaken by Greenex Mining along the drainage lines south of OHD in the 1980s provide some insight into groundwater occurrence within the alluvial deposits. Mollemans and Hatcher (1988) report that costeans (a shallow exploration pit/trench) excavated along the Booths alluvial deposit north of BP33 frequently collapsed due to the ingress of water. They suggest that seepage from OHD may provide a permanent source of water to the alluvial channels downstream of the dam. The presence of relatively persistent pools of water along the drainage line south of OHD and shallow groundwater levels (<5 m) in mineral holes adjacent to BP33 support this theory.

The aquifers are likely to operate at a very local scale, being of both limited lateral extent (200 – 300 m) and thickness (up to 6 m). Groundwater flow directions within the alluvial aquifer are likely to be consistent with the surface water gradient and generally flow from north to south past BP33.

## 2.4 Groundwater Receptors

**GROUNDWATER BORES**

There are no active groundwater bores within 9 km of the BP33 site. The closest groundwater bore to BP33 is RN023177, located 2.5 km north of the pit (see Figure 2-2). RN023177 was drilled in 1984 and was constructed in the Burrell Creek Formation as a potential water supply bore for Greenex mining operations at Observation Hill. The bore is not currently in use. The next closest groundwater bore RN038217 is located 9 km south of BP33 on the Fog Bay Road. RN038217 was drilled in 2013 to provide a domestic water supply.

**ENVIRONMENTAL RECEPTORS**

Groundwater Dependant Ecosystems Atlas

Groundwater dependent Ecosystems (GDEs) have been identified using the GDE Atlas, a national dataset of Australian GDEs developed by the Bureau of Meteorology (BOM, 2019) to assist groundwater management and planning. Figure 2-2 maps the terrestrial ecosystem layer in the vicinity of BP33. This layer shows the potential for ecosystems that rely on the subsurface presence of groundwater – including vegetation ecosystems such as forests and riparian vegetation. Four mapped categories are presented: known GDEs based on regional studies and high, medium and low GDE potential based on remote sensing and image analysis.

The GDE Atlas maps an area of medium GDE potential (shown in green in Figure 2-2) along the drainage lines to the immediate east and south of BP33.

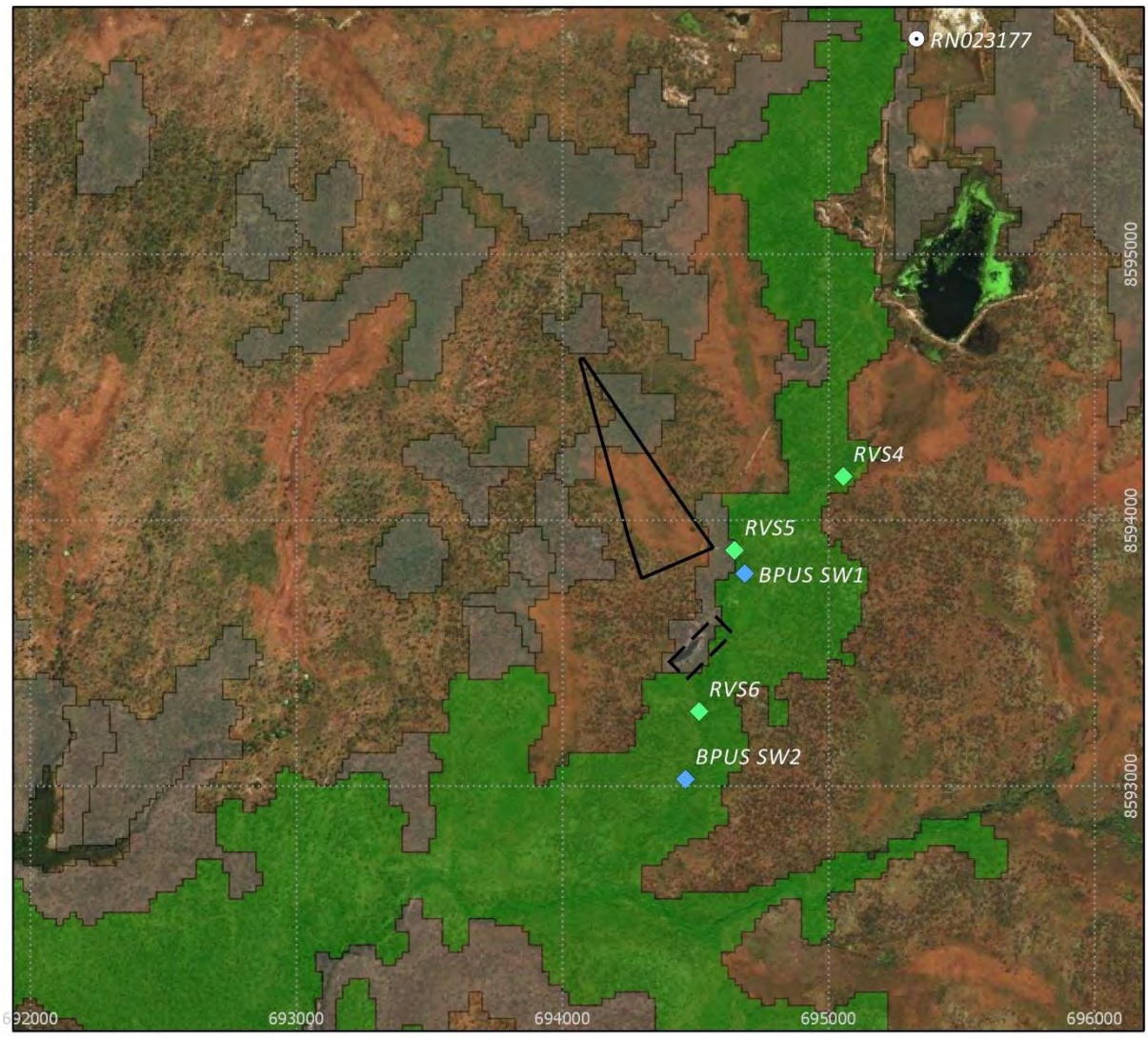
Field Surveys

EcOz Environmental Consultants (EcOz) was engaged by Core Lithium to map riparian vegetation communities and collect baseline information on community structure and condition along the drainage line downstream of OHD. The field survey (EcOz, 2019) mapped 3.6 hectares of GDE vegetation within the riparian zone of the drainage line. Three vegetation monitoring sites were established (see Figure 2-2 for locations) as part of the survey. At the time of surveying in June 2019, pools of water were observed around the northern two monitoring sites, RVS4 and RVS5.

As part of the Environmental Impact Assessment (EIS) for the Grants Lithium mine EcOz established two surface water monitoring sites on the drainage line south of OHD: BPUS SW1 and BPUS SW2 (Figure 2-2). The sites have been monitored at a quarterly frequency since October 2017. Surface water flows at the

monitoring sites generally cease early in the dry season (April/May). Anecdotal information suggests that in wetter years pools of surface water persist throughout the dry season.

**Figure 2.2 Groundwater receptors around BP33**




## Figure 2-2 BP33 Groundwater Receptors

N

**Proposed BP33 mine workings**

Approx. extent of box cut

Approx. extent of underground workings

**BP33 Existing monitoring sites**

Surface water monitoring site

Vegetation monitoring site

Registered groundwater bores

**Terrestrial GDE Potential (Bom, 2019)**

Known GDE

High potential GDE

Moderate potential GDE

Low potential GDE

0 300 600 m

GDA 94 Zone 52,
1:25 000 @ A4

# 3 Methods

## 3.1 Drilling and Construction

Drilling was undertaken by Bores NT using a truck mounted Bourne drilling rig equipped to drill using rotary air and rotary mud methods. Bores were constructed in accordance with the Minimum Construction Requirements for Water Bores in Australia, 4th Edition (NUDLC, 2020).

Shallow bores (< 10 m deep) were drilled with a 200 mm mill claw and were constructed with 50 mm or 100 mm Class 12 PVC casing and machine slotted screens. The bores were gravel packed with 3 mm washed gravel, sealed with a bentonite plug (minimum expanded thickness of 1 m) and grouted to surface with a cement-bentonite grout.

Intermediate depth bores were constructed with Class 9 PVC surface casing (205 mm) installed and cemented to a depth of 5.7 m. In accordance with licensing conditions the cement was left to cure 24-hours before drilling recommenced with a 200 mm mill claw. Where groundwater yields in excess of 0.5 L/s were intersected in the weathered zone of the Burrell Creek Formation bores were constructed with 100 mm PVC casing and screens, gravel packed with 3 mm washed gravel and sealed with bentonite pellets. The annulus of the bores was backfilled with cuttings to a depth of 5 m and grouted to surface with a cement-bentonite grout. Holes which did not produce free water through the weathering zone had 158 mm steel casing run. The casing was seated at the base of the 200 mm hole and was necessary to prevent hole collapse in the weathered Burrell Creek Formation. Drilling continued through fresh Burrell Creek Formation using a 152 mm hammer bit until free water was intersected. Bores were then constructed with 100 mm Class 12 PVC casing and screens, 3 mm washed gravel and a bentonite plug, which was placed within the 152 mm hole. Bores were backfilled with cuttings and grouted to surface from a depth of 5 m. In the deep bore (BPG4) the 158 mm steel casing was pressure cemented from 47 m to surface with cement bentonite-grout. The cement was allowed 24-hours to cure before drilling continued with a 152 mm hammer bit through fresh Burrell Creek Formation. The hole was drilled to a total depth of 109 m.

Drill cuttings were collected every 3 m (twice for each 6 m drilling rod) and laid out in order of increasing depth for logging by the site hydrogeologist. Bore yields were gauged by measuring flow from the discharge line and where necessary by damning the area around the surface casing and diverting flow through a short section of 200 mm casing. The flow was then measured using 10 L/23 L buckets or in the case of higher yielding site BPG4 by use of a V-notch weir. Airlift rates were recorded at each visible increase in yield. Field parameters - Electrical Conductivity (EC), pH, temperature – were recorded at each yield measurement using a portable water quality meter (see Section 3.3 for further detail).

## 3.2 Slug Tests and Recovery Test

Slug tests were completed using a solid slug and a Solinst Level Logger pressure transducer/data logger. The Level Logger was lowered on a stainless-steel cable to a depth approximately 5 m below the standing water level. Two solid slugs (40 mm and 80 mm diameter) were constructed from weighted PVC tubing with external endcaps. The two sizes allowed testing of both 50 mm and 100 mm diameter monitoring bores. The slug was gradually lowered on nylon rope until it was positioned immediately above the water level and was then rapidly released to approximate an instantaneous upward displacement of the water level (falling head test). Following a recovery period (up to several hours in low-K bores), the slug was rapidly removed, resulting in a downward displacement of the water level (rising head test). The water level data was downloaded and processed in Microsoft excel. Slug test analysis was completed using Aqtesolv® for Windows (Hydrosolve, 2007).

A recovery test was completed on (BPG4i). A Solinst level logger was installed in the base of the bore immediately following airlifting. As the bore has a very low yield the airlift effectively removed all groundwater from the casing, which approximated the instantaneous displacement required for the slug test. Recovery was recorded using the level logger and the recovery test was analysed as a standard rising head test using the Bouwer-Rice (1976) solution.

## 3.3 Water Quality

Field parameters (temperature, Electrical Conductivity (EC) and pH) were measured using a TPS Water Quality meter (model WP-81). EC and pH were field calibrated against standard solutions for a precision of ±1 % and ±0.01 units respectively. Temperature measurements have an instrument precision of ±0.4°C.

# 4 Investigation Drilling

## 4.1 Program Design

Thirteen investigation bores were recommended to characterise groundwater conditions around BP33. Nested bore sites with shallow and deep bores were located up-gradient and down-gradient of the BP33 deposit to investigate the extent of the alluvial aquifer, the potential for Groundwater Dependent Ecosystems and interactions with the drainage line running to the east of the pit lake. A triple nested site was positioned immediately east of the BP33 pit-lake with a shallow bore in the top of the BCF/Alluvial aquifer, a bore in the weathered BCF and a bore in the deeper, fresh BCF. A summary of the program design and the investigation rationale for each site is provided in Table 4.1.

**Table 4.1 Planned drilling locations and site rationale**

| SITE NAME | SITE TYPE | NO. BORES | TARGET AQUIFER | RATIONALE |
|---|---|---|---|---|
| BPG1 | Single bore | 1 | BCF | Assess groundwater conditions up gradient of proposed box cut |
| BPG2 | Nested | 2 | Alluvial Aquifer BCF | Assess groundwater conditions up gradient between proposed box cut and Observation Hill Dam in area of mapped GDE potential |
| BPG3 | Nested | 2 | Alluvial Aquifer BCF | Assess groundwater conditions and establish a groundwater monitoring point at field verified GDE and vegetation monitoring site RVS5 |
| BPG4 | Nested | 3 | Alluvial Aquifer BCF (weathered) BCF | Establish a nested monitoring site to investigate the degree of vertical connection between Burrell Creek Formation aquifer, the weathered zone in the Burrell Creek Formation and the Alluvial Aquifer in the immediate vicinity of the proposed mine workings |
| BPG5 | Nested | 2 | Alluvial Aquifer BCF | Assess groundwater conditions and establish monitoring at field verified GDE and surface water monitoring site BPUS SW2 |
| BGP6 | Single bore | 1 | BCF | Assess conditions downgradient of proposed box cut |
| BPG7 | Nested | 2 | Alluvial Aquifer BCF | Assess groundwater conditions downgradient of proposed mine in area of mapped GDE potential |

## 4.2 Drilling Results

The investigation program at BP33 was undertaken over a two-week period in early September, 2020 and involved the drilling and construction of 13 monitoring bores. A map of bore locations is provided in Figure 4.1 and a summary of drilling results shown in Table 4.2. Further detail on the investigation drilling and bore construction is provided in Appendix A (Composite Drilling Logs). The following general comments can be made from the investigation drilling:

- The alluvial sediments have limited thickness (0 - 4.5 m) and were unsaturated at drilling locations sites BPG3, BPG4, BPG5 located around surface water and vegetation monitoring points near the eastern drainage line. Results suggest that any permanent groundwater features or GDEs are more likely reliant on water sourced from the weathered top of the Burrell Creek Formation. The alluvial aquifer has limited saturated extent and is either not continuous along the length of the drainage line or is restricted to the immediate area around the active drainage channel.

- Bore yields in the BCF ranged from < 0.1 L/s (seepage) to 3 L/s. The BCF displays negligible primary porosity and higher yielding groundwater intersections occur around quartz veins or in discrete fracture zones within the metasediments. These typically occur in top 20 m of fresh BCF. Generally, the weathered zone exhibited low permeability and does not produce free groundwater, the exception being in the north of the site (BPG1, BPG2) and BPG7 where the weathering profile was less extensive and groundwater was intersected in fractured and weathered metasediments.
- Groundwater levels area shallow ranging from 3.4 - 7.9 metres below ground level (mBGL). The depth to groundwater is correlated with surface elevation (i.e., shallower groundwater occurs in lower lying areas and deeper groundwater depths occur in topographically elevated areas).
- Field measurements of water quality taken during bore development indicate groundwater Electrical Conductivity (EC) ranges from 50 - 310 µS/cm and has a lower EC in the northernmost sites (BPG1, BPG2). There is no uniform trend of increasing or decreasing EC with bore depth or aquifer.

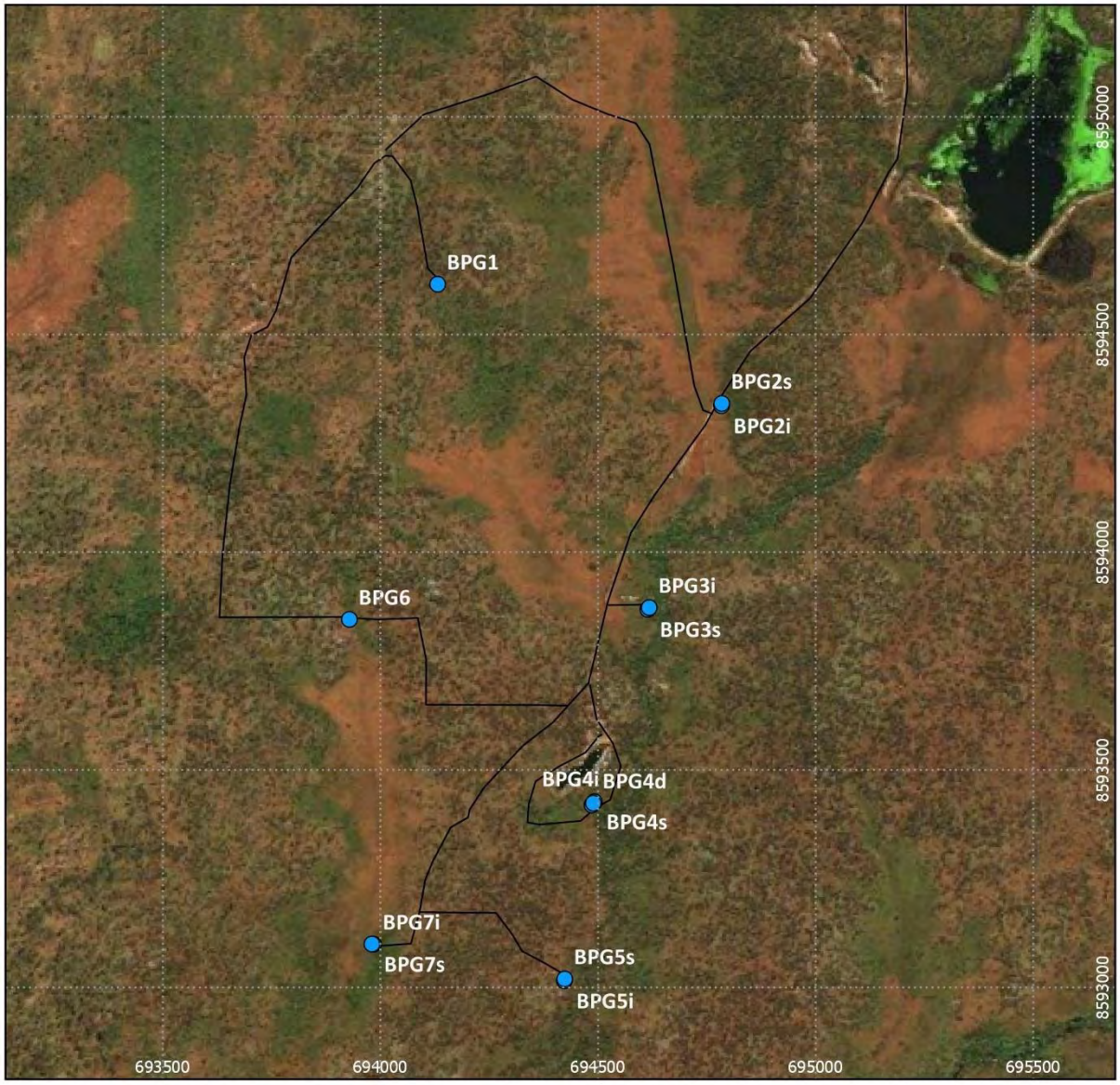



**Figure 4-1 BP33 Drilling Locations**

BP33 Bores
Access Track

0 200 400 600 800 1000 m

GDA 94 Zone 52,
1:15 000 @ A4

N

**Table 4.1 Summary of drilling results from BP33 investigation drilling**

| SITE ID | AQUIFER TYPE | DRILLED DEPTH (mBLG)* | CONSTRUCTED DEPTH (mBLG)* | AIRLIFT YIELD (L/S) ^ | ELEVATION TOP OF CASING (mAHD) | STANDING WATER LEVEL (mBLG)* | ELECTRICAL CONDUCTIVITY (µS/CM) | COMMENT |
|---|---|---|---|---|---|---|---|---|
| **BPG1** | Fractured/weathered BCF with pegmatite | 37 | 36 | 1.5 | 31.63 | 7.87 | 60 | Bore drilled directly into outcropping BCF with no alluvial cover present. Only moderate weathering observed in BCF. Groundwater was intersected around thin pegmatite/quartz band and in the underlying fractured sandstone |
| **BPG2i** | Fractured/weathered BCF with quartz veins | 29.5 | 28.3 | 0.4 | 19.07 | 3.51 | 50 | Groundwater was intersected around quartz veins and in fractured weathered schist. As with BPG1 the weathering profile in BCF was less extensive and the formation more competent relative to sites further to the south. |
| **BPG2s** | Alluvial Sediments (Silty sand with laterite band) | 4 | 3.5 | Seepage | 19.01 | 3.47 | 170 | Bore constructed across a thin alluvial sequence (4.5 m) comprising sand and silty-sand, which had a saturated thickness of 1 m at time of drilling. |
| **BPG3i** | Fresh BCF | 49 | 48.75 | 0.1 | 14.68 | 4.22 | 270 | BCF sequence displayed limited fracturing. No groundwater observed in the weathered zone (4.5 – 30 m), minor water cuts occurred within the fresh schists. |
| **BPG3s** | Alluvial Sediments | 4.5 | 4.5 | Dry | 14.52 | Dry | N/A | Bore constructed across a thin alluvial sequence (4.5 m) comprising silt, laterite and quartz. The alluvials were unsaturated at time of drilling. |
| **BP4d** | Fractured Fresh BCF | 109 | 109 | 2.6 | 13.52 | 3.35 | 280 | Groundwater was intersected in fractured schist and sandstone just below the weathered zone of the BCF. Airlift yields (measured using a V-notch weir) of up to 5.5 L/s were recorded through a discrete fracture zone (50 – 54 m). Yield dropped progressively with increased drilling depth to a final yield of 2.5 L/s from 109 m. As there were no problems with hole integrity the decrease in yield suggests the fracture zone has limited spatial extent. |

| SITE ID | AQUIFER TYPE | DRILLED DEPTH (mBLG)* | CONSTRUCTED DEPTH (mBLG)* | AIRLIFT YIELD (L/S) ^ | ELEVATION TOP OF CASING (mAHD) | STANDING WATER LEVEL (mBLG)* | ELECTRICAL CONDUCTIVITY (µS/CM) | COMMENT |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | No additional water bearing zones encountered from 54 – 109 m. Produced groundwater had a strong hydrogen sulphide smell. |
| **BPG4i** | Weathered BCF | 35.4 | 35.4 | Seepage | 13.54 | 3.82 | 310 | Bore constructed in the heavily weathered schists and sandstones of the BCF. Cuttings were damp but no free water encountered during drilling. |
| **BPG4s** | Weathered BFC | 8 | 8 | Seepage | 13.52 | 3.68 | 120 | Only 2 m of unsaturated alluvial sediments intersected. Bore constructed in heavily weathered top of the BCF. |
| **BPG5i** | Fractured Fresh BCF | 57.3 | 57.3 | 3 | 12.51 | 4.72 | 180 | Seepage (<0.1 L/s) observed in the base of the weathered zone with a significant water strike (3 L/s) recorded around a discrete quartz vein in the top of the fresh BCF at 53 m. |
| **BPG5s** | Weathered BCF | 8 | 8 | Seepage | 12.26 | 5.17 | 180 | Only 2 m of unsaturated alluvial sediments intersected. Bore constructed in heavily weathered top of the BCF. |
| **BPG6** | Fractured Fresh BCF | 73 | 73 | 1.5 | 24.26 | 7.53 | 210 | No groundwater observed in weathered BCF. Groundwater (2.8 L/s during drilling) intersected in fractured siltstone/quartz vein from a depth of 70 – 71 m. |
| **BPG7i** | Fractured Fresh BCF | 53.2 | 53.2 | 0.5 | 13.62 | 4.03 | 230 | Groundwater (0.7 L/s) intersected in discrete fracture zone at 16 m in the weathered zone, which was cased off. Deeper groundwater intersection (0.7 L/s) at 47 m occurred around a quartz band within fresh schist. |
| **BPG7s** | Weathered BCF | 7 | 7 | Seepage | 13.41 | 4.23 | 100 | Drilling intersected around 4 m of alluvial sediments (silt and silty-sand) which were unsaturated at time of drilling. The bore was constructed in the heavily weathered top of the BCF. |

* mBGL (metres below ground level
^ Airlift yields are final constructed yield

# 5 Slug and Recovery Tests

The slug test and recovery results are summarised in Table 5.1. Individual summary of the data and analysis for each of the tests completed are provided in Appendix B. Displacement was calculated from the water level logger data. The data was parsed to ensure that time zero represented the maximum displacement in accordance with the translation method (Butler, 1998). The translated data is presented in the individual bore summaries in Appendix B. Aqtesolv® for Windows (Hydrosolve, 2007), a groundwater industry standard hydraulic analysis package, was used to analyse the data, with the Bouwer-Rice (1976) and Dagan (1978) the primary solutions used to calculate hydraulic conductivity in the bores showing over-damped responses (Newcomer, 2008). These are straight line solutions that assume a quasi-stead-state by neglecting storativity (Hydrosolve, 2007). Type-curves were matched to the head ranges recommended by Butler (1989), particularly when the data did not present as a straight line. The straight-line methods readily allow observation of the double straight-line effect in bores that may be screened across the water table due to filter pack drainage (Bouwer, 1989). A confined Bouwer-Rice (1976) solution was used for the deeper bores constructed in the Burrell Creek. An unconfined Bouwer-Rice (1976) solution was applied in the shallow bores constructed in the top of the weathered Burrell Creek and alluvial sediments. In shallow bores screened across the watertable (BG2S, BG5S, BG7S) a secondary analysis was undertaken using the Dagan (1978) solution, which allows correction of the displacement data to account for the effective porosity of the filter pack.

The test results reveal that the permeability of the Burrell Creek Formation is dependent on secondary porosity (i.e., fracture and joint development). Fresh and weathered Burrell Creek Formation with negligible fracturing displayed a hydraulic conductivity range of 0.003 – 0.08 m/day. Bores that intersected fractured Burrell Creek Formation (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.

**Table 5.1 Summary of slug test and recovery test results**

| SITE ID | EASTING GDA94 Z52 | NORTHING GDA94 Z52 | AQUIFER TYPE | BORE DEPTH (mBGL) | TEST TYPE | HYDRAULIC CONDUCTIVITY (m/day) *BOUWER-RICE* | | *DAGAN* | | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Falling | Rising | Falling | Rising | |
| **BPG1** | 694131 | 8594616 | Fractured/weathered BCF with pegmatite | 35.8 | Slug | 1.7 | 1.95 | - | - | Aquifer zone in fracture around pegmatite intrusion and underlying sandstone. Thickness based on water bearing zone. Best characterised as K of fracture zone, BCF less weathered in north of BP33 site and is more representative of fresh, fractured BCF |
| **BPG2i** | 694784 | 8594336 | Fractured/weathered BCF with quartz veins | 28.3 | Slug | 0.56 | 0.58 | - | - | Small yields within BCF associated with water intersections around discrete quartz veins, bore in north of site where the BCF is more competent/slightly less weathered than to the south of BP33 |
| **BPG2s** | 694784 | 8594342 | Alluvial Sediments (Silty sand with laterite band) | 3.5 | Slug | 0.4 | - | 0.43 | - | Water level was at the base of the screens at the time of testing so no rising head test could be undertaken. The Dagan (1978) method has been used to approximate K in bores which are unconfined and screened across the watertable |
| **BPG3i** | 694617 | 8593873 | Fresh BCF | 49 | Slug | 0.027 | 0.038 | - | - | Bore screens fresh BCF with minor water intersections around slightly more weathered bands and micro fractures |
| **BPG3s** | 694614 | 8593869 | - | 4.5 | - | - | - | - | - | Bore screened across alluvial sequence. Sediments were unsaturated at time of construction so no slug test could be completed. |

| SITE ID | EASTING GDA94 Z52 | NORTHING GDA94 Z52 | AQUIFER TYPE | BORE DEPTH (mBGL) | TEST TYPE | HYDRAULIC CONDUCTIVITY (m/day) *BOUWER-RICE* Falling | *BOUWER-RICE* Rising | *DAGAN* Falling | *DAGAN* Rising | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|
| **BP4d** | 694492 | 8593426 | Fractured Fresh BCF | 109 | Slug | - | - | - | - | Displacement data could not be analysed due to inertial effects largely due to large casing diameter and relatively high transmissivity. Recommended that a conventional pumping test be undertaken to determine the K of the fracture zone |
| **BPG4i** | 694486 | 8593420 | Weathered BCF | 35.4 | Slug | 0.005 | 0.008 | - | - | Constructed in heavily weathered BCF (schist, quartz and sandstone) toward the base of the weathering profile |
| | | | | | Recovery | - | 0.003 | - | - | |
| **BPG4s** | 694492 | 8593427 | Weathered BFC | 8 | Slug | 0.024 | 0.021 | - | - | Constructed in heavily weathered schist and siltstone (BCF) at the top of the formation, screens fully submerged. |
| **BPG5i** | 694422 | 8593016 | Fractured Fresh BCF | 57.3 | Slug | 1.26 | 1.34 | - | - | Groundwater intersected around quartz veins and fractures in fresh BCF schist |
| **BPG5s** | 694423 | 8593020 | Weathered BCF | 8 | Slug | 0.048 | 0.035 | 0.042 | 0.043 | Constructed in heavily weathered schist (BCF) |
| **BPG6** | 693929 | 8593846 | Fractured Fresh BCF | 73 | Slug | 2.58 | 2.24 | - | - | Groundwater intersected in heavily fractured siltstone, aquifer response relates to the fracture zone rather than bulk BCF material |
| **BPG7i** | 693984 | 8593099 | Fractured Fresh BCF | 53.2 | Slug | 0.43 | 0.27 | - | - | Groundwater intersected around quartz veining at the transition from weathered to fresh schist (BCF) |
| **BPG7s** | 693980 | 8593100 | Weathered BCF | 7 | Slug | 0.077 | 0.073 | 0.068 | 0.075 | Bore constructed in extremely weathered schist with quartz veining at the top of the BCF |

# 6 Conclusions and Recommendations

The findings from the investigation drilling and hydraulic testing program can be summarised as follows:

- The geology of the BP33 site is dominated by metasediments of the Burrell Creek Formation comprising schists, phyllite, siltstone and sandstone. Groundwater is hosted in discrete zones that are associated with quartz veins or fractured metasediments. The fracture zones have limited thickness, typically less than 1 m, and generally occur below the weathering zone.
- The alluvial sediments have limited spatial extent and thickness (< 4.5 m). At time of drilling the alluvial sediments were unsaturated at the drilling sites between the BP33 pit/proposed mine workings and the active drainage line to the east. Results suggest that any groundwater dependent ecosystems along the drainage line are more likely to source water from the weathered top of the Burrell Creek Formation than the alluvial sediments.
- Hydraulic testing reveals the permeability of the Burrell Creek Formation is dependent on secondary porosity (i.e., fracturing). Fresh and weathered Burrell Creek Formation with negligible fracturing has a low hydraulic conductivity (0.003 – 0.08 m/day). Fractured Burrell Creek Formation (fresh or weathered) has a hydraulic conductivity two orders of magnitude higher (0.27 – 2.6 m/day). The alluvial sediments (silty sand) have a hydraulic conductivity in the order of 0.4 m/day.
- Groundwater quality can be classified as fresh with an Electrical Conductivity (EC) range of 50 - 310 µS/cm. The EC is lower in the northernmost sites (BPG1, BPG2). There is no uniform trend of increasing or decreasing EC with bore depth or aquifer.

The report makes the following recommendations:

- Water level loggers should be installed in all monitoring bores and the BP33 pit-lake to allow for the collection of a baseline groundwater level data set prior to any mine activity commencing.
- Water quality sampling should be undertaken with an initial monthly frequency for the first six months post drilling. After an appropriate baseline data set has been collected the monitoring frequency should be reviewed and site specific trigger levels developed. This process should be guided by outputs from the numerical groundwater model.
- A pumping test program is recommended to assess whether the aquifer has potential to augment project water supplies at Observation Hill Dam and to confirm the extent of the fractured aquifer around the monitoring bores. This should comprise of a longer pumping test (minimum 24-hours) on deep bore (BPG4) to better characterise the hydraulic conductivity of the fractured BCF and connections between this system and the shallow groundwater system. Shorter pumping tests (8-hours) are also recommended on higher yielding bores BPG1, BPG5, BPG6.

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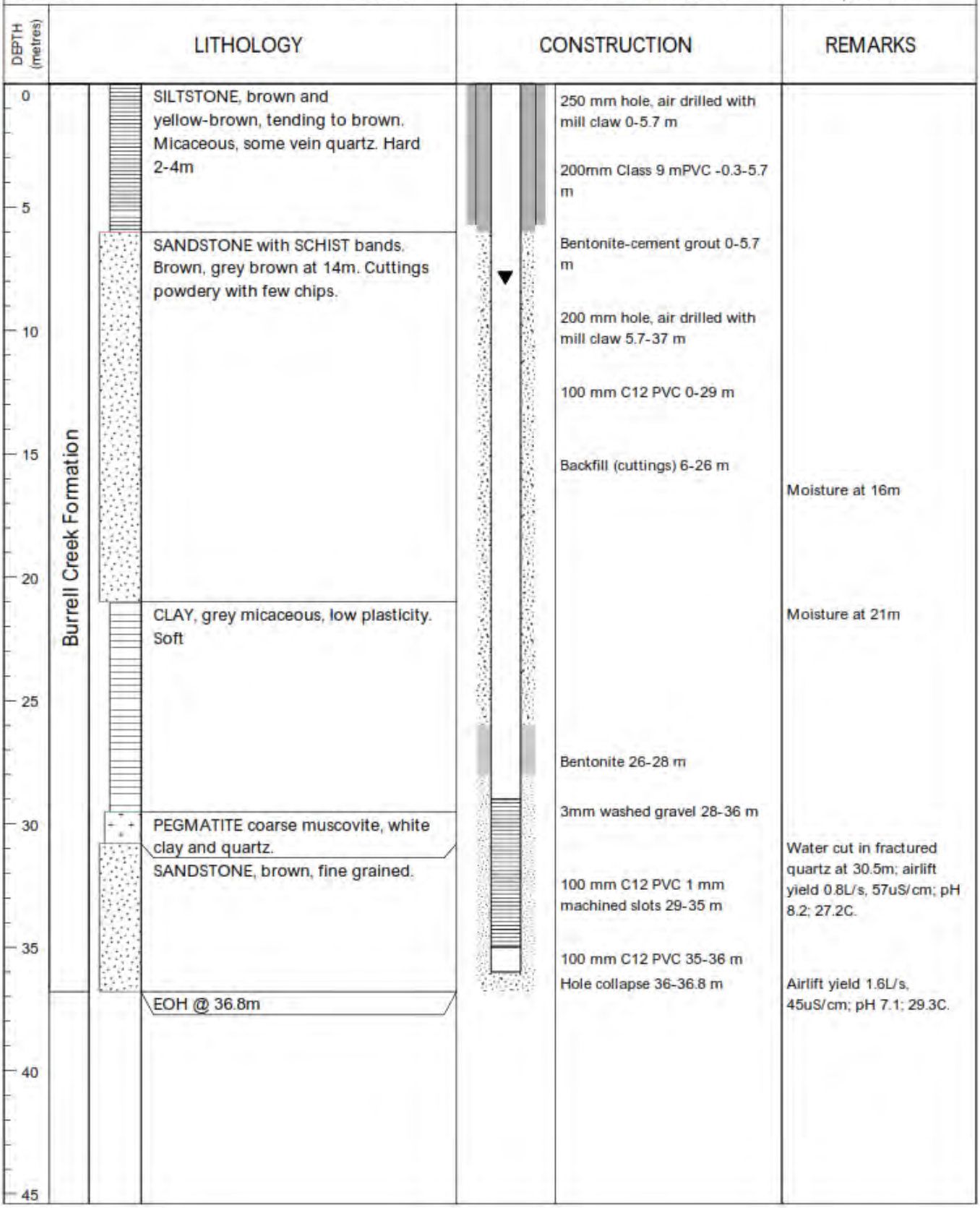
# Appendix A Composite Bore Logs

# GROUNDWATER ENTERPRISES

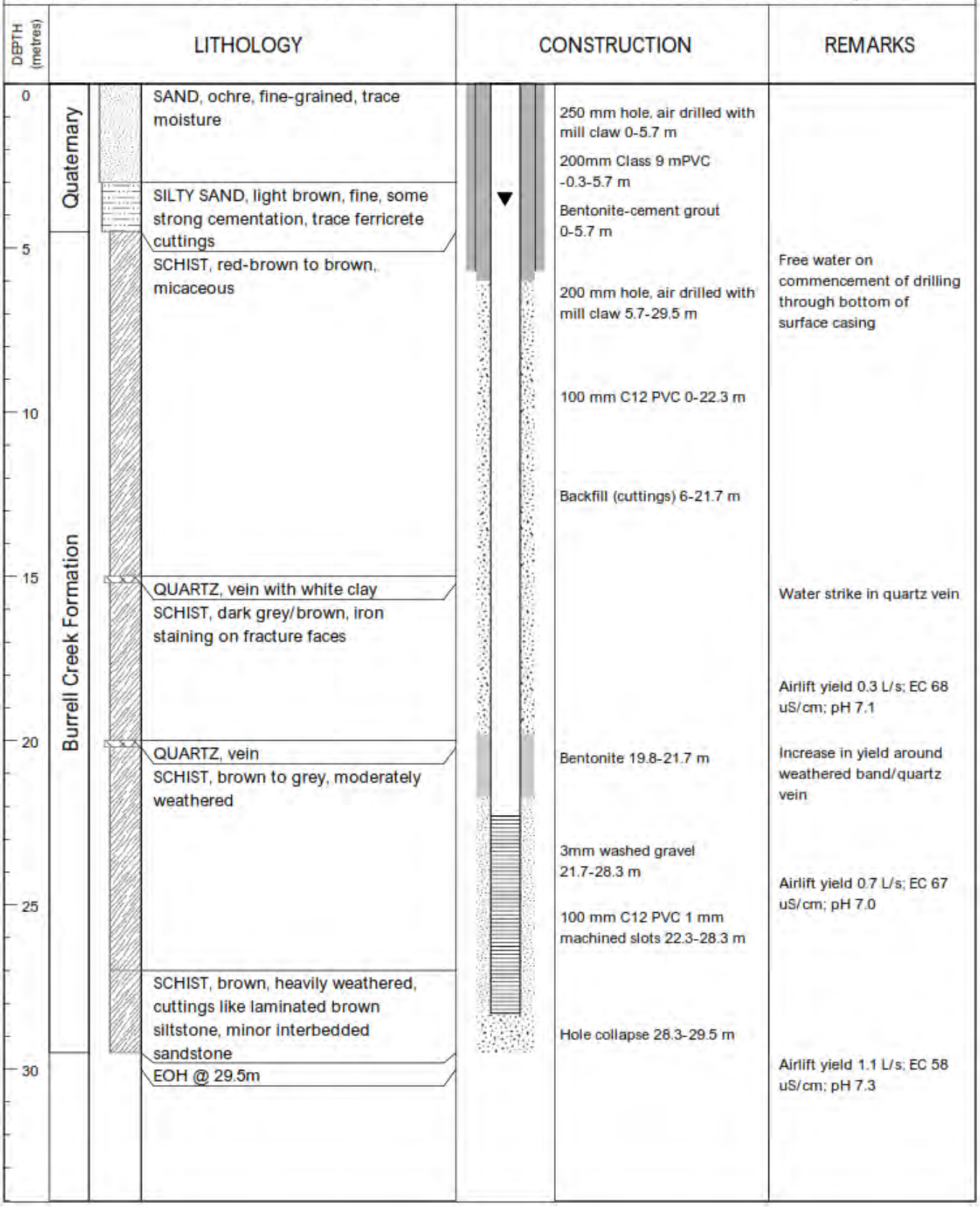
# BOREHOLE LOG: BPG1

CLIENT: Core Lithium
NORTHING: 8594616 GDA 94 Zone 53
EASTING: 694131.5 GDA 94 Zone 53
LOCATION: BP33 Lithium Prospect
DRILLER: BoresNT
LOGGED BY: R Morris
DATE COMPLETED: 14 Sep 2020
CASING HEIGHT (mm): 0.7
TOTAL DEPTH (mBGL): 37
CONSTRUCTED DEPTH (mBGL): 36
STANDING WATER LEVEL (mBGL): 7.87
BORE ID: RN041833
ELEVATION (mAHD): 31.015
AIRLIFT YIELD (L/s): 1.5
SALINITY (µS/cm): 59



# GROUNDWATER ENTERPRISES — BOREHOLE LOG: BPG2i

| | | | |
|---|---|---|---|
| CLIENT: Core Lithium | LOCATION: BP33 Lithium Prospect | CASING HEIGHT (mm): 0.8 | BORE ID: RN041791 |
| NORTHING: 8594338 GDA 94 Zone 53 | DRILLER: BoresNT | TOTAL DEPTH (mBGL): 29.5 | ELEVATION (mAHD): |
| EASTING: 694788 GDA 94 Zone 53 | LOGGED BY: R Morris | CONSTRUCTED DEPTH (mBGL): 28.3 | AIRLIFT YIELD (L/s): 0.4 |
| | DATE COMPLETED: 01 Sep 2020 | STANDING WATER LEVEL (mBGL): 3.51 | SALINITY (µS/cm): 54 |



# GROUNDWATER ENTERPRISES

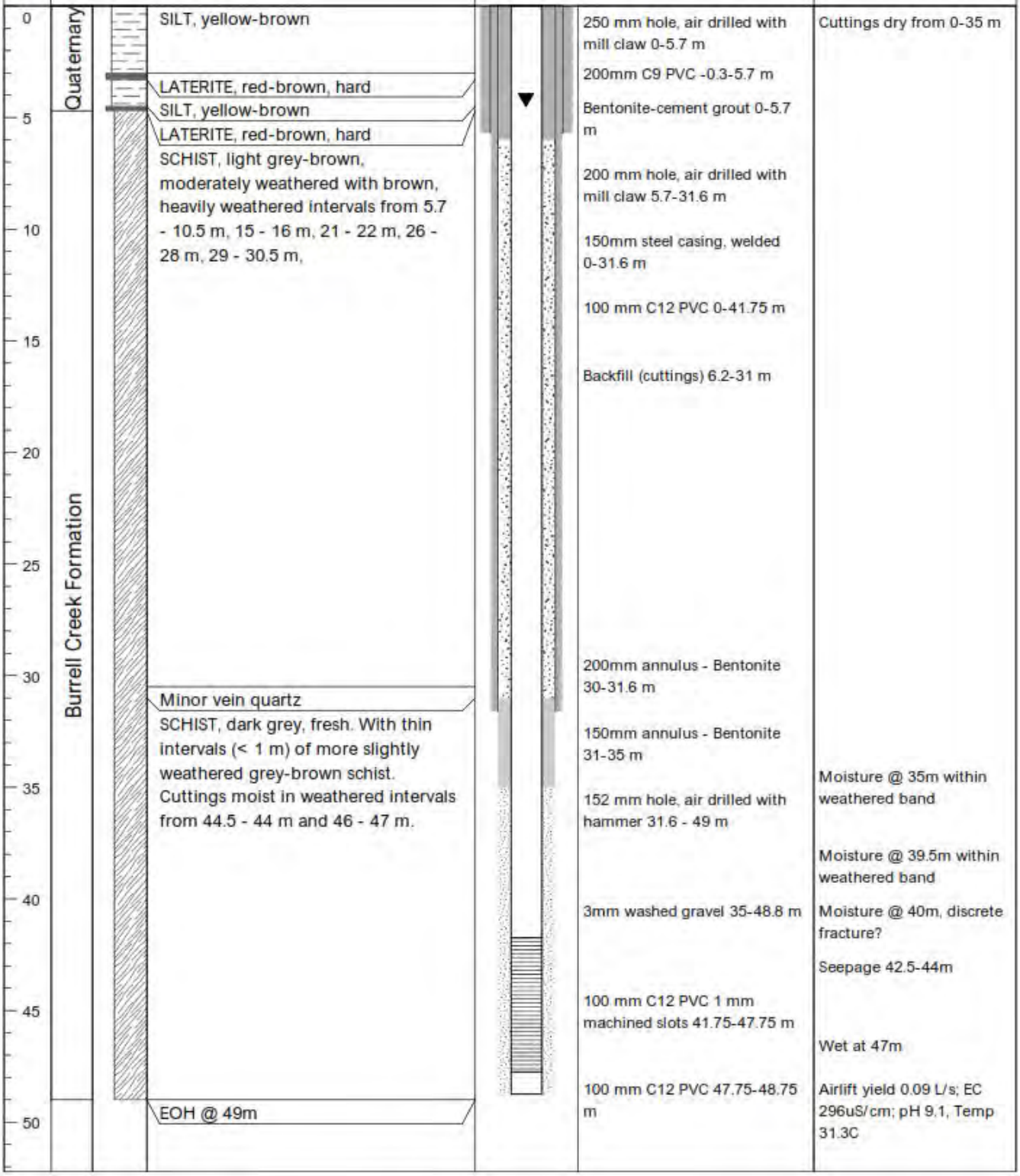
# BOREHOLE LOG: BPG2s

CLIENT: Core Lithium
NORTHING: 8594338 GDA 94 Zone 53
EASTING: 694788 GDA 94 Zone 53
LOCATION: BP33 Lithium Prospect
DRILLER: BoresNT
LOGGED BY: R Morris
DATE COMPLETED: 01 Sep 2020
CASING HEIGHT (mm): 0.8
TOTAL DEPTH (mBGL): 4
CONSTRUCTED DEPTH (mBGL): 3.5
STANDING WATER LEVEL (mBGL): 3.47
BORE ID: RN041792
ELEVATION (mAHD):
AIRLIFT YIELD (L/s): Seepage
SALINITY (µS/cm): 166

| DEPTH (metres) | LITHOLOGY | CONSTRUCTION | REMARKS |
|---|---|---|---|
| 0 | Quaternary: SILTY SAND, ochre with thin grey bands of fine sand | 200 mm hole, air drilled with mill claw 0-4.0 m | |
| 1 | | 100 mm C12 PVC 0-2.5 m | |
| 2 | | Bentonite-cement grout 0-2.1 m | Moisture from 1-2 m |
| 3 | | Bentonite 2.1-2.3 m<br>3mm washed gravel 2.5-3.5 m<br>100 mm C12 PVC 1 mm machined slots 2.5-3.5 m | |
| 4 | BCF: SCHIST, grey-brown, moderately weathered, with some vein quartz.<br>EOH @ 4m | Backfill with cuttings 3.5-4.0 m | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |

# GROUNDWATER ENTERPRISES — BOREHOLE LOG: BPG3i

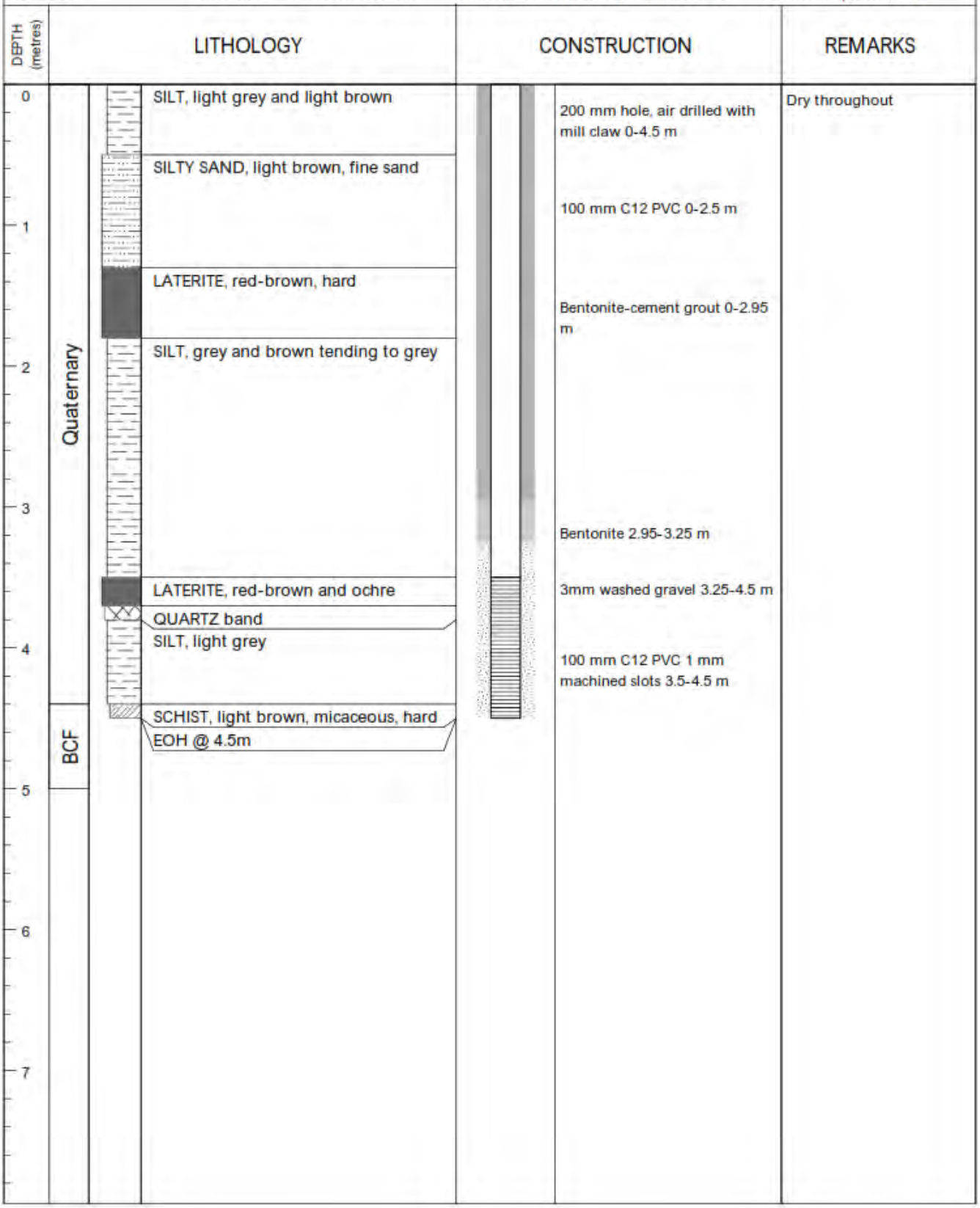
| | | | |
|---|---|---|---|
| CLIENT: Core Lithium | LOCATION: BP33 Lithium Prospect | CASING HEIGHT (mm): 0.8 | BORE ID: RN041793 |
| NORTHING: 8593875 GDA 94 Zone 53 | DRILLER: BoresNT | TOTAL DEPTH (mBGL): 49 | ELEVATION (mAHD): TBC |
| EASTING: 694619 GDA 94 Zone 53 | LOGGED BY: R Morris | CONSTRUCTED DEPTH (mBGL): 48.75 | AIRLIFT YIELD (L/s): 0.1 |
| | DATE COMPLETED: 02 Sep 2020 | STANDING WATER LEVEL (mBGL): 4.22 | SALINITY (µS/cm): 268 |



# GROUNDWATER ENTERPRISES

# BOREHOLE LOG: BPG3s

CLIENT: Core Lithium
NORTHING: 8593868 GDA 94 Zone 53
EASTING: 694611 GDA 94 Zone 53
LOCATION: BP33 Lithium Prospect
DRILLER: BoresNT
LOGGED BY: R Morris
DATE COMPLETED: 03 Sep 2020
CASING HEIGHT (mm): 0.5
TOTAL DEPTH (mBGL): 4.5
CONSTRUCTED DEPTH (mBGL): 4.5
STANDING WATER LEVEL (mBGL): DRY
BORE ID: RN041794
ELEVATION (mAHD): TBC
AIRLIFT YIELD (L/s): Dry
SALINITY (µS/cm): NA



# GROUNDWATER ENTERPRISES — BOREHOLE LOG: BPG4d

| | | | |
|---|---|---|---|
| CLIENT: Core Lithium | LOCATION: BP33 Lithium Prospect | CASING HEIGHT (mm): 0.3 | BORE ID: RN041830 |
| NORTHING: 8593425 GDA 94 Zone 53 | DRILLER: BoresNT | TOTAL DEPTH (mBGL): 109 | ELEVATION (mAHD): TBC |
| EASTING: 694497 GDA 94 Zone 53 | LOGGED BY: R Morris | CONSTRUCTED DEPTH (mBGL): 109 | AIRLIFT YIELD (L/s): 2.6 |
| | DATE COMPLETED: 12 Sep 2020 | STANDING WATER LEVEL (mBGL): 3.35 | SALINITY (µS/cm): 280 |

| DEPTH (metres) | LITHOLOGY | CONSTRUCTION | REMARKS |
|---|---|---|---|
| 0 | SILT, grey and yellow-brown, micaceous, trace clay | 250 mm hole, air drilled with mill claw 0-5.7 m | |
| 5 | SCHIST grey-brown, micaceous, heavily weathered | Cemented 200mm C9 PVC -0.3-5.7 m | |
| | SILTSTONE, brown, micaceous, heavily weathered | 200 mm hole, air drilled with mill claw 0-47 m | |
| 10 | SCHIST, brown, grey-brown to red-brown brown alternating bands. Harder and softer bands, Heavily weathered. | 150mm steel casing, welded 0-47 m | |
| 15 | | 150mm Annulus - Bentonite-cement grout 0-47 m. Pressure cemented | Moisture at 13m |
| 20 | QUARTZ vein at 20m. Bit grinding and decreased ROP | | Moistue at 20.5m |
| 25 | SCHIST, brown, very soft 23-24m, few chips | | Wet on rod change at 24m |
| | Red-brown | | Increased moisture from 25m<br>Increased moisture from 28m |
| 30 | SANDSTONE, grey-brown tending to grey with depth, micaceous | | Cuttings dry 28.5-30m |
| | QUARTZ vein at 32.5m. Rig chattering | | Cuttings damp rod change at 30m |
| 35 | SANDSTONE, grey-brown tending to grey with depth, micaceous. Rig chattering and bit grinding. | | Moisture at 35.5m |
| | | | Cuttings damp on rod change at 36m |
| 40 | | | Cuttings damp on rod change at 42m |
| 45 | Fracture at 45.5m, poor returns | | Water cut @ 45.5 m |
| | SANDSTONE, grey, micaceous, very fine grained. Cuttings as powder with no chips | | Airlift yield 1.5L/s, 265uS/cm; pH 10; 29.8C |
| 50 | Fracture at 51m. Blocky cuttings with iron staining on faces | | Cuttings dry after drilling through casing shoe |
| | | | Water cut in fracture at 51m. 161uS/cm; pH 8.6; 27.1C |
| 55 | Fracture 53-54m. Blocky cuttings, some vein quartz | 150mm open hole 47-109 m | Water cut in fracture |

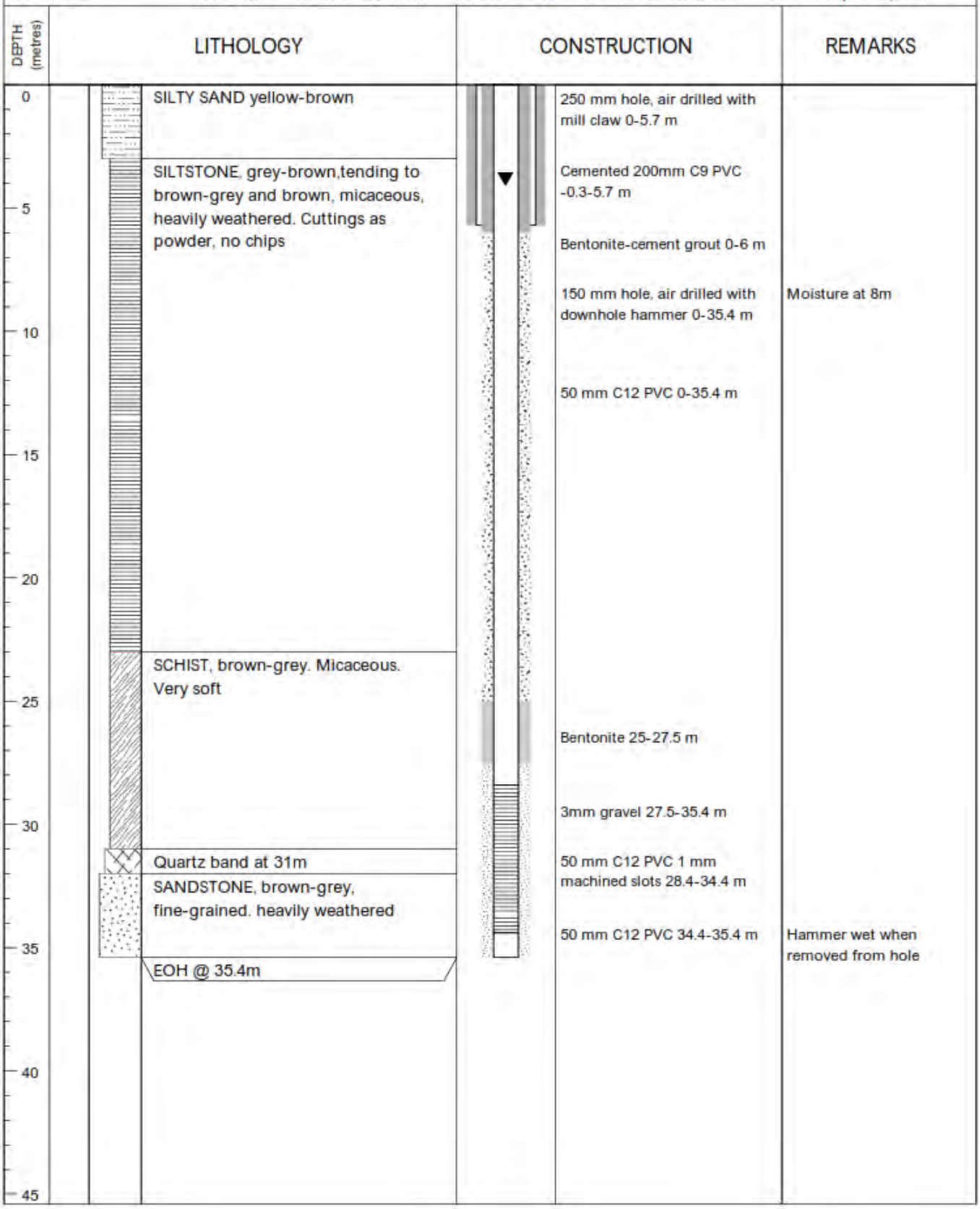
# GROUNDWATER ENTERPRISES — BOREHOLE LOG: BPG4d

| | | | |
|---|---|---|---|
| CLIENT: Core Lithium | LOCATION: BP33 Lithium Prospect | CASING HEIGHT (mm): 0.3 | BORE ID: RN041830 |
| NORTHING: 8593425 GDA 94 Zone 53 | DRILLER: BoresNT | TOTAL DEPTH (mBGL): 109 | ELEVATION (mAHD): TBC |
| EASTING: 694497 GDA 94 Zone 53 | LOGGED BY: R Morris | CONSTRUCTED DEPTH (mBGL): 109 | AIRLIFT YIELD (L/s): 2.6 |
| | DATE COMPLETED: 12 Sep 2020 | STANDING WATER LEVEL (mBGL): 3.35 | SALINITY (µS/cm): 280 |

| DEPTH (metres) | LITHOLOGY | CONSTRUCTION | REMARKS |
|---|---|---|---|
| 60 | SANDSTONE dark grey, fine to medium, STRONG H2S ODOUR | | 53-54m. 5.5L/s; 295uS/cm; pH 8.95; 27.6C. Strong H2S odour |
| | | | Airlift yield 4.4L/s; 255uS/cm; pH 8.7; 28.1C |
| 65 | SCHIST, dark grey, heavily micaceous. No chips in cuttings | | |
| | SANDSTONE dark grey, some brown silt, mostly 2-3mm cuttings, with some up to 3cm | | Airlift yield 5L/s; 252uS/cm; pH 9.1; 28.6C |
| 70 | SANDSTONE, dark grey, fine-grained. Some vein quartz | 150mm open hole 47-109 m | |
| | as above, some larger cuttings | | Airlift yield 4.4L/s |
| 75 | | | |
| 80 | Fracture 77.8- 78.5m, large cuttings, angular | | Airlift yield 5L/s; 336uS/cm; pH 8.0; 30.8C |
| 85 | Fracture 83.5-84m. Angular cuttings and some vein quartz | | Airlift yield 5L/s; 322uS/cm; pH 7.9; 31.2C |
| | SANDSTONE, dark grey, fine grained. Cuttings mostly 203mm. Decreased ROP at 84m | | |
| 90 | | | Airlift yield 5.5L/s; 312uS/cm; pH 8.3; 28.1C |
| 95 | Fracture(?) at 94.5m | | |
| | Fracture at 95.2m. Trace vein quartz | | Airlift yield 3.5L/s; 354/cm; pH 8.3; 26.9C |
| 100 | | 150mm open hole 47-109 m | |
| | Fracture(?) at 101.5m | | Airlift yield 2.5L/s; 280/cm; pH 7.9; 27.2C |
| 105 | Fracture(?) at 105.25m. Hammer torquing | | |
| | EOH @ 109m | | Airlift yield 2.5L/s |
| 110 | | | |

# GROUNDWATER ENTERPRISES — BOREHOLE LOG: BPG4i

| | | | |
|---|---|---|---|
| CLIENT: Core Lithium | LOCATION: BP33 Lithium Prospect | CASING HEIGHT (mm): 0.7 | BORE ID: RN041831 |
| NORTHING: 8593422 GDA 94 Zone 53 | DRILLER: BoresNT | TOTAL DEPTH (mBGL): 35.4 | ELEVATION (mAHD): TBC |
| EASTING: 694486 GDA 94 Zone 53 | LOGGED BY: R Morris | CONSTRUCTED DEPTH (mBGL): 35.4 | AIRLIFT YIELD (L/s): Seepage |
| | DATE COMPLETED: 13 Sep 2020 | STANDING WATER LEVEL (mBGL): 3.82 | SALINITY (µS/cm): 307 |



# GROUNDWATER ENTERPRISES

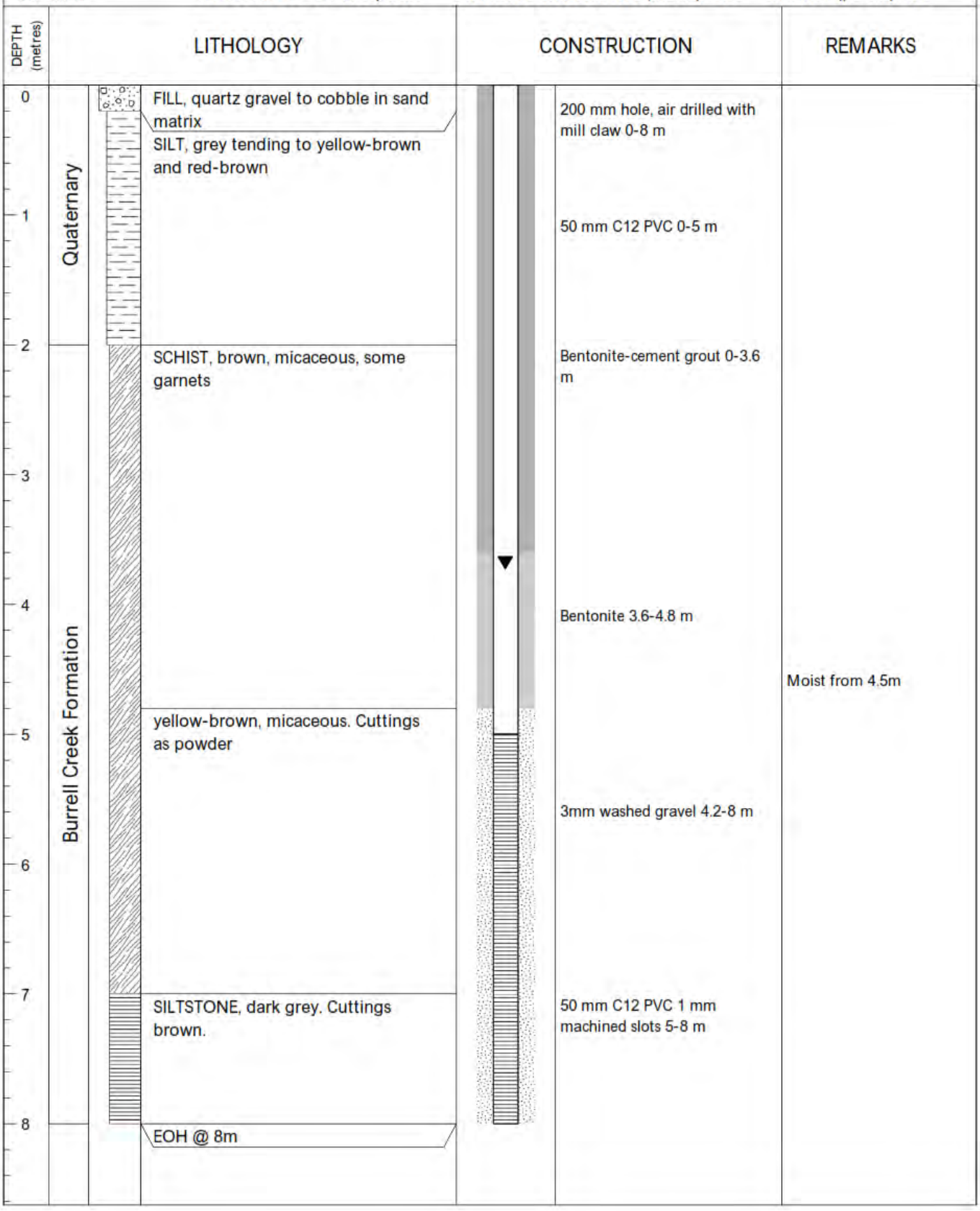
# BOREHOLE LOG: BPG4s

CLIENT: Core Lithium
NORTHING: 8593425
GDA 94 Zone 53
EASTING: 694497
GDA 94 Zone 53

LOCATION: BP33 Lithium Prospect
DRILLER: BoresNT
LOGGED BY: R Morris
DATE COMPLETED: 11 Sep 2020

CASING HEIGHT (mm): 0.4
TOTAL DEPTH (mBGL): 8
CONSTRUCTED DEPTH (mBGL): 8
STANDING WATER LEVEL (mBGL): 3.68

BORE ID: RN041832
ELEVATION (mAHD): TBC
AIRLIFT YIELD (L/s): Seepage
SALINITY (µS/cm): 122

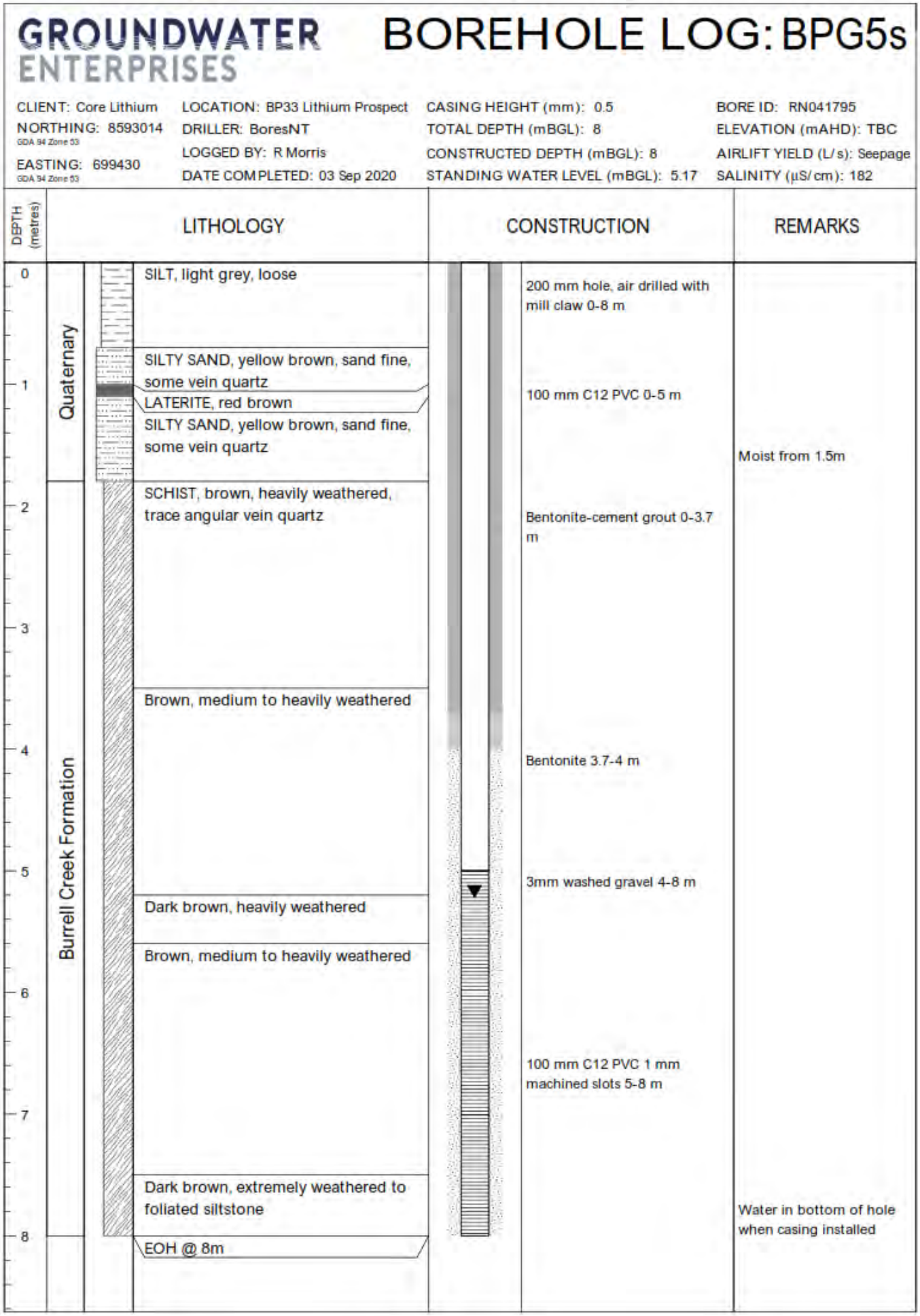


# GROUNDWATER ENTERPRISES

# BOREHOLE LOG: BPG5i

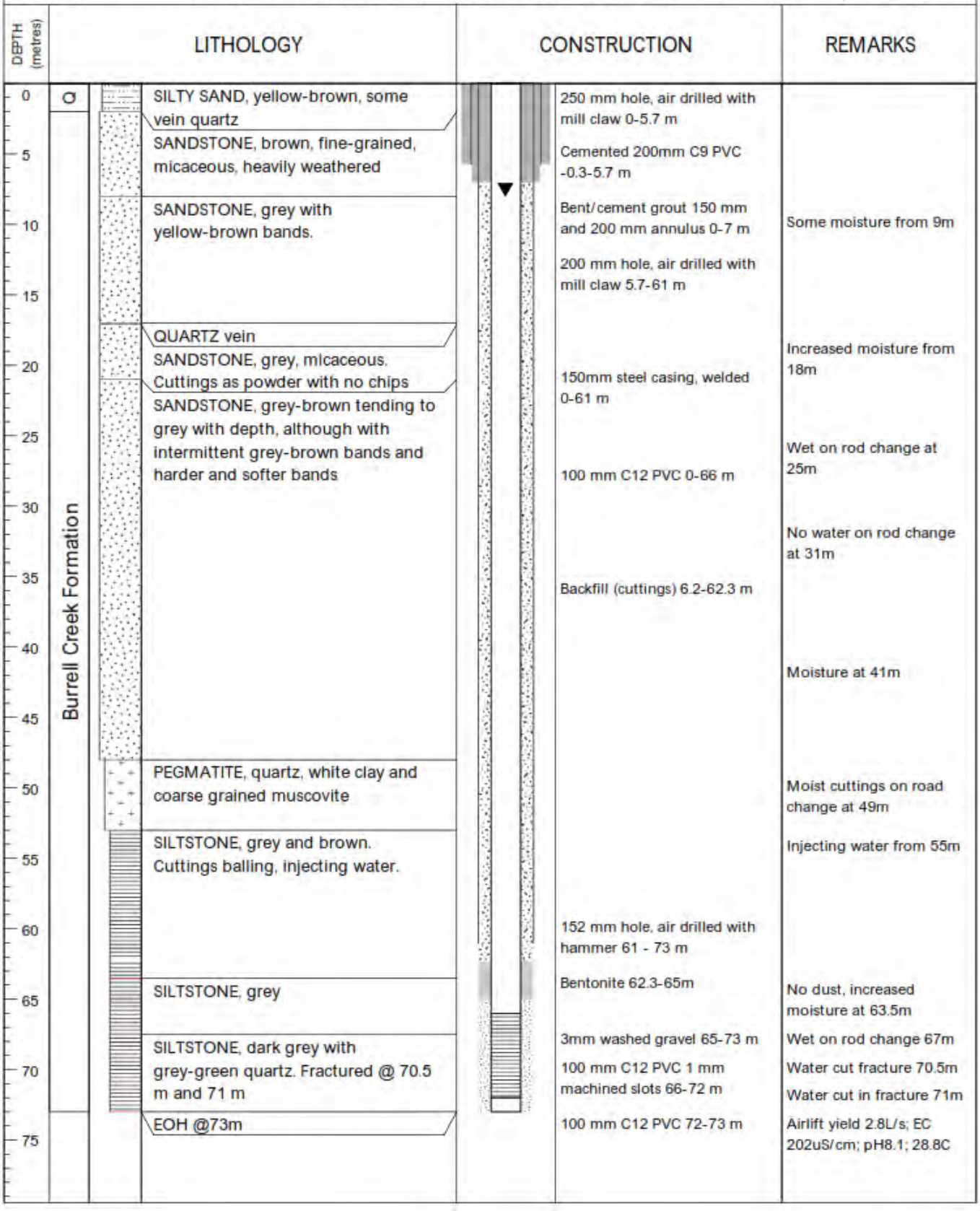
CLIENT: Core Lithium
NORTHING: 8593014 GDA 94 Zone 53
EASTING: 699430 GDA 94 Zone 53
LOCATION: BP33 Lithium Prospect
DRILLER: BoresNT
LOGGED BY: R Morris
DATE COMPLETED: 04 Sep 2020
CASING HEIGHT (mm): 0.8
TOTAL DEPTH (mBGL): 57.3
CONSTRUCTED DEPTH (mBGL): 57.3
STANDING WATER LEVEL (mBGL): 4.72
BORE ID: RN041796
ELEVATION (mAHD): TBC
AIRLIFT YIELD (L/s): 3
SALINITY (µS/cm): 175

| DEPTH (metres) | LITHOLOGY | CONSTRUCTION | REMARKS |
|---|---|---|---|
| 0 | Q / Burrell Creek Formation: SILTY SAND, yellow brown to light grey, with laterite bands | 250 mm hole, air drilled with mill claw 0-5.7 m | Moist from 1.5m |
| 5 | SCHIST, brown, heavily weathered | Cemented 200mm C9 PVC -0.3-5.7 m | |
| | SCHIST, grey and brown, foliated, some gravel sized chips | Bent/cement grout 150 mm annulus 0-3.5 m and 200 mm annulus 0-6.5 m | Wet upon restart after waiting overnight for cement to cure |
| 10 | SCHIST, brown, heavily weathered | 200 mm hole, air drilled with mill claw 5.7-61 m | Cuutings damp 5.7 - 30 m |
| | SCHIST, olive/light brown, moderately weathered. Increased ROP at 16m. | 150mm steel casing, welded 0-47.3 m | |
| 15 | Small hard band, vein quartz. Cuttings balling | | |
| | SCHIST, light brown, heavily weathered | 100 mm C12 PVC 0-49.3 m | |
| 20 | | Backfill (cuttings) 0-49 m | |
| 25 | SCHIST, brown, extremely weathered. | | |
| | SCHIST, light brown, heavily weathered | | |
| 30 | | | Increased moisture 30 - 34 m |
| 35 | SCHIST, grey-brown, some silt, lightly-moderately weathered | | Wet from 36m. Injecting water to clean hole |
| 40 | QUARTZ, vein | | |
| | SCHIST, dark grey with some brown, fresh to moderately weathered | | Airlift yield 0.13L/s; EC 98uS/cm; pH 8.0; 29.6C |
| 45 | | 152 mm hole, air drilled with hammer 47.3 - 57.3 m | Airlift yield 0.13L/s; EC 17uS/cm; pH 8.0; 30.7C |
| | | Bentonite 48-49 m | Dry 48-50.5 m |
| 50 | SCHIST, dark grey, fresh. Quartz veins at 53 m. | 3mm washed gravel 49-57.3 m | Moist from 50.5m |
| | | 100 mm C12 PVC 1 mm machined slots 49.3-55.3 m | Wet, associated with quartz vein. |
| 55 | | | Airlift yield 2.9L/s; 183uS/cm; pH 7.9; 29.7C |
| | | 100 mm C12 PVC 56.3-57.3 m | |
| 60 | End of hole @ 57.3 m | | Airlift yield 2.9L/s; 175uS/cm; pH 7.8; 29.4C |


GROUNDWATER ENTERPRISES
BOREHOLE LOG: BPG5s
CLIENT: Core Lithium
NORTHING: 8593014
GDA 94 Zone 53
EASTING: 699430
GDA 94 Zone 53
LOCATION: BP33 Lithium Prospect
DRILLER: BoresNT
LOGGED BY: R Morris
DATE COMPLETED: 03 Sep 2020
CASING HEIGHT (mm): 0.5
TOTAL DEPTH (mBGL): 8
CONSTRUCTED DEPTH (mBGL): 8
STANDING WATER LEVEL (mBGL): 5.17
BORE ID: RN041795
ELEVATION (mAHD): TBC
AIRLIFT YIELD (L/s): Seepage
SALINITY (µS/cm): 182
DEPTH (metres)
LITHOLOGY
CONSTRUCTION
REMARKS
0
1
2
3
4
5
6
7
8
Quaternary
Burrell Creek Formation
SILT, light grey, loose
SILTY SAND, yellow brown, sand fine, some vein quartz
LATERITE, red brown
SILTY SAND, yellow brown, sand fine, some vein quartz
SCHIST, brown, heavily weathered, trace angular vein quartz
Brown, medium to heavily weathered
Dark brown, heavily weathered
Brown, medium to heavily weathered
Dark brown, extremely weathered to foliated siltstone
EOH @ 8m
200 mm hole, air drilled with mill claw 0-8 m
100 mm C12 PVC 0-5 m
Bentonite-cement grout 0-3.7 m
Bentonite 3.7-4 m
3mm washed gravel 4-8 m
100 mm C12 PVC 1 mm machined slots 5-8 m
Moist from 1.5m
Water in bottom of hole when casing installed

# GROUNDWATER ENTERPRISES — BOREHOLE LOG: BPG6

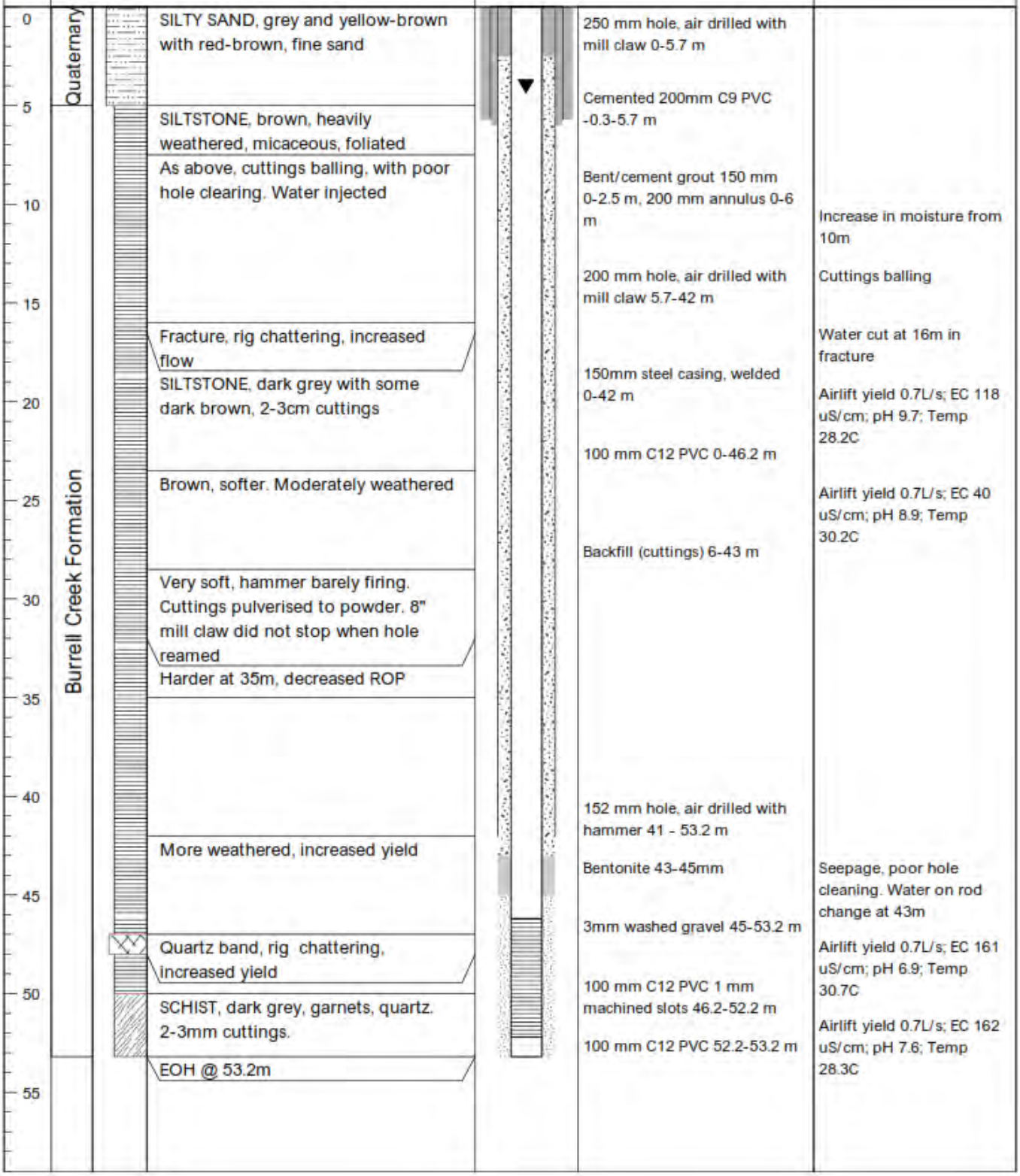
CLIENT: Core Lithium
NORTHING: 8593848 GDA 94 Zone 53
EASTING: 693928 GDA 94 Zone 53
LOCATION: BP33 Lithium Prospect
DRILLER: BoresNT
LOGGED BY: R Morris
DATE COMPLETED: 09 Sep 2020
CASING HEIGHT (mm): 0.7
TOTAL DEPTH (mBGL): 73
CONSTRUCTED DEPTH (mBGL): 73
STANDING WATER LEVEL (mBGL): 7.53
BORE ID: RN041799
ELEVATION (mAHD): TBC
AIRLIFT YIELD (L/s): 1.5
SALINITY (µS/cm): 210



# GROUNDWATER ENTERPRISES

# BOREHOLE LOG: BPG7i

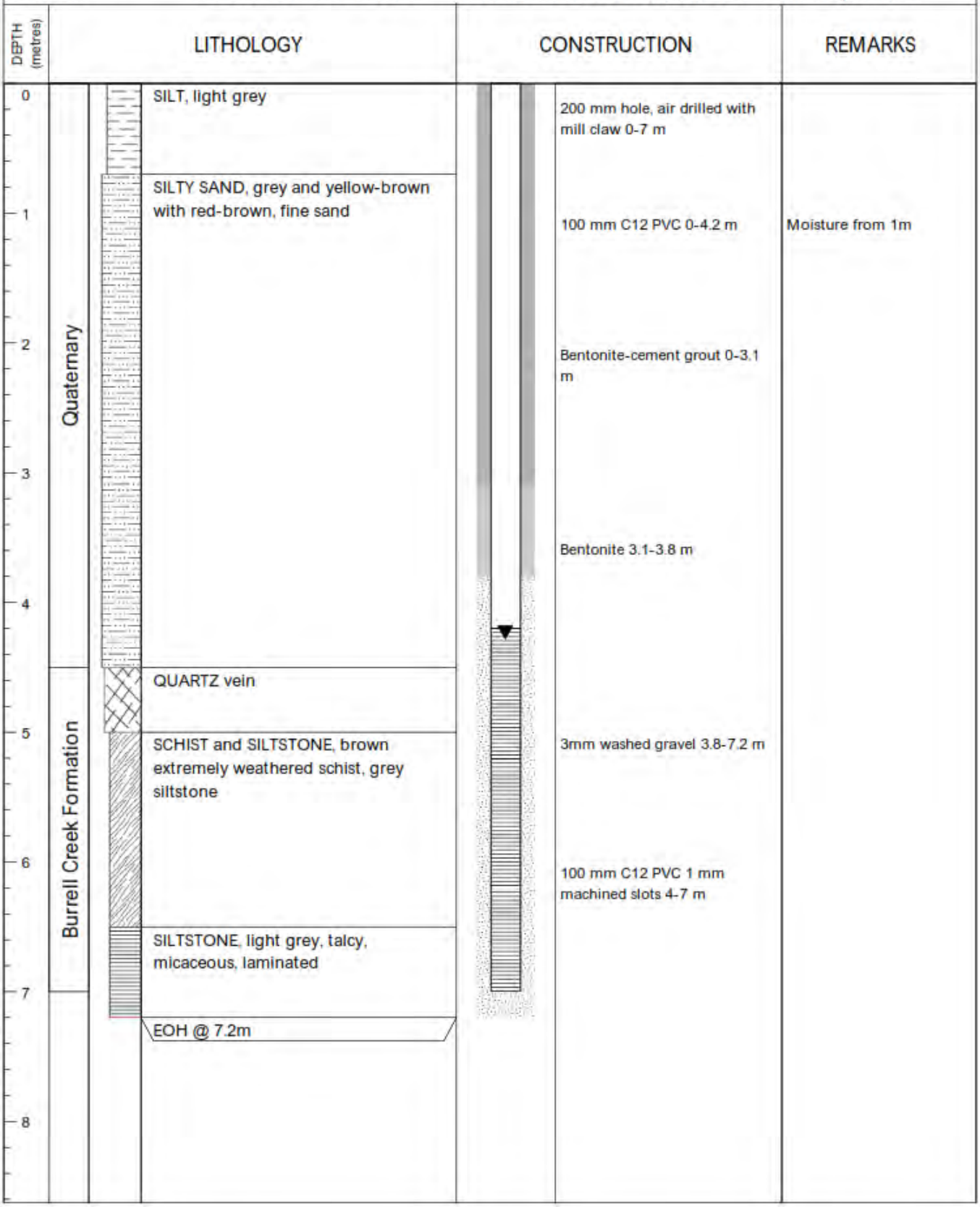
CLIENT: Core Lithium
NORTHING: 8593098 GDA 94 Zone 53
EASTING: 693991 GDA 94 Zone 53
LOCATION: BP33 Lithium Prospect
DRILLER: BoresNT
LOGGED BY: R Morris
DATE COMPLETED: 07 Sep 2020
CASING HEIGHT (mm): 0.8
TOTAL DEPTH (mBGL): 53.2
CONSTRUCTED DEPTH (mBGL): 53.2
STANDING WATER LEVEL (mBGL): 4.03
BORE ID: RN041798
ELEVATION (mAHD): TBC
AIRLIFT YIELD (L/s): 0.5
SALINITY (µS/cm): 231



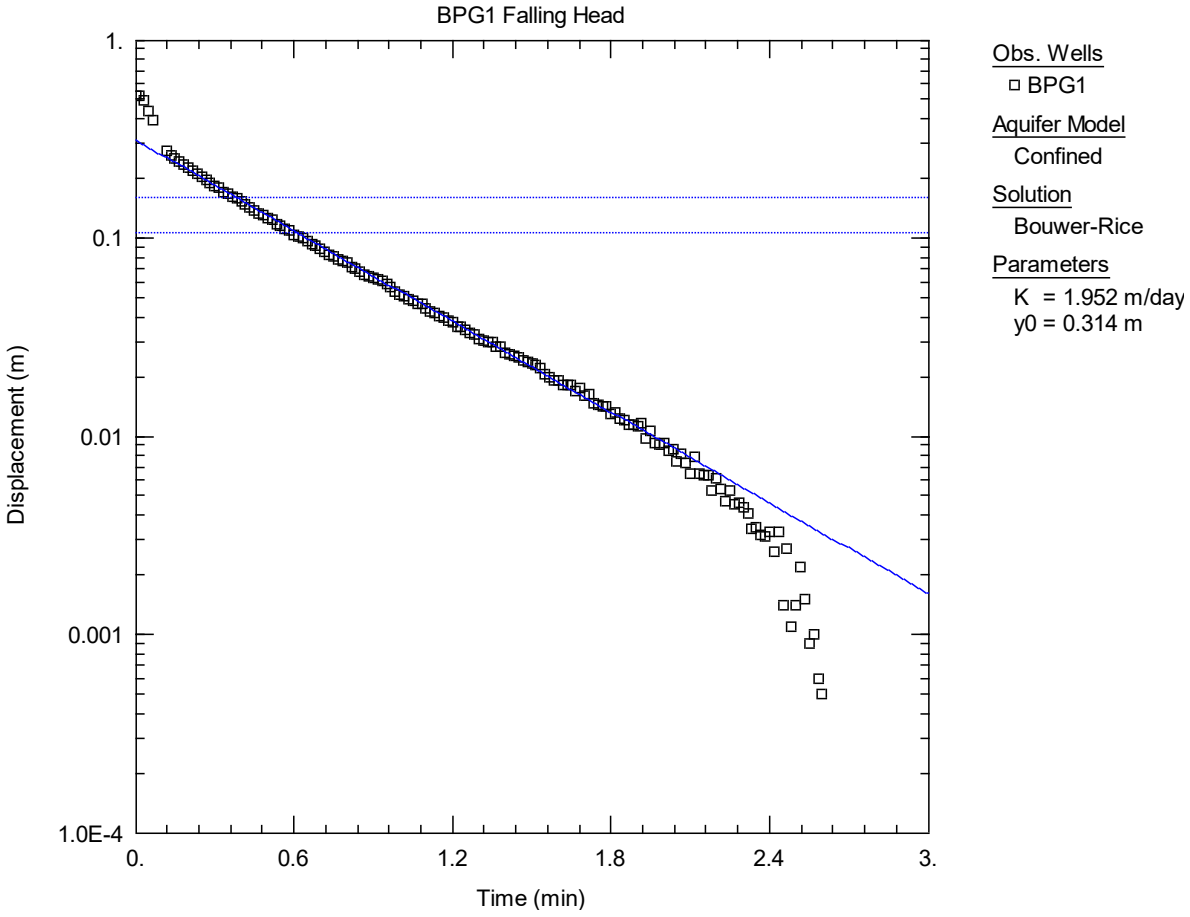
# GROUNDWATER ENTERPRISES

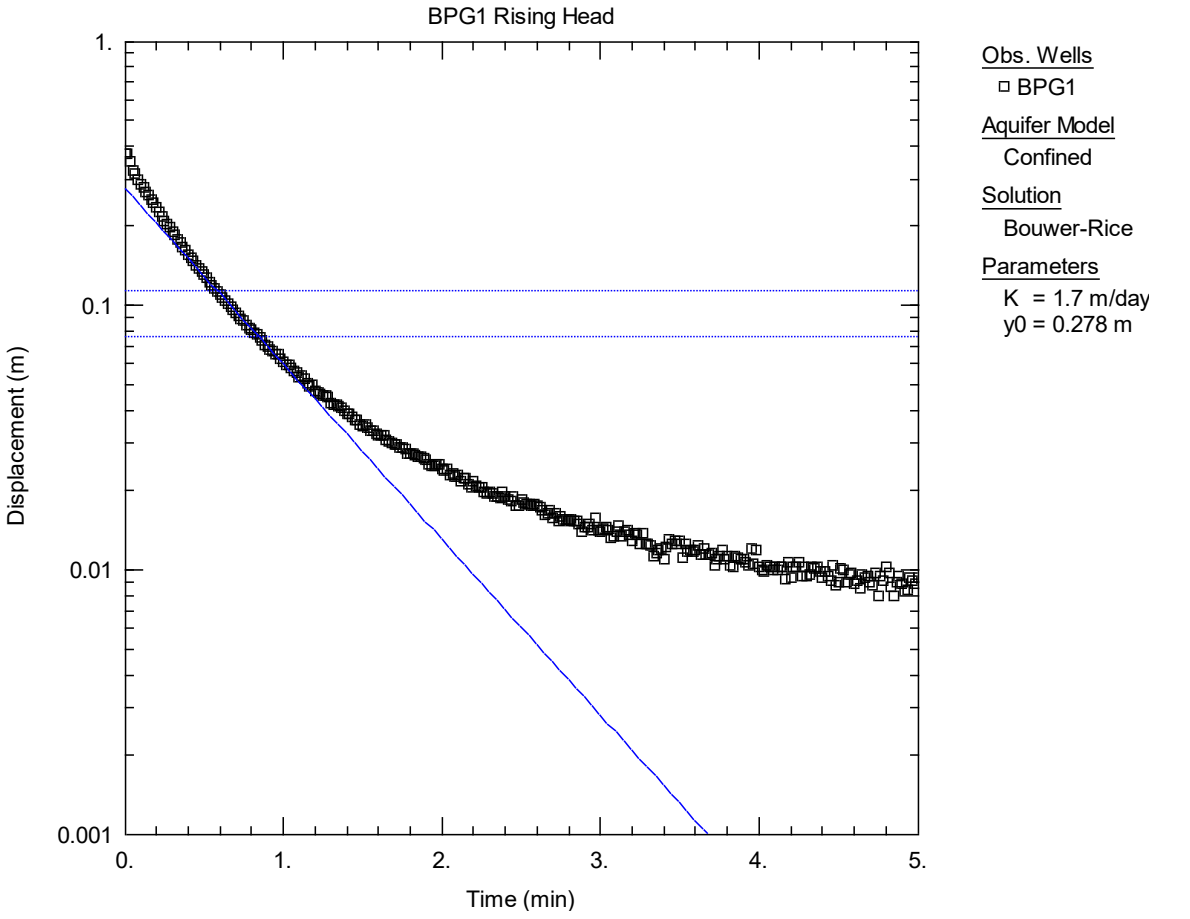
# BOREHOLE LOG: BPG7s

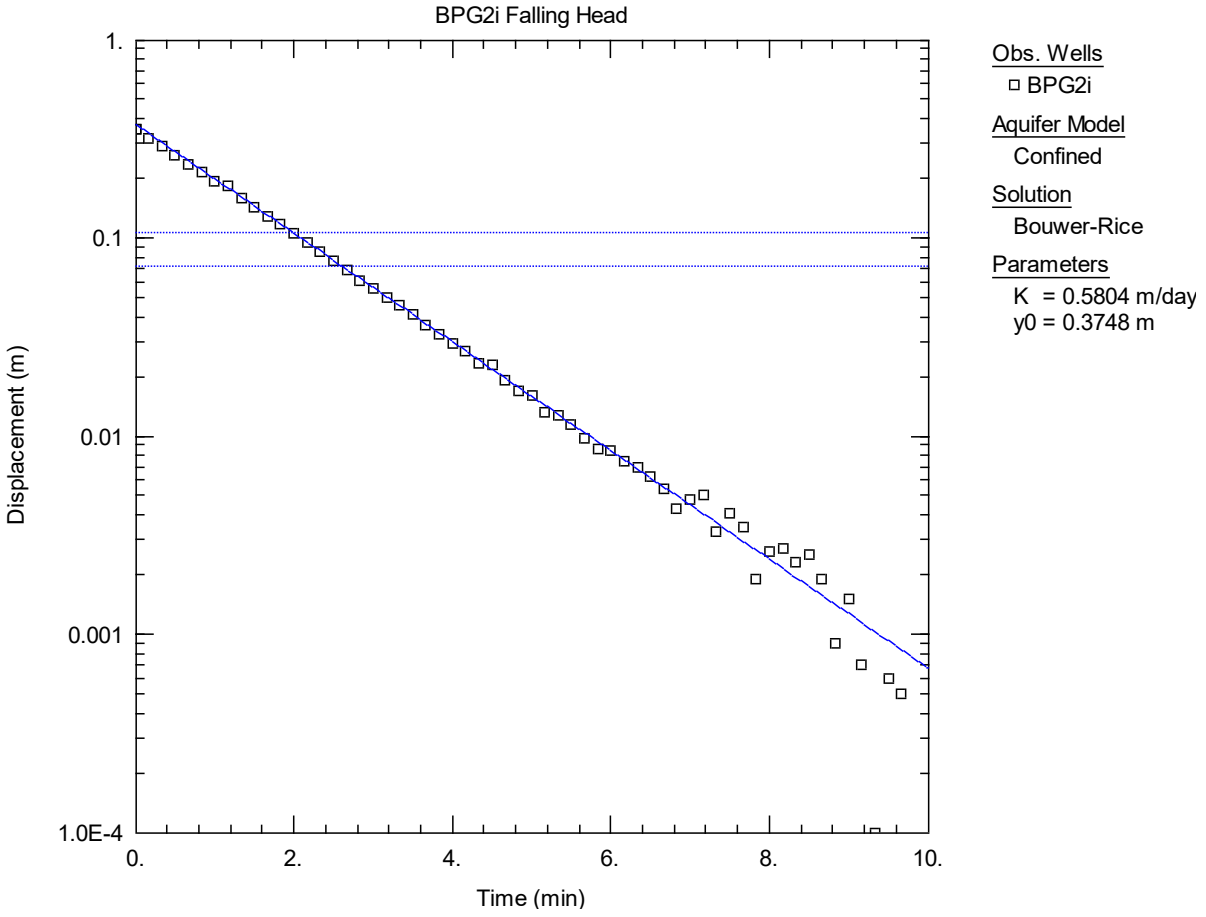
| | | | |
|---|---|---|---|
| CLIENT: Core Lithium | LOCATION: BP33 Lithium Prospect | CASING HEIGHT (mm): 0.5 | BORE ID: RN041797 |
| NORTHING: 8593098 GDA 94 Zone 53 | DRILLER: BoresNT | TOTAL DEPTH (mBGL): 7 | ELEVATION (mAHD): TBC |
| EASTING: 693991 GDA 94 Zone 53 | LOGGED BY: R Morris | CONSTRUCTED DEPTH (mBGL): 7 | AIRLIFT YIELD (L/s): Seepage |
| | DATE COMPLETED: 05 Sep 2020 | STANDING WATER LEVEL (mBGL): 4.23 | SALINITY (µS/cm): 96 |

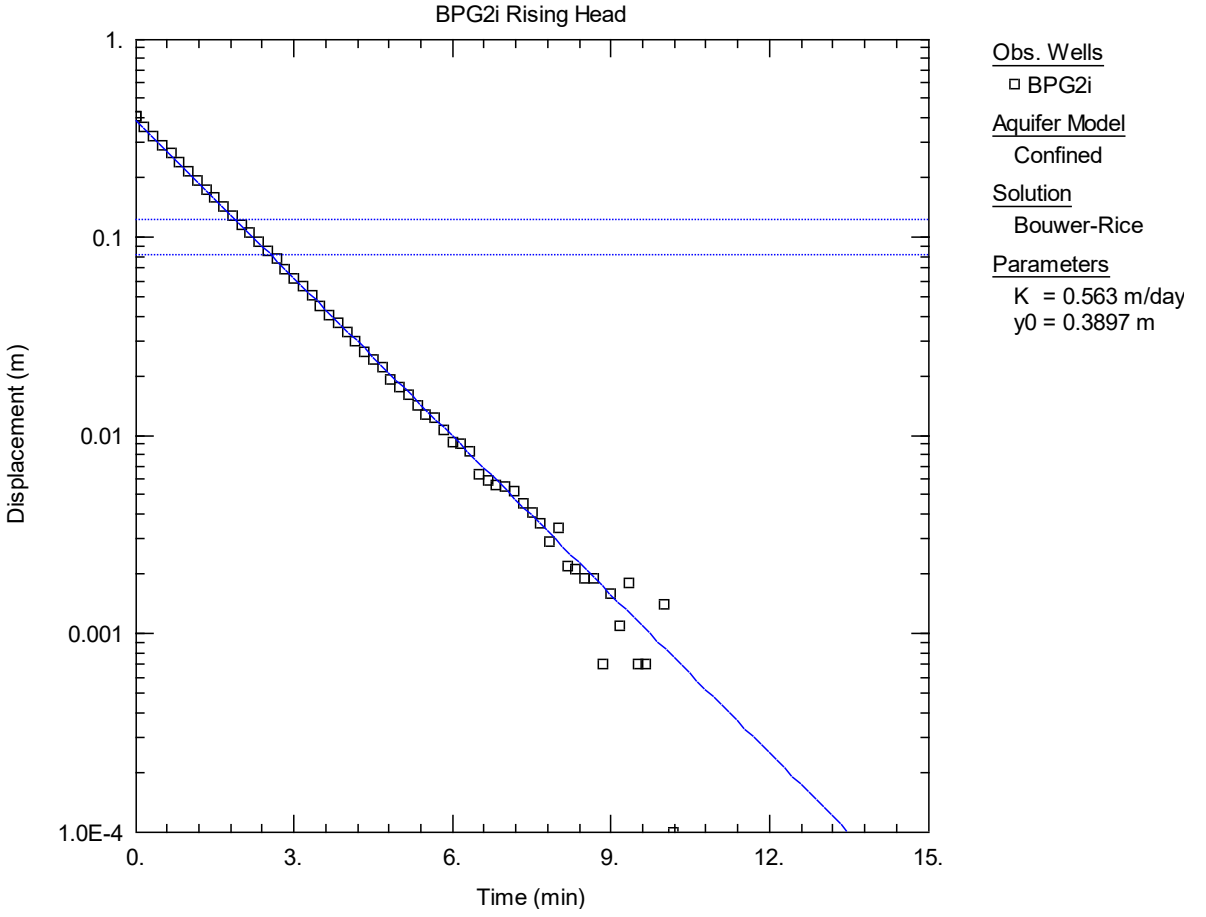


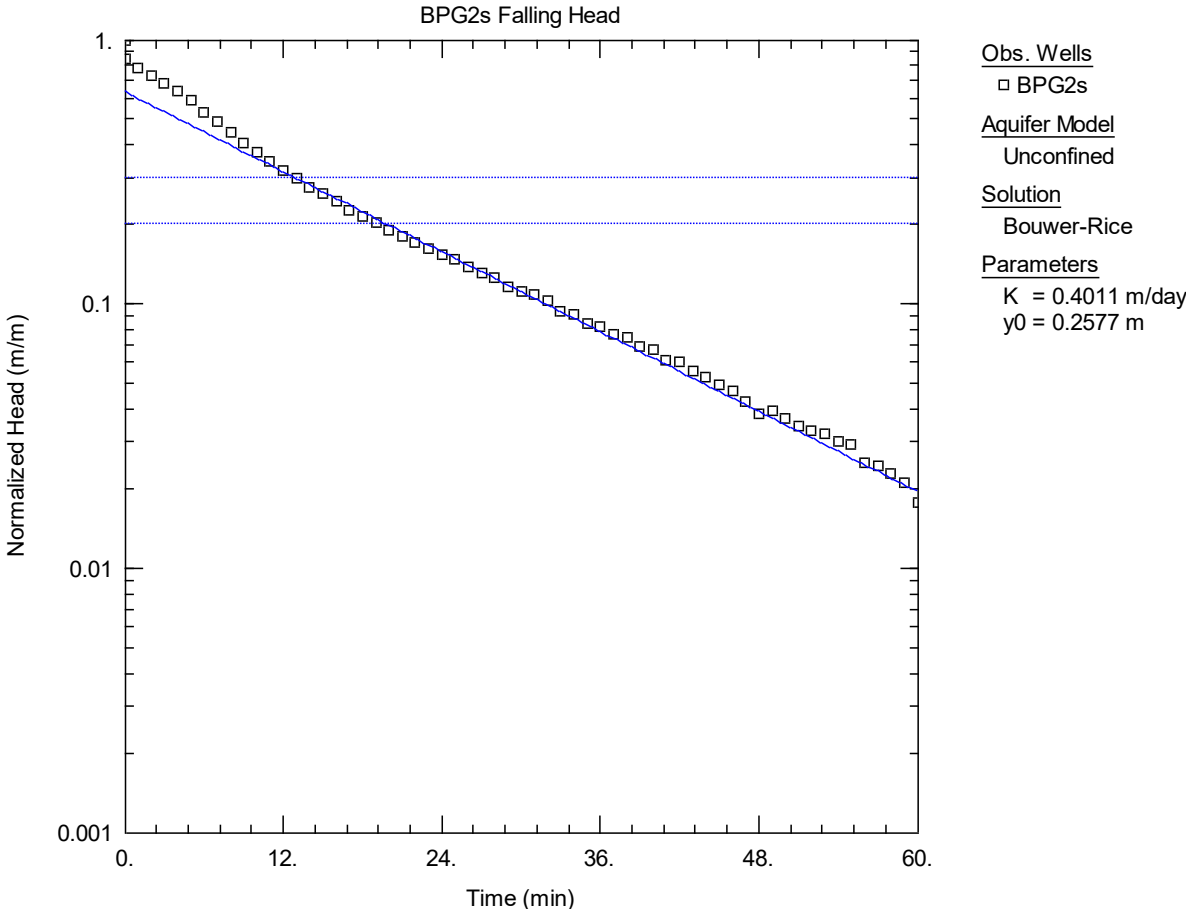
# Appendix B Aquifer Testing Analysis

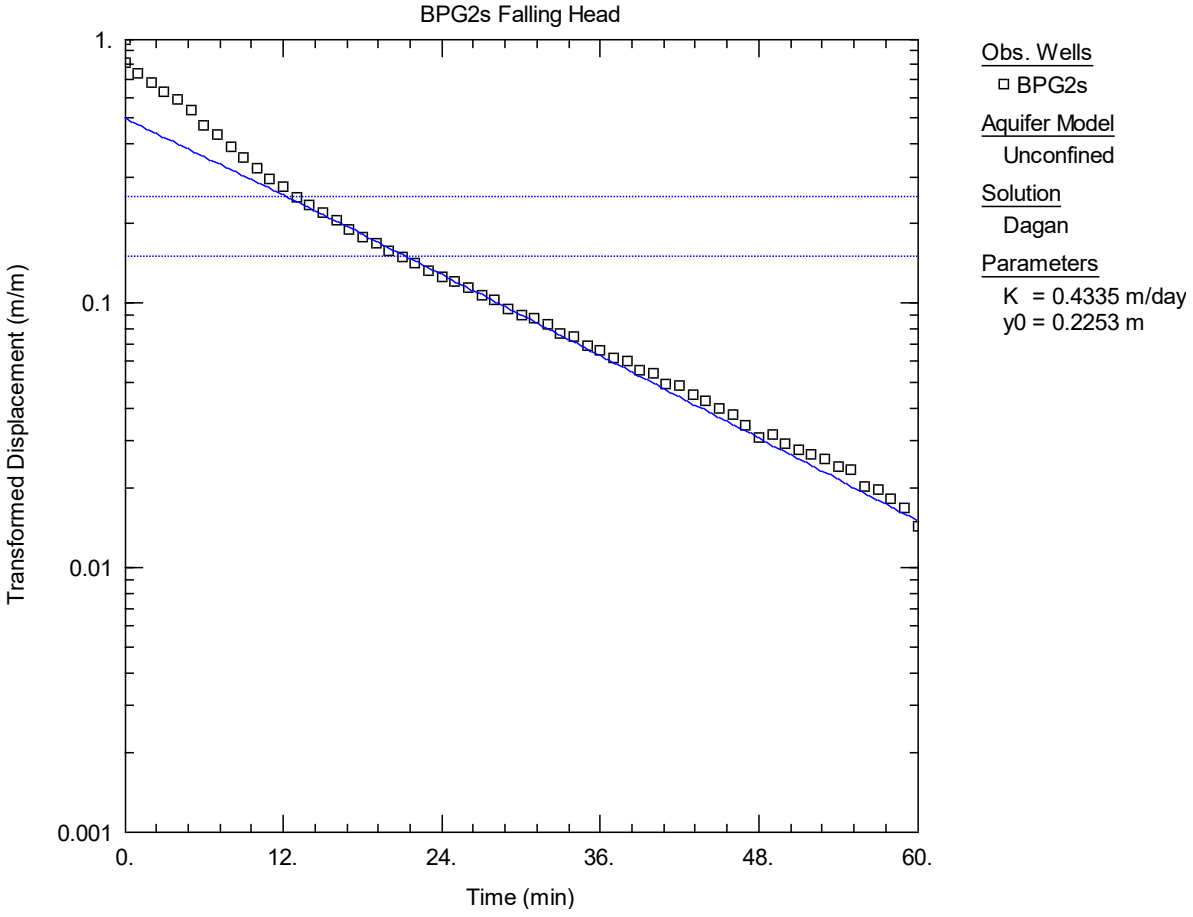


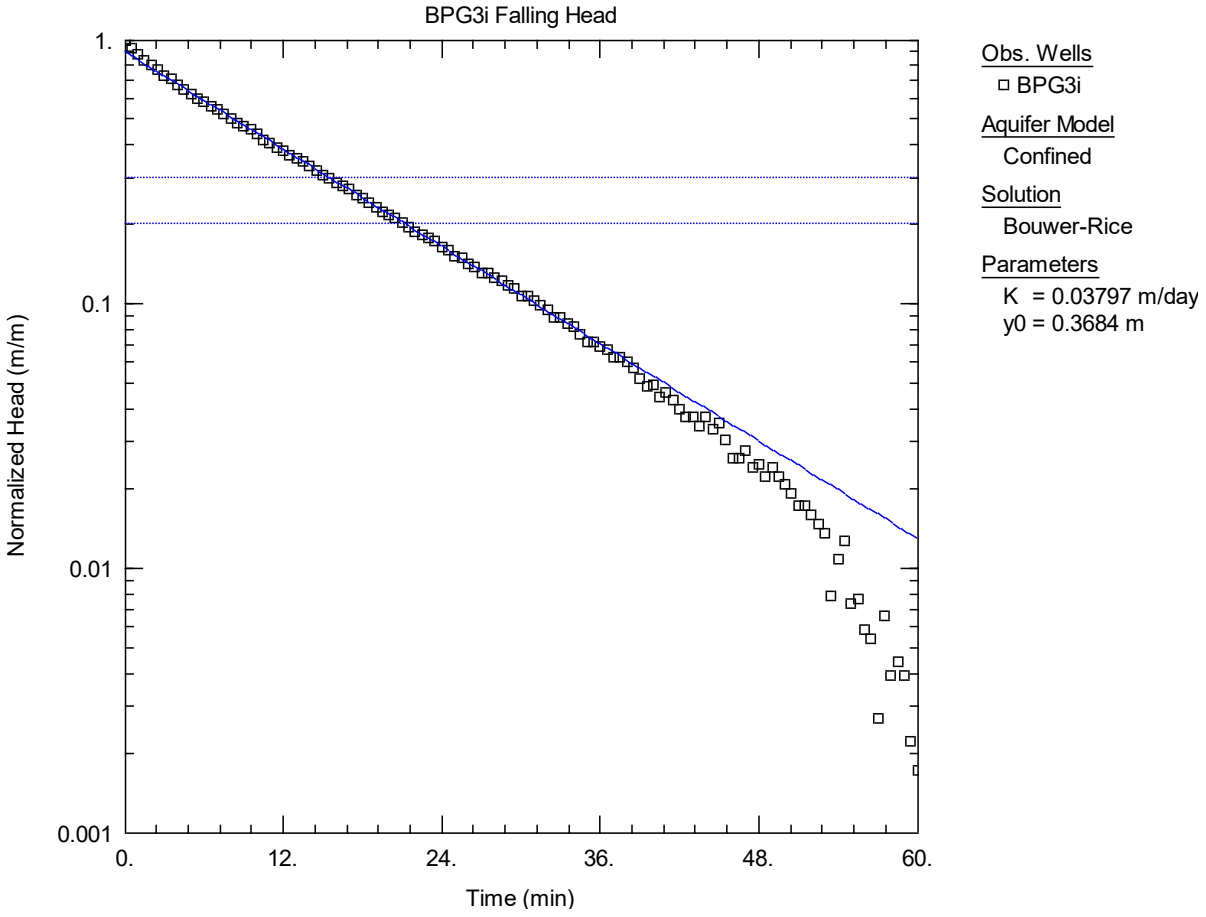



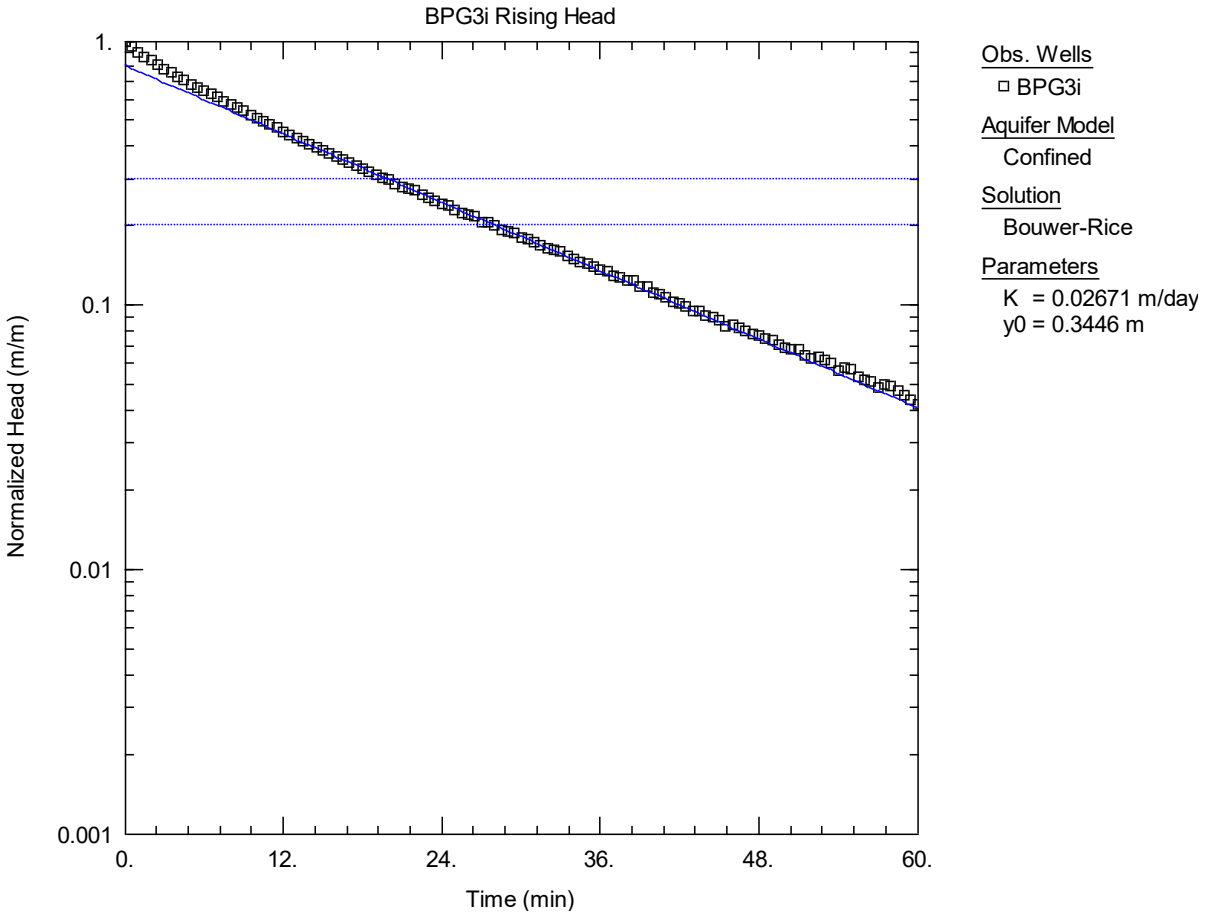

BPG2i Falling Head
Displacement (m)
1.
0.1
0.01
0.001
1.0E-4
0.
2.
4.
6.
8.
10.
Time (min)
Obs. Wells
BPG2i
Aquifer Model
Confined
Solution
Bouwer-Rice
Parameters
K = 0.5804 m/day
y0 = 0.3748 m

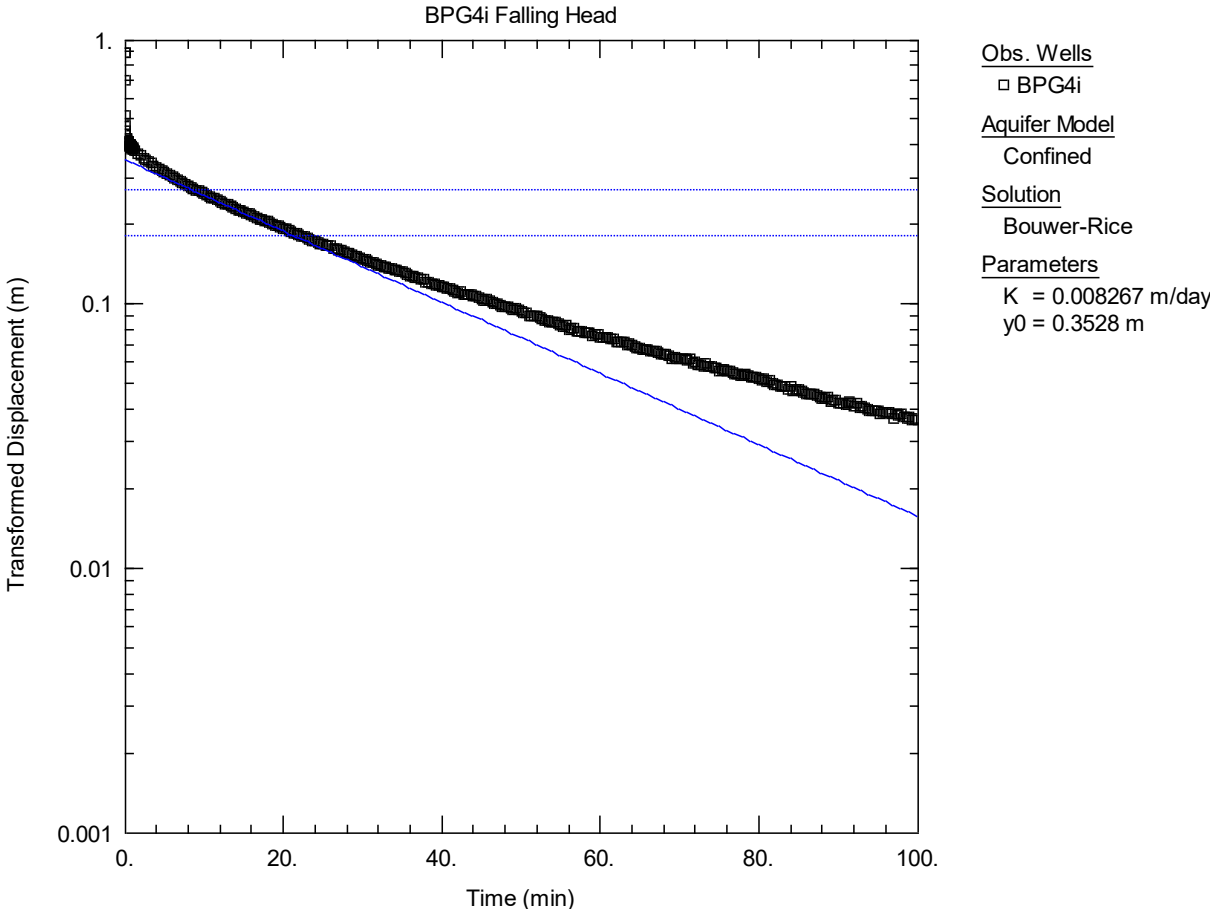

BPG2i Rising Head
Displacement (m)
1.
0.1
0.01
0.001
1.0E-4
0.
3.
6.
9.
12.
15.
Time (min)
Obs. Wells
BPG2i
Aquifer Model
Confined
Solution
Bouwer-Rice
Parameters
K = 0.563 m/day
y0 = 0.3897 m

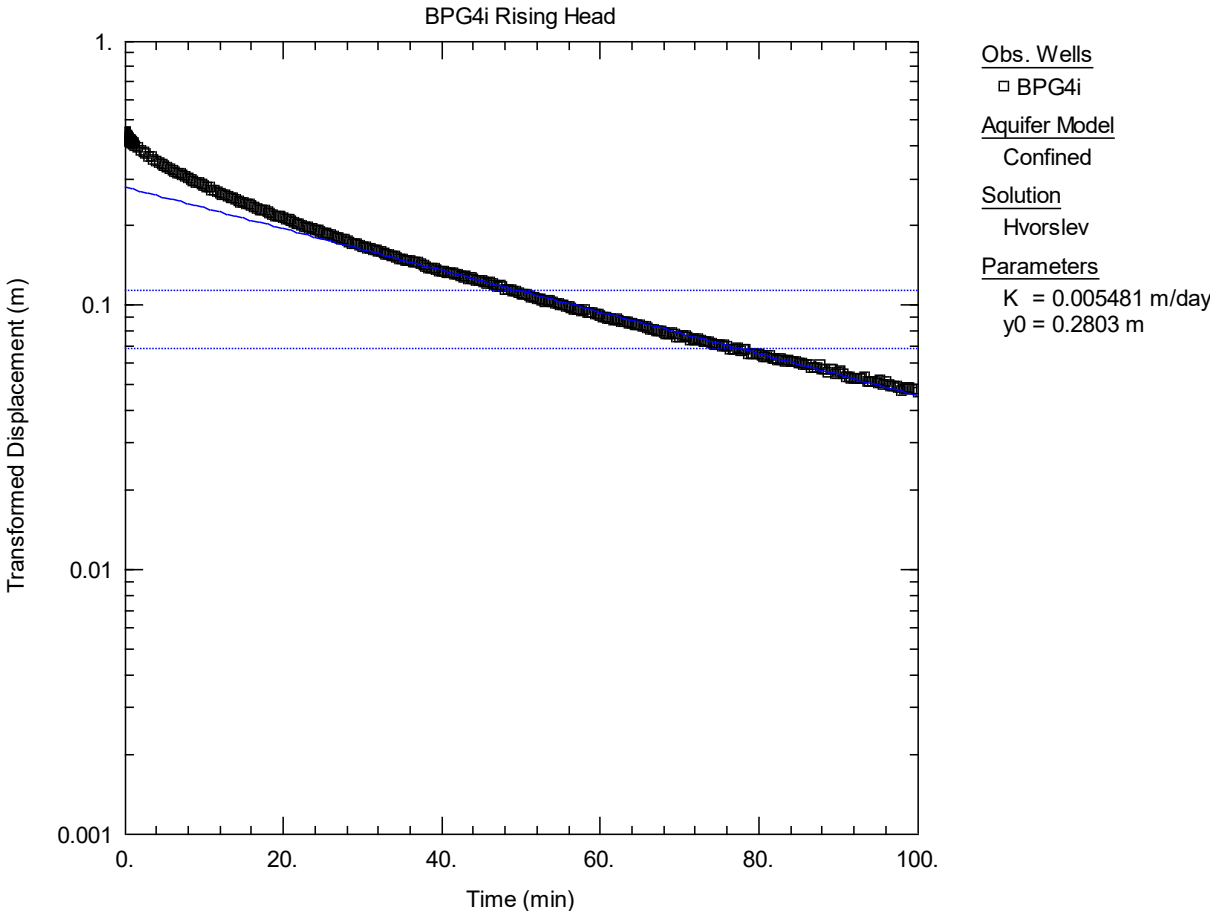

BPG2s Falling Head
Normalized Head (m/m)
1.
0.1
0.01
0.001
0.
12.
24.
36.
48.
60.
Time (min)
Obs. Wells
BPG2s
Aquifer Model
Unconfined
Solution
Bouwer-Rice
Parameters
K = 0.4011 m/day
y0 = 0.2577 m

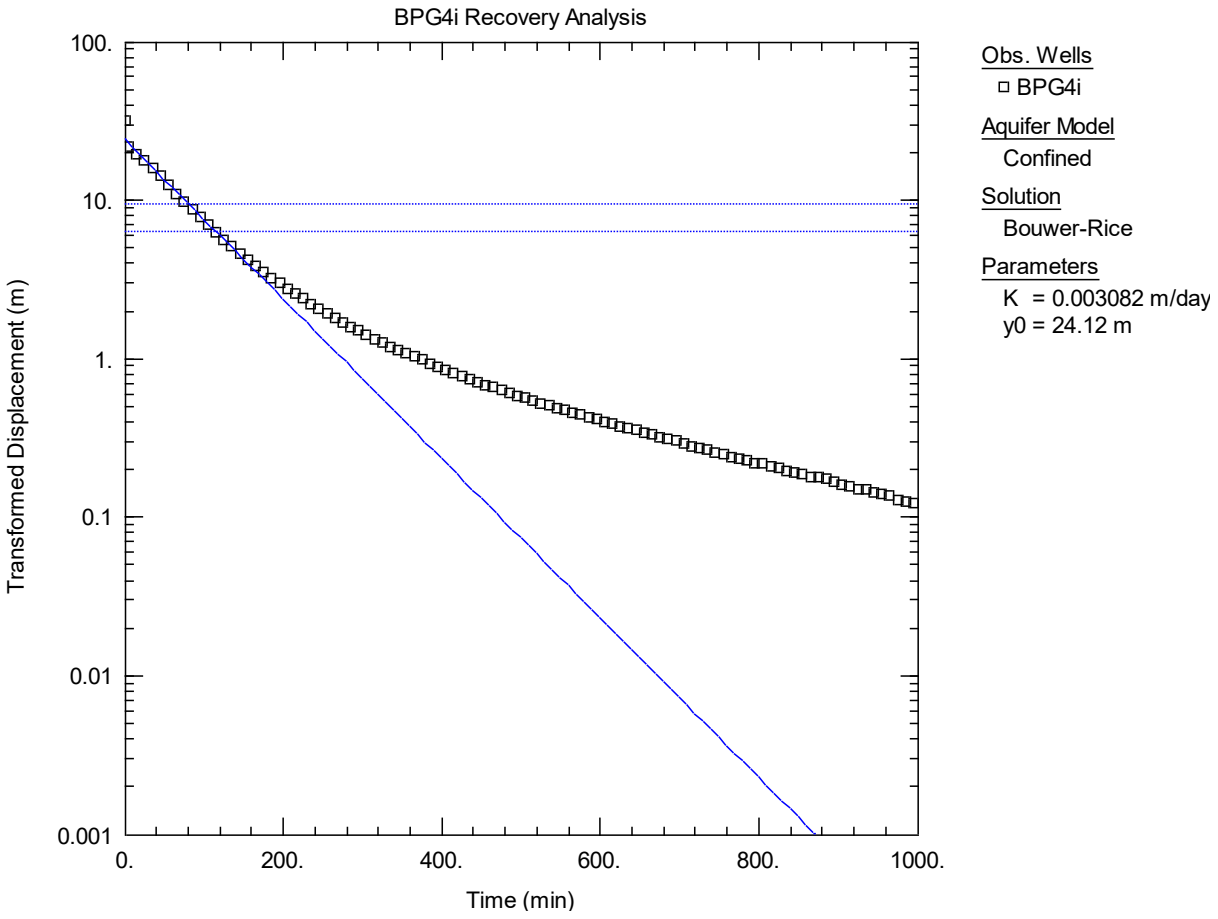

BPG2s Falling Head
Transformed Displacement (m/m)
1.
0.1
0.01
0.001
0.
12.
24.
36.
48.
60.
Time (min)
Obs. Wells
BPG2s
Aquifer Model
Unconfined
Solution
Dagan
Parameters
K = 0.4335 m/day
y0 = 0.2253 m

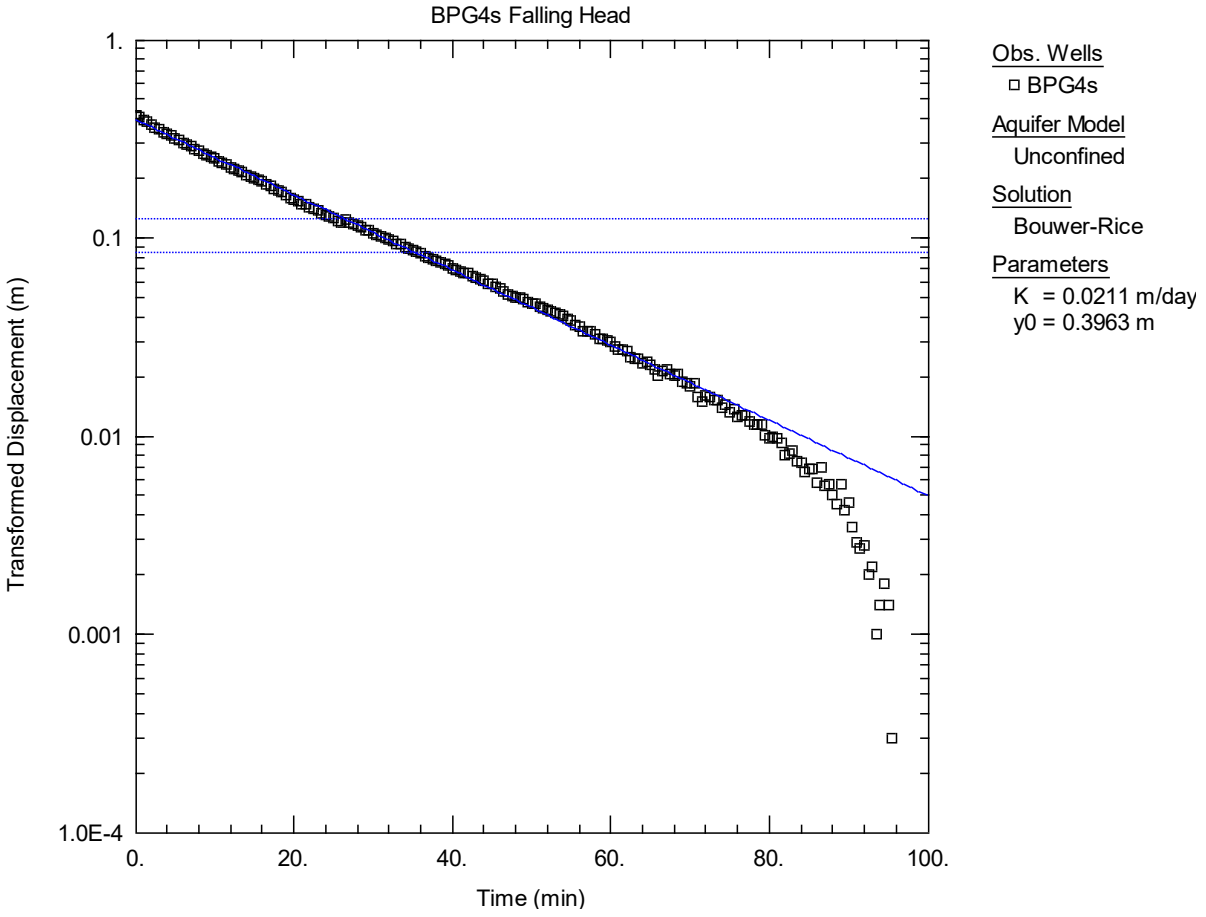

BPG3i Falling Head
Normalized Head (m/m)
1.
0.1
0.01
0.001
0.
12.
24.
36.
48.
60.
Time (min)
Obs. Wells
BPG3i
Aquifer Model
Confined
Solution
Bouwer-Rice
Parameters
K = 0.03797 m/day
y0 = 0.3684 m

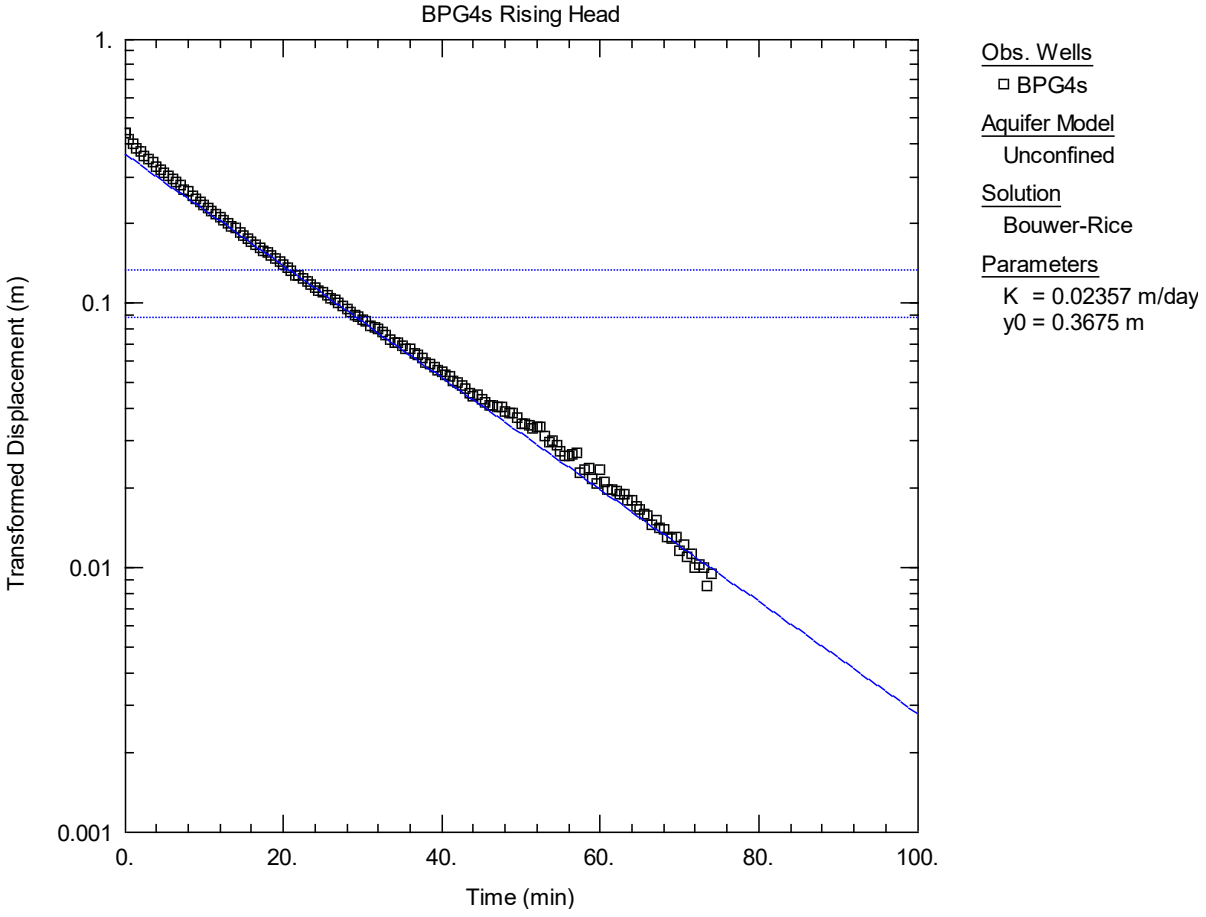

BPG3i Rising Head
Normalized Head (m/m)
1.
0.1
0.01
0.001
0.
12.
24.
36.
48.
60.
Time (min)
Obs. Wells
BPG3i
Aquifer Model
Confined
Solution
Bouwer-Rice
Parameters
K = 0.02671 m/day
y0 = 0.3446 m

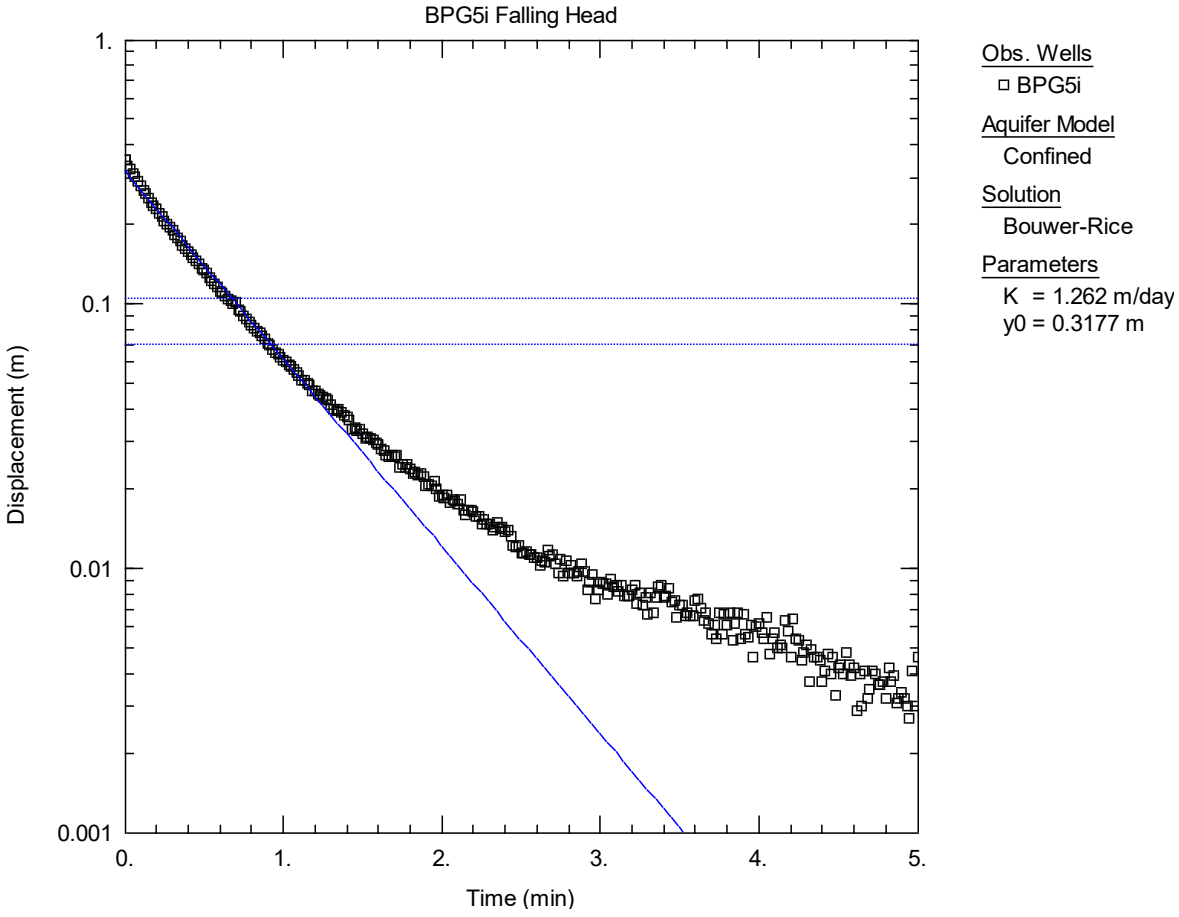

BPG4i Falling Head
Transformed Displacement (m)
1.
0.1
0.01
0.001
0.
20.
40.
60.
80.
100.
Time (min)
Obs. Wells
BPG4i
Aquifer Model
Confined
Solution
Bouwer-Rice
Parameters
K = 0.008267 m/day
y0 = 0.3528 m

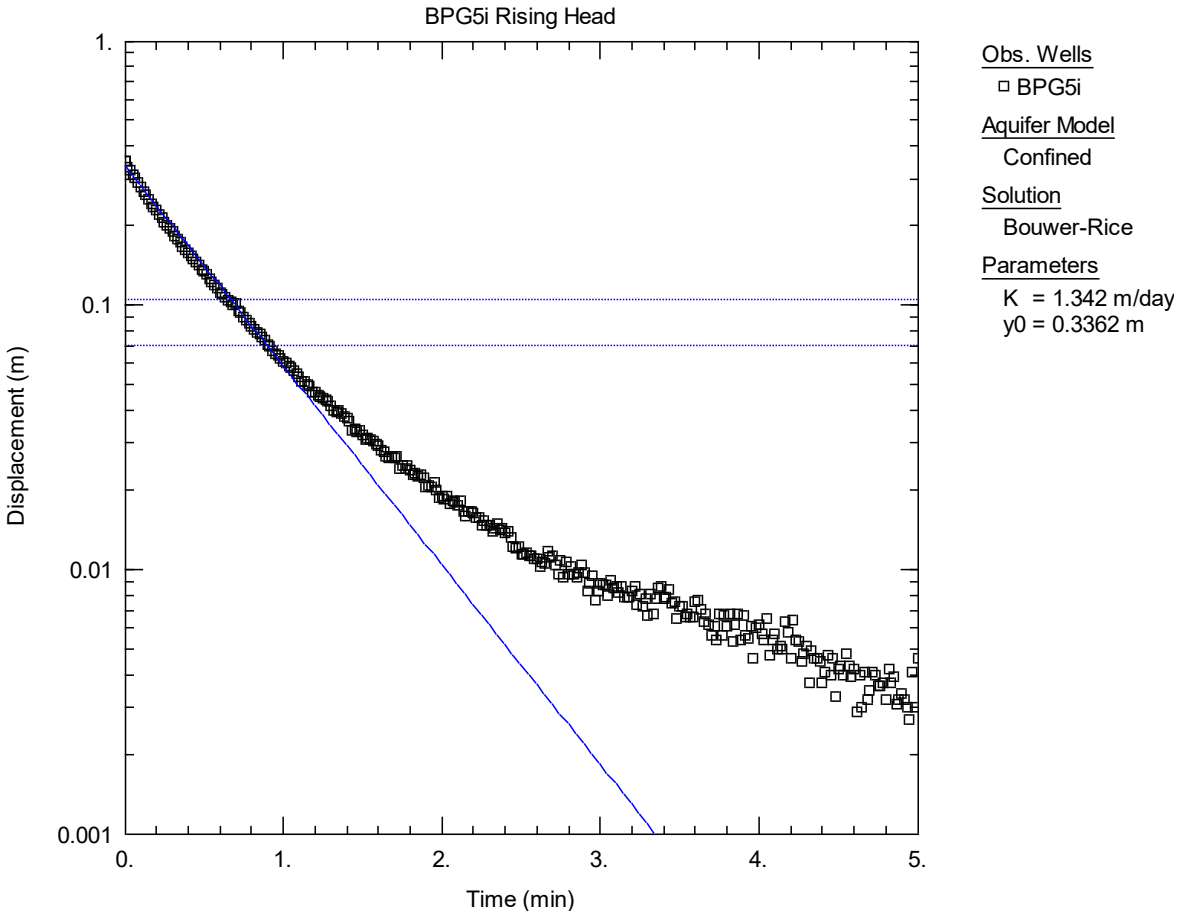

BPG4i Rising Head
Transformed Displacement (m)
1.
0.1
0.01
0.001
0.
20.
40.
60.
80.
100.
Time (min)
Obs. Wells
BPG4i
Aquifer Model
Confined
Solution
Hvorslev
Parameters
K = 0.005481 m/day
y0 = 0.2803 m

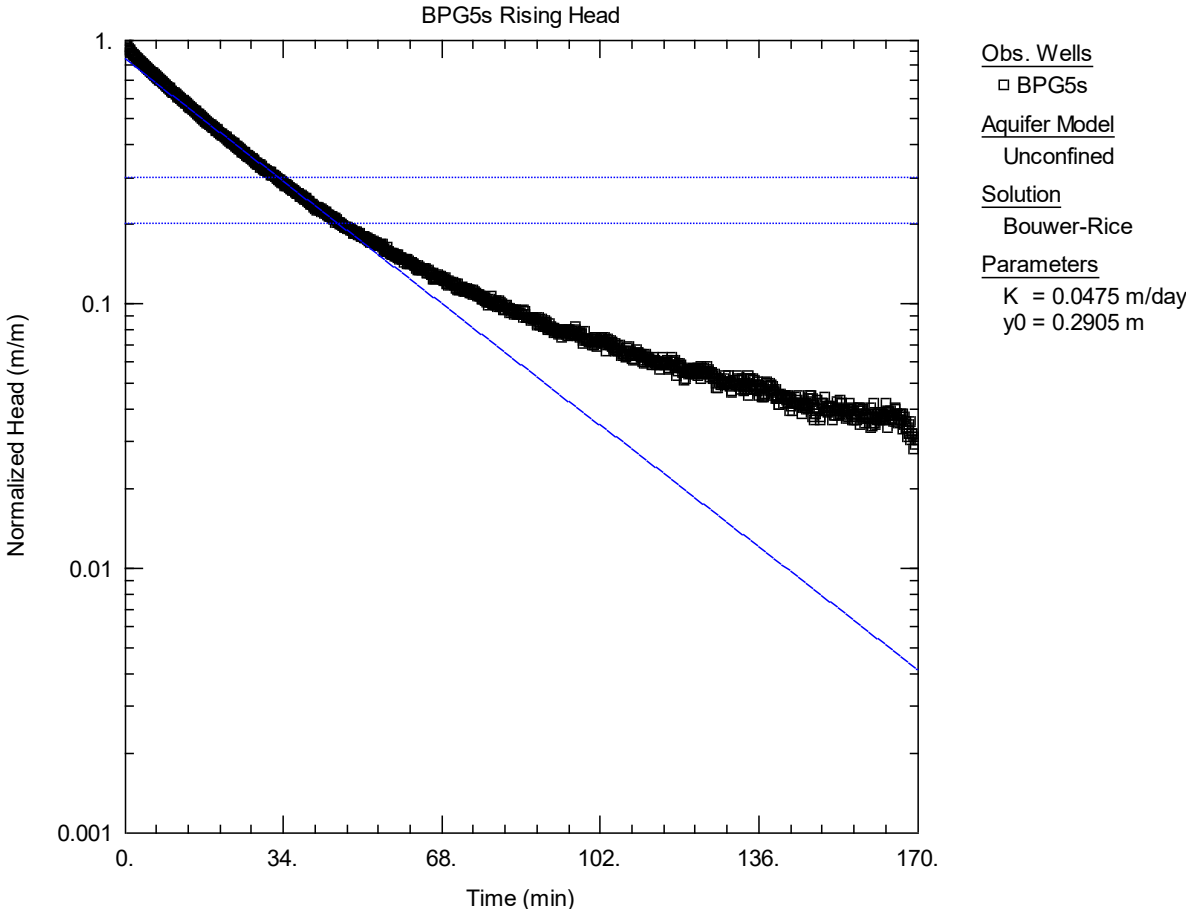

BPG4i Recovery Analysis
100.
10.
1.
0.1
0.01
0.001
Transformed Displacement (m)
0.
200.
400.
600.
800.
1000.
Time (min)
Obs. Wells
BPG4i
Aquifer Model
Confined
Solution
Bouwer-Rice
Parameters
K = 0.003082 m/day
y0 = 24.12 m

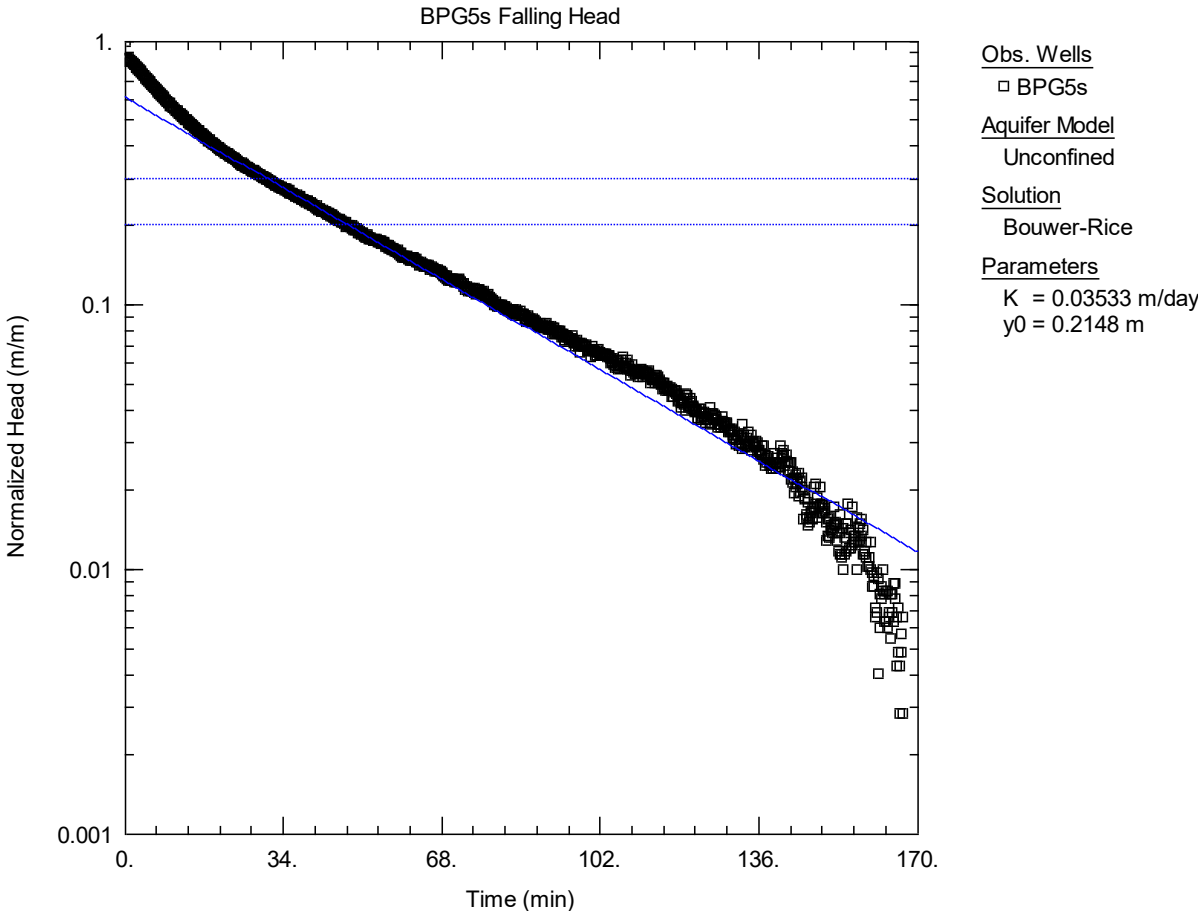

BPG4s Falling Head
Transformed Displacement (m)
1.
0.1
0.01
0.001
1.0E-4
0.
20.
40.
60.
80.
100.
Time (min)
Obs. Wells
BPG4s
Aquifer Model
Unconfined
Solution
Bouwer-Rice
Parameters
K = 0.0211 m/day
y0 = 0.3963 m

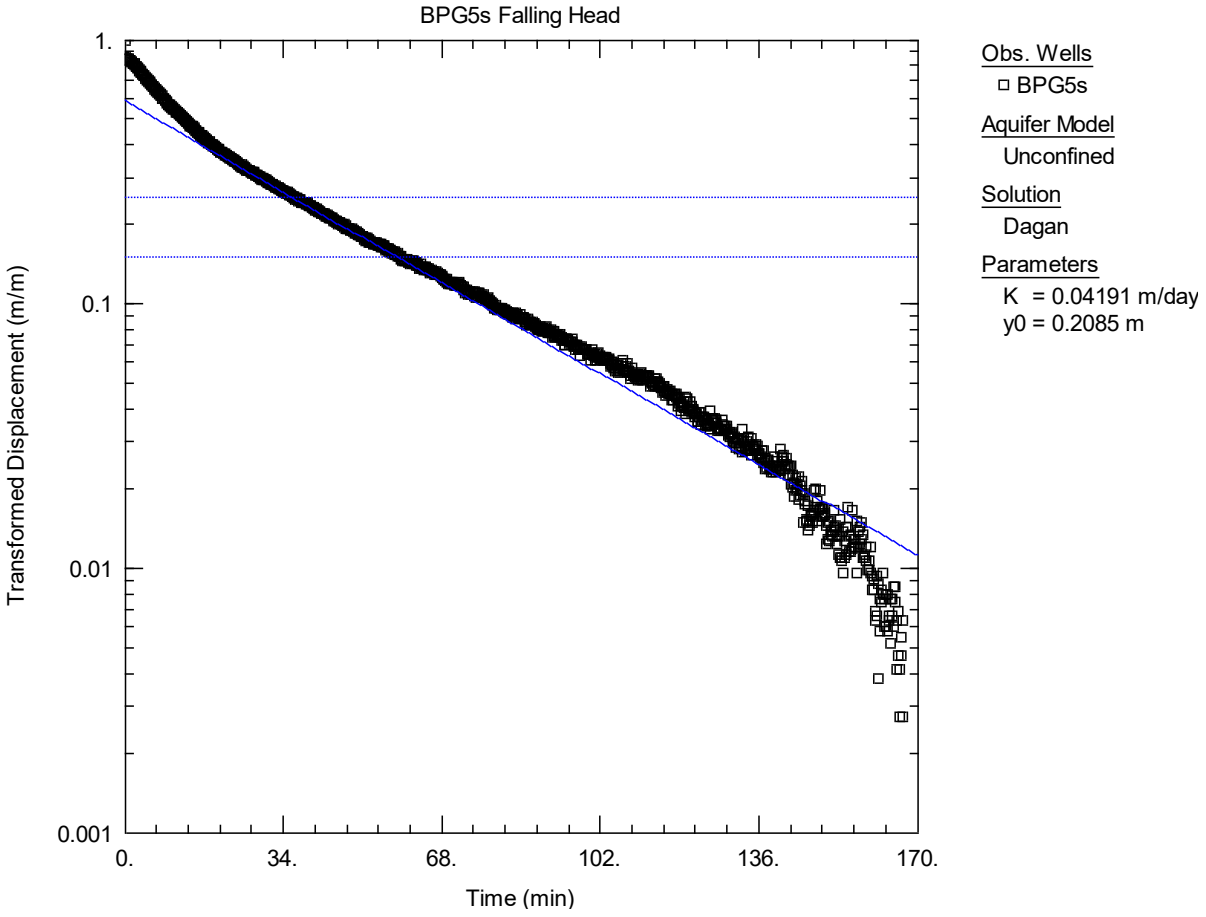

BPG4s Rising Head
Transformed Displacement (m)
1.
0.1
0.01
0.001
0.
20.
40.
60.
80.
100.
Time (min)
Obs. Wells
BPG4s
Aquifer Model
Unconfined
Solution
Bouwer-Rice
Parameters
K = 0.02357 m/day
y0 = 0.3675 m

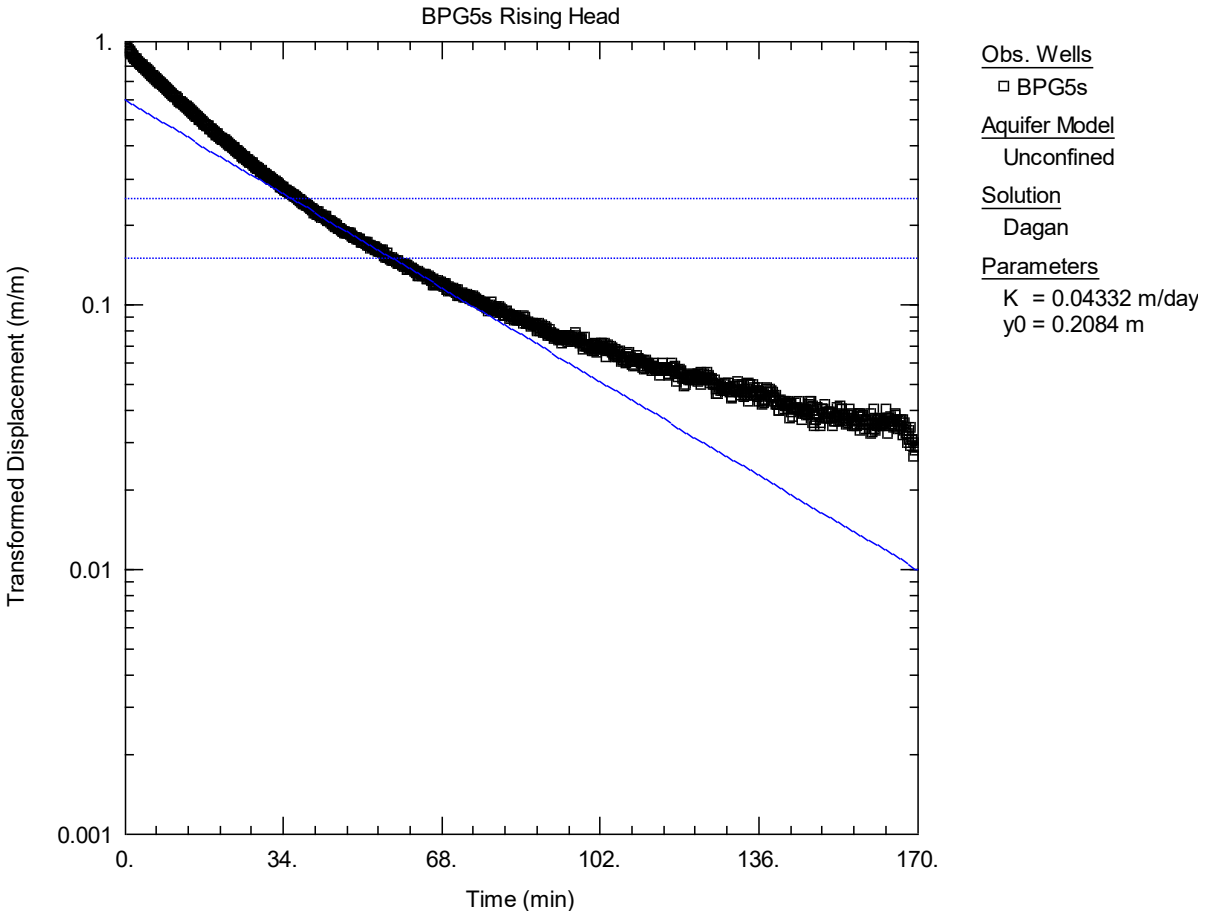

BPG5i Falling Head
Displacement (m)
1.
0.1
0.01
0.001
0.
1.
2.
3.
4.
5.
Time (min)
Obs. Wells
BPG5i
Aquifer Model
Confined
Solution
Bouwer-Rice
Parameters
K = 1.262 m/day
y0 = 0.3177 m

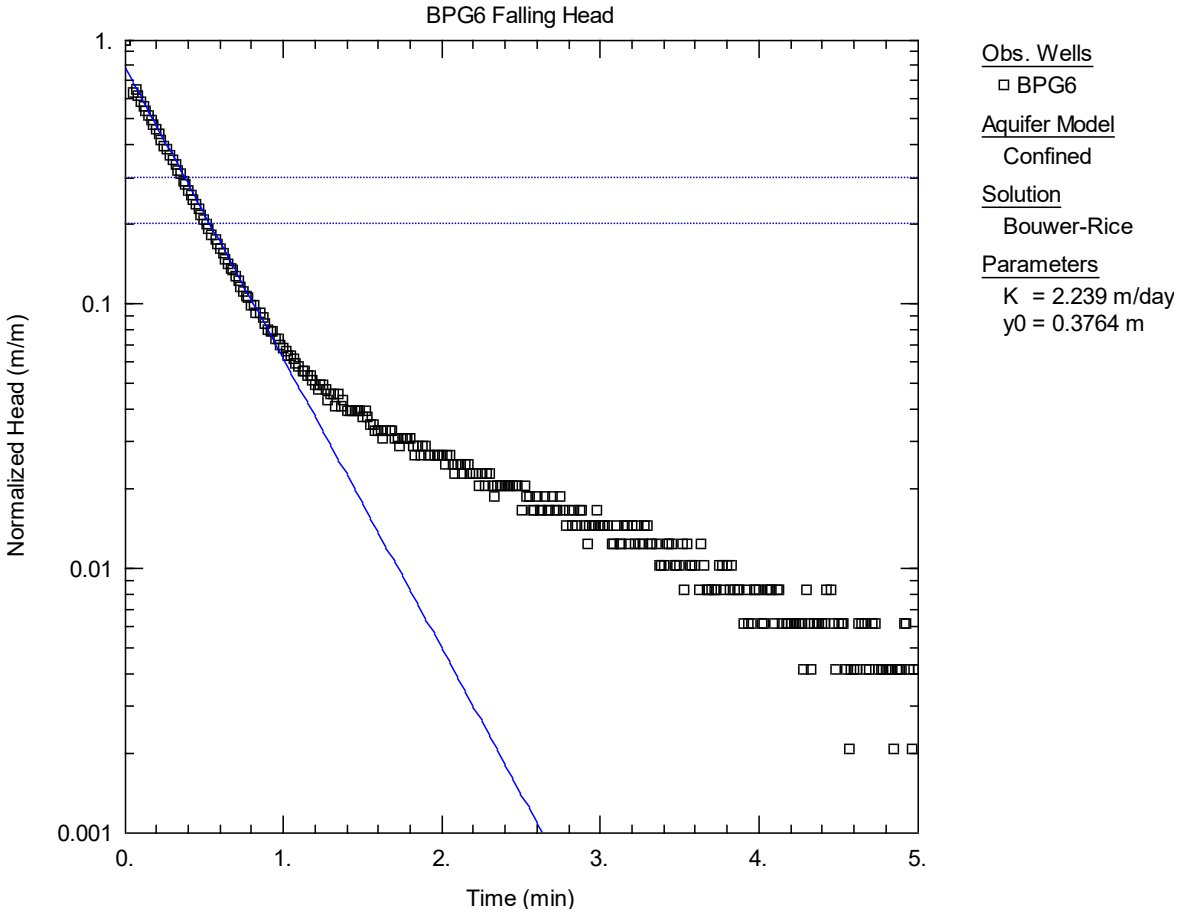

BPG5i Rising Head
Displacement (m)
1.
0.1
0.01
0.001
0.
1.
2.
3.
4.
5.
Time (min)
Obs. Wells
BPG5i
Aquifer Model
Confined
Solution
Bouwer-Rice
Parameters
K = 1.342 m/day
y0 = 0.3362 m

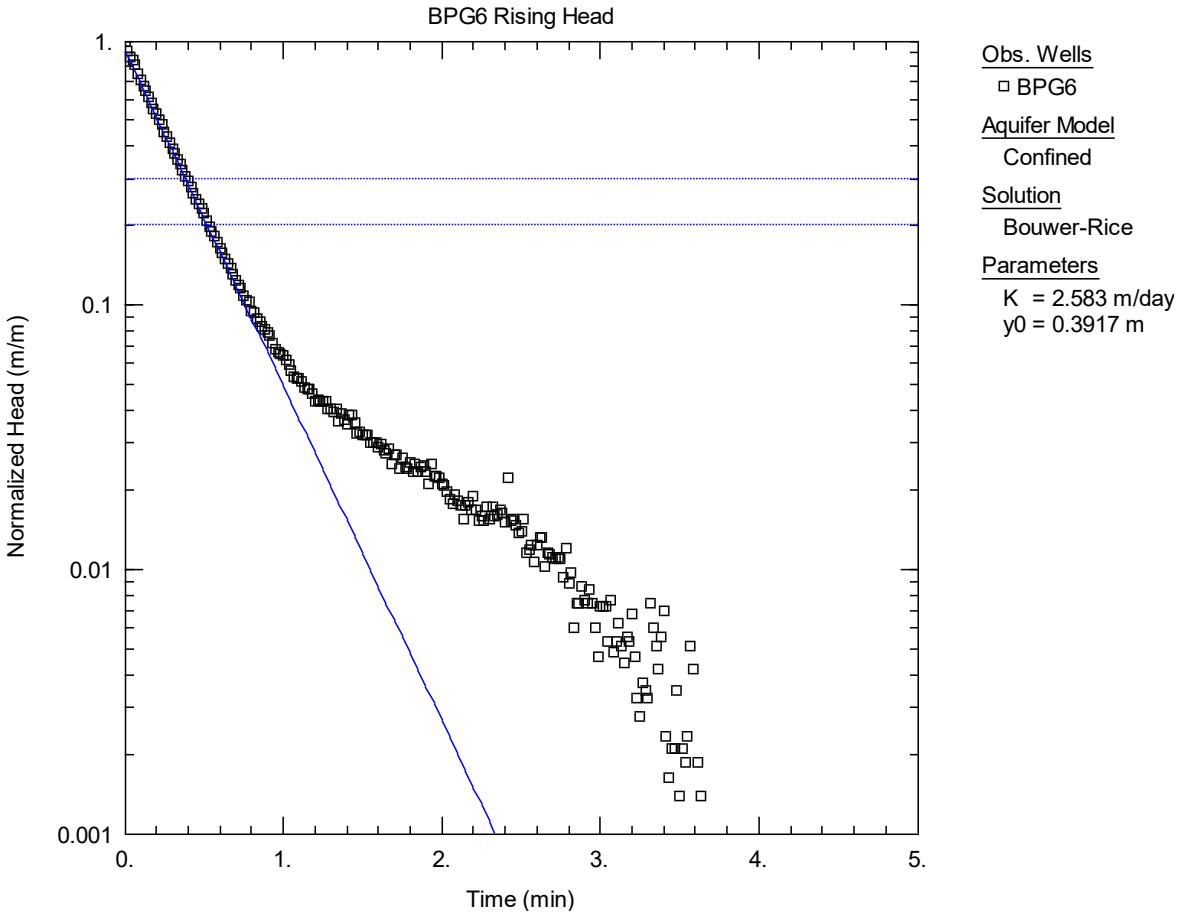

BPG5s Rising Head
Normalized Head (m/m)
1.
0.1
0.01
0.001
0.
34.
68.
102.
136.
170.
Time (min)
Obs. Wells
BPG5s
Aquifer Model
Unconfined
Solution
Bouwer-Rice
Parameters
K = 0.0475 m/day
y0 = 0.2905 m

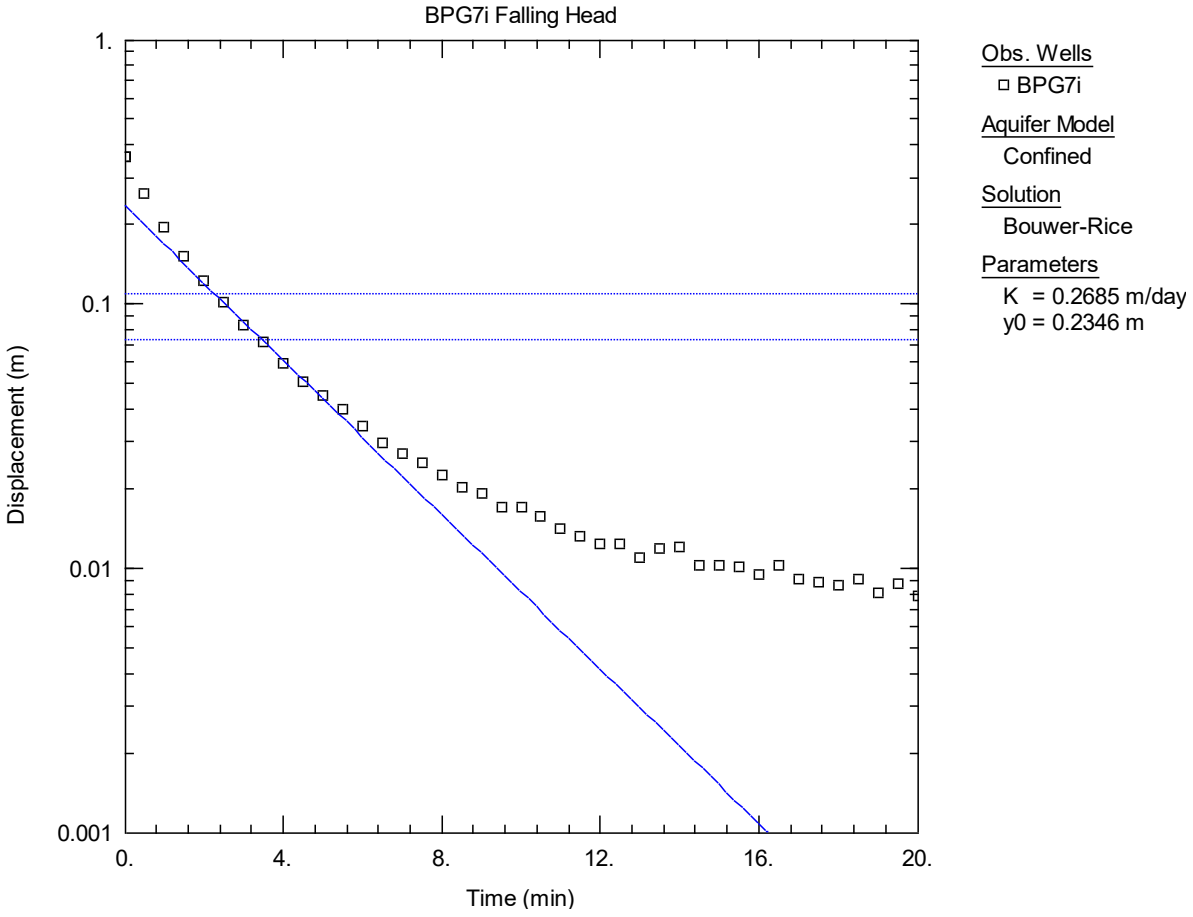

BPG5s Falling Head
Normalized Head (m/m)
1.
0.1
0.01
0.001
0.
34.
68.
102.
136.
170.
Time (min)
Obs. Wells
BPG5s
Aquifer Model
Unconfined
Solution
Bouwer-Rice
Parameters
K = 0.03533 m/day
y0 = 0.2148 m

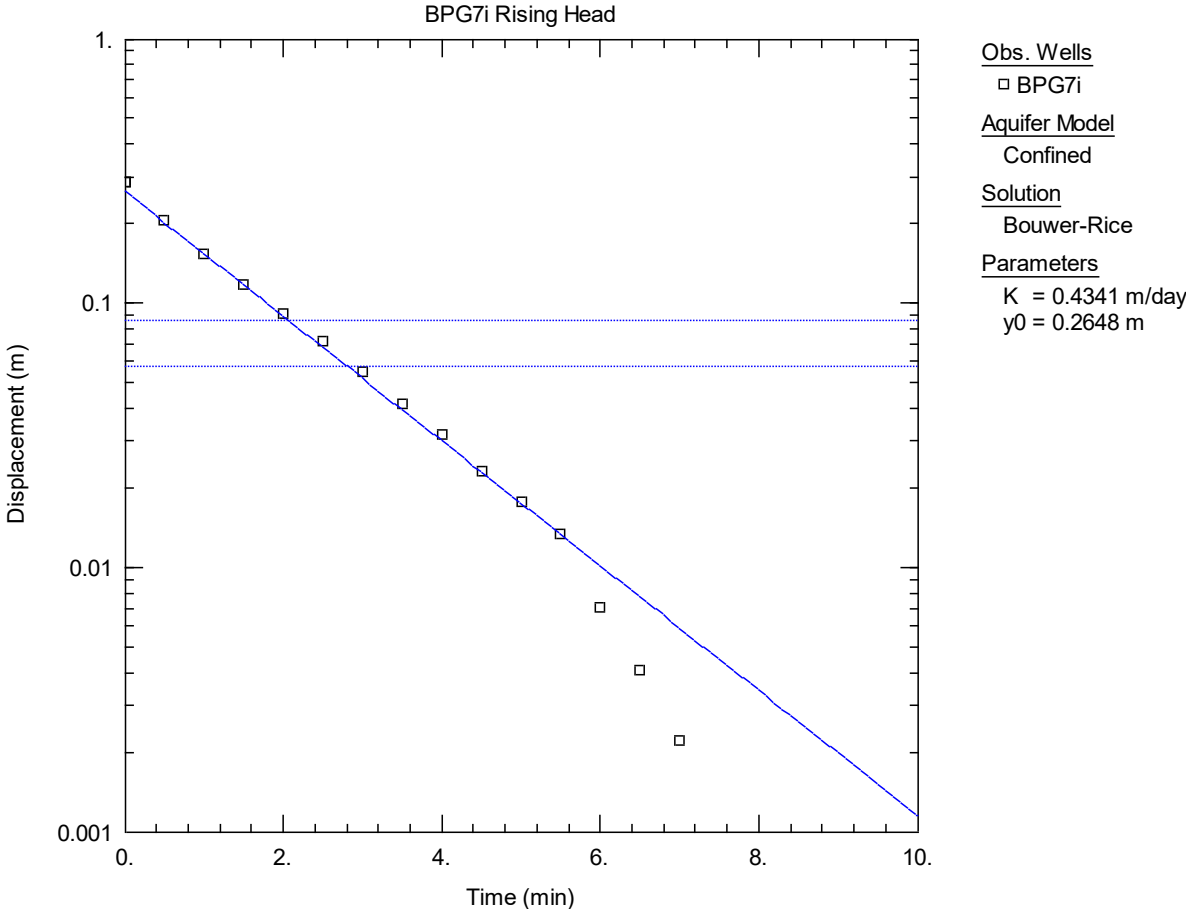

BPG5s Falling Head
Transformed Displacement (m/m)
1.
0.1
0.01
0.001
0.
34.
68.
102.
136.
170.
Time (min)
Obs. Wells
BPG5s
Aquifer Model
Unconfined
Solution
Dagan
Parameters
K = 0.04191 m/day
y0 = 0.2085 m

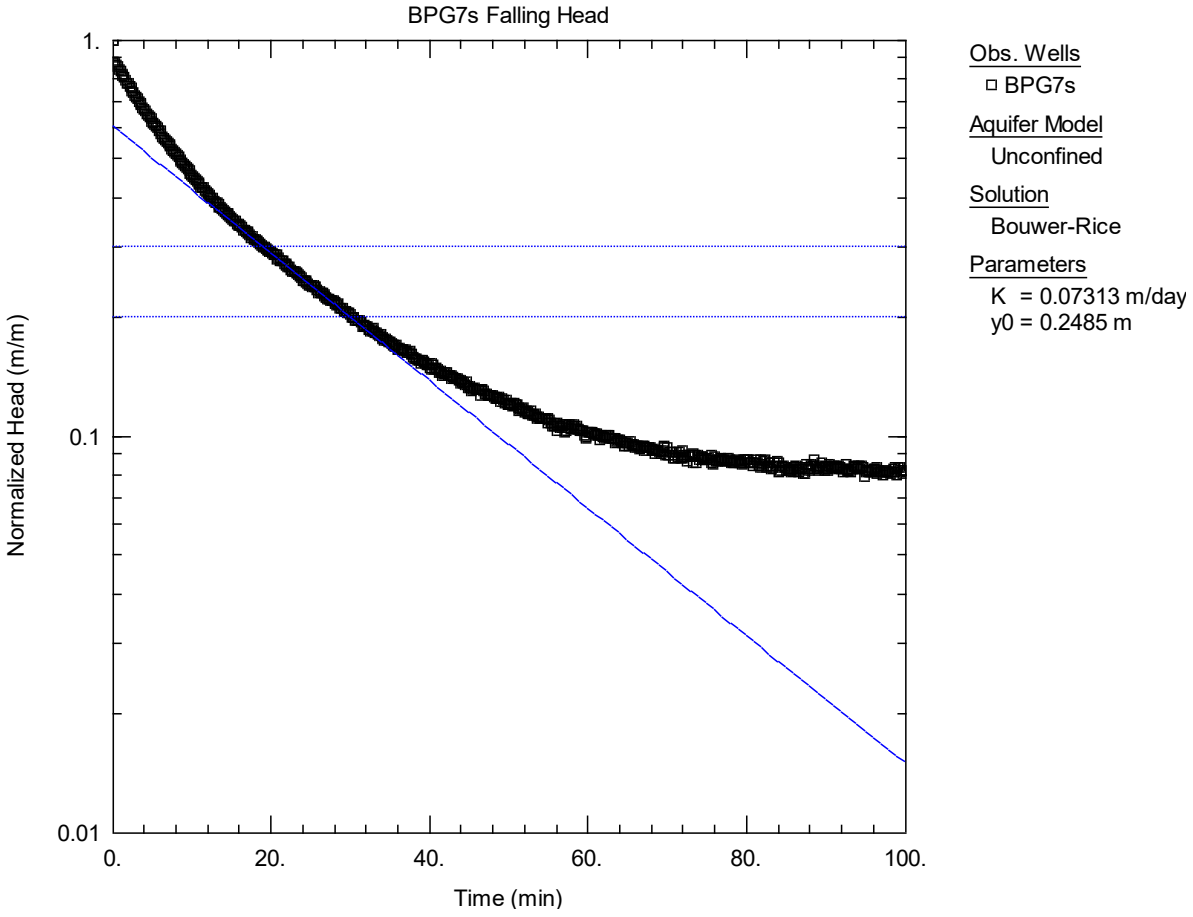

BPG5s Rising Head
Transformed Displacement (m/m)
1.
0.1
0.01
0.001
0.
34.
68.
102.
136.
170.
Time (min)
Obs. Wells
BPG5s
Aquifer Model
Unconfined
Solution
Dagan
Parameters
K = 0.04332 m/day
y0 = 0.2084 m

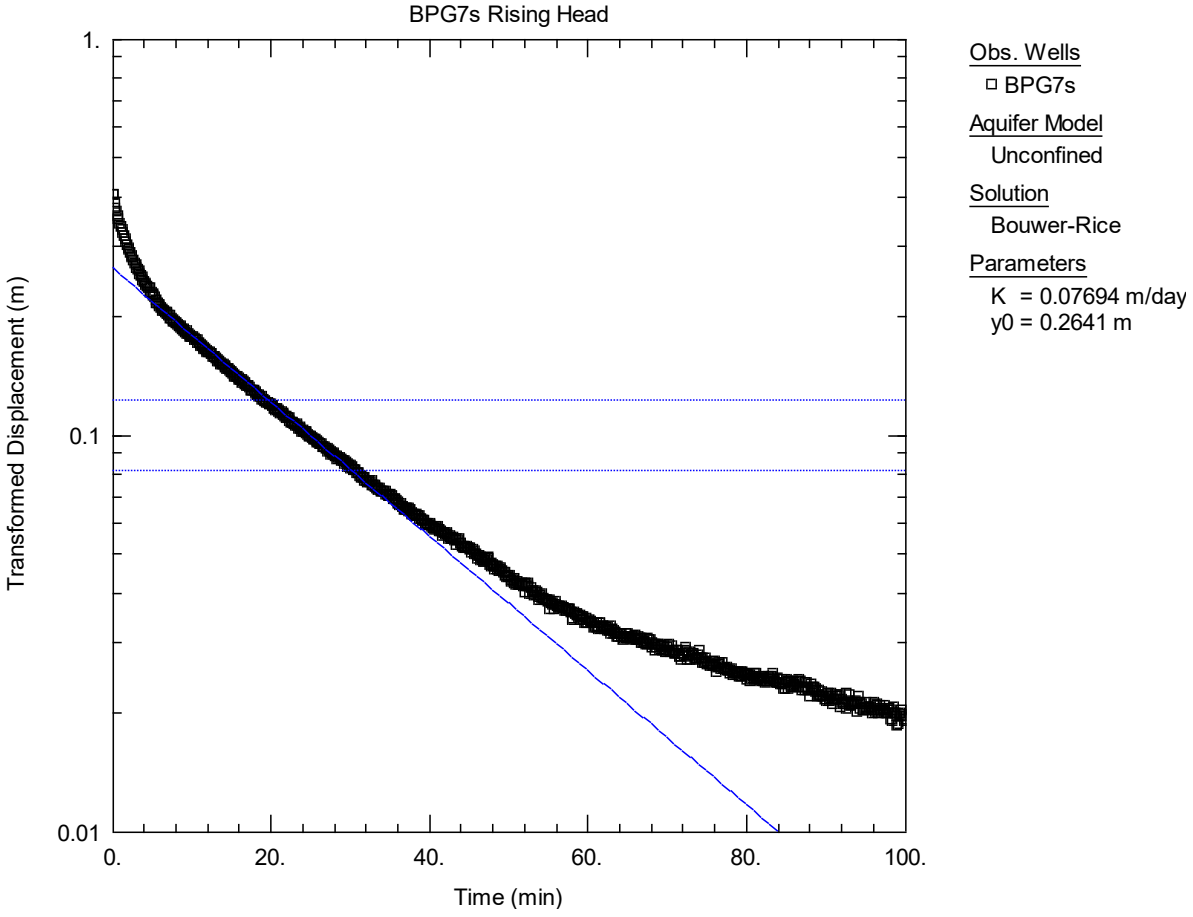

BPG6 Falling Head
Normalized Head (m/m)
1.
0.1
0.01
0.001
0.
1.
2.
3.
4.
5.
Time (min)
Obs. Wells
BPG6
Aquifer Model
Confined
Solution
Bouwer-Rice
Parameters
K = 2.239 m/day
y0 = 0.3764 m

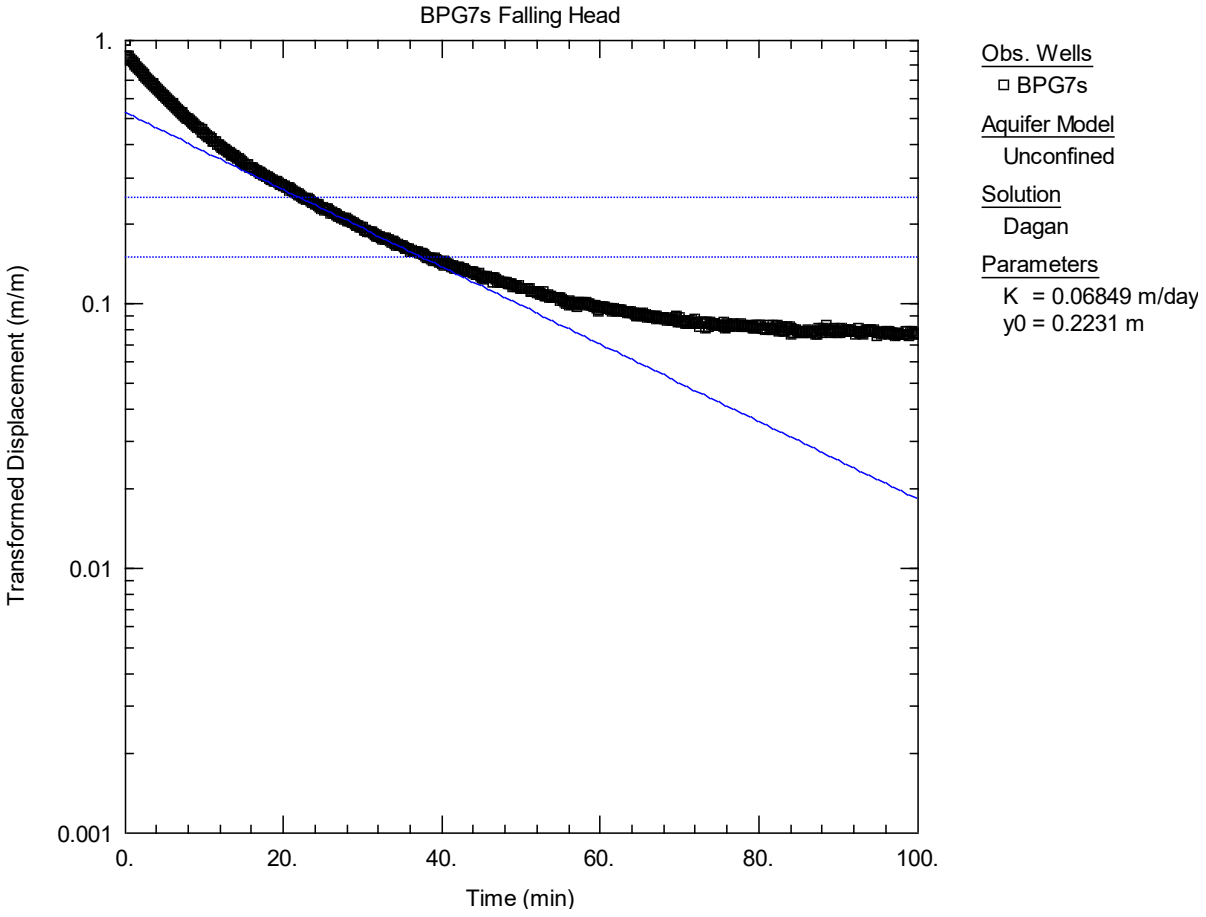

BPG6 Rising Head
Normalized Head (m/m)
1.
0.1
0.01
0.001
0.
1.
2.
3.
4.
5.
Time (min)
Obs. Wells
BPG6
Aquifer Model
Confined
Solution
Bouwer-Rice
Parameters
K = 2.583 m/day
y0 = 0.3917 m

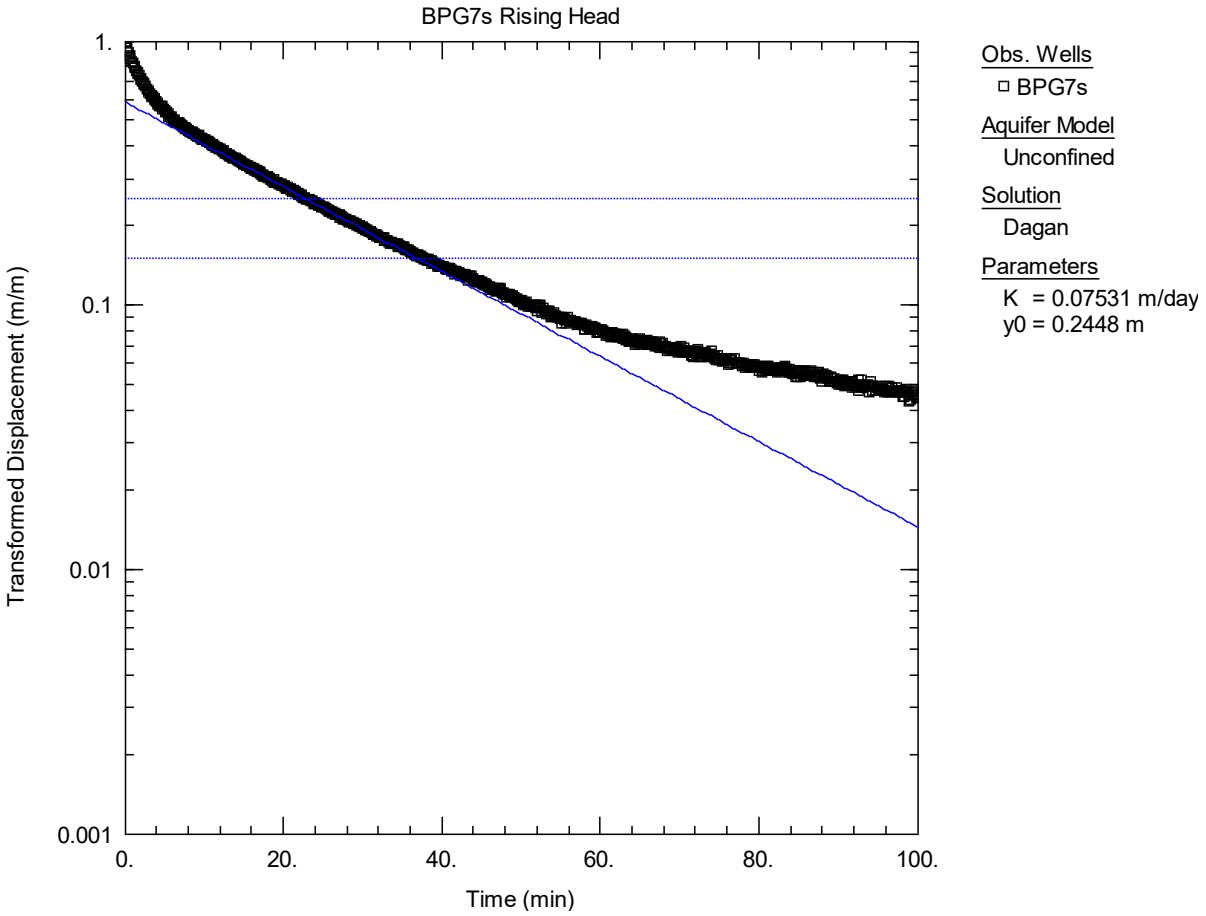

BPG7i Falling Head
Displacement (m)
1.
0.1
0.01
0.001
0.
4.
8.
12.
16.
20.
Time (min)
Obs. Wells
BPG7i
Aquifer Model
Confined
Solution
Bouwer-Rice
Parameters
K = 0.2685 m/day
y0 = 0.2346 m


BPG7i Rising Head
Displacement (m)
1.
0.1
0.01
0.001
0.
2.
4.
6.
8.
10.
Time (min)
Obs. Wells
BPG7i
Aquifer Model
Confined
Solution
Bouwer-Rice
Parameters
K = 0.4341 m/day
y0 = 0.2648 m


BPG7s Falling Head
Normalized Head (m/m)
1.
0.1
0.01
0.
20.
40.
60.
80.
100.
Time (min)
Obs. Wells
BPG7s
Aquifer Model
Unconfined
Solution
Bouwer-Rice
Parameters
K = 0.07313 m/day
y0 = 0.2485 m


BPG7s Rising Head
Transformed Displacement (m)
1.
0.1
0.01
0.
20.
40.
60.
80.
100.
Time (min)
Obs. Wells
BPG7s
Aquifer Model
Unconfined
Solution
Bouwer-Rice
Parameters
K = 0.07694 m/day
y0 = 0.2641 m


BPG7s Falling Head
Transformed Displacement (m/m)
1.
0.1
0.01
0.001
0.
20.
40.
60.
80.
100.
Time (min)
Obs. Wells
BPG7s
Aquifer Model
Unconfined
Solution
Dagan
Parameters
K = 0.06849 m/day
y0 = 0.2231 m


BPG7s Rising Head
Transformed Displacement (m/m)
1.
0.1
0.01
0.001
0.
20.
40.
60.
80.
100.
Time (min)
Obs. Wells
BPG7s
Aquifer Model
Unconfined
Solution
Dagan
Parameters
K = 0.07531 m/day
y0 = 0.2448 m

# Finniss Lithium Project

# BP33 Groundwater Modelling Report

Final Version 3.0

October 2021

PREPARED FOR CORE EXPLORATION LIMITED

BY CLOUDGMS

CLOUDGMS PTY LTD
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# Abbreviations and acronyms

| | |
|---|---|
| DENR | Department of Environment and Natural Resources |
| EoM | end of mining |
| GDE | groundwater dependant ecosystem |
| GIS | geographical information system |
| GL | gigalitre ($10^9$ litres) |
| GLP | Grants Lithium Project |
| kL | kilolitre ($10^3$ litres) |
| km | kilometre |
| $km^2$ | square kilometre |
| L/s | litres per second |
| LoM | life of mine |
| $m^2/d$ | metres squared per day |
| m^2/d | metres squared per day |
| $m^3$ | cubic metre |
| $m^3/d$ | cubic metres per day |
| $m^3/s$ | cubic metres per second |
| ML | megalitre ($10^6$ litres) |
| ML/a | megalitre per year |
| mAHD | metres above Australian Height Datum |
| mBGL | metres Below Ground Level |
| mm | millimetre |
| mm/d | millimetre per day |
| pF | log scale for representing soil matric potential |
| RMS | root mean square |
| SRMS | scaled root mean square |
| SRTM | Shuttle Radar Topographic Mission |
| T | Transmissivity (metres squared per day) |
| WRD | waste rock dump |

# 1 Introduction

## 1.1. Background

Core Lithium Limited (Core) is proposing to expand its planned Finniss Lithium Project mining activities on the Cox Peninsula, 33 km west of Berry Springs. Core currently holds mining authorisation for an open pit mine and processing of the Grants resource on Mineral Lease (ML) 31726; referred to as Grants Lithium Project (GLP). Core is also proposing to develop an underground mine at the BP33 resource, located approximately 4.5 km south-east of the Grants pit. The BP33 project will involve the underground mining of ore and trucking to the Grants processing plant via a 7.5 km purpose-built haul road.

The action was referred to the NT Environment Protection Authority (NT EPA) for consideration under section 48 of the Environment Protection Act. In October, 2020, the NT EPA determined that the BP33 project should be assessed by the Supplementary Environmental Report (SER) process. The NT EPA direction outlined additional information requirements for the SER, including further detail on groundwater processes and impacts.

This report documents the development of conceptual and numerical groundwater models for the BP33 site and the use of these models to assess potential groundwater impacts. It also provides guidance on specific impacts, information and processes required under the SER direction.

## 1.2. Model Objectives

The objective of the BP33 groundwater model is to identify potential impacts to the groundwater system and associated environmental receptors resulting from the development of the proposed underground mine at BP33. The model also aims to assess any cumulative impacts resulting from the proposed open pit mine at the Grants deposit.

## 1.3. Modelling study scope of works and modelling process

The modelling study follows a staged approach in accordance with the 2012 Australian Groundwater Modelling Guidelines (Barnett, et al., 2012). A flow diagram of the modelling process is presented in Figure 1 1. The scope of the groundwater modelling study includes the following major components:

- Collation of available data for the BP33 and Grants site;
- Data review and conceptualisation of the groundwater system;
- Groundwater model design and configuration;
- Transient model development and calibration;
- Predictive scenario modelling to assess the potential for mining impacts;
- Predictive uncertainty analysis.

Mining activities at the GLP have been included in the modelling and calibration process in order to assess the cumulative impact from mining at the GLP and BP33. For detailed discussion of the proposed mining activities, site conceptualisation and model results for the GLP refer to CloudGMS (2018).

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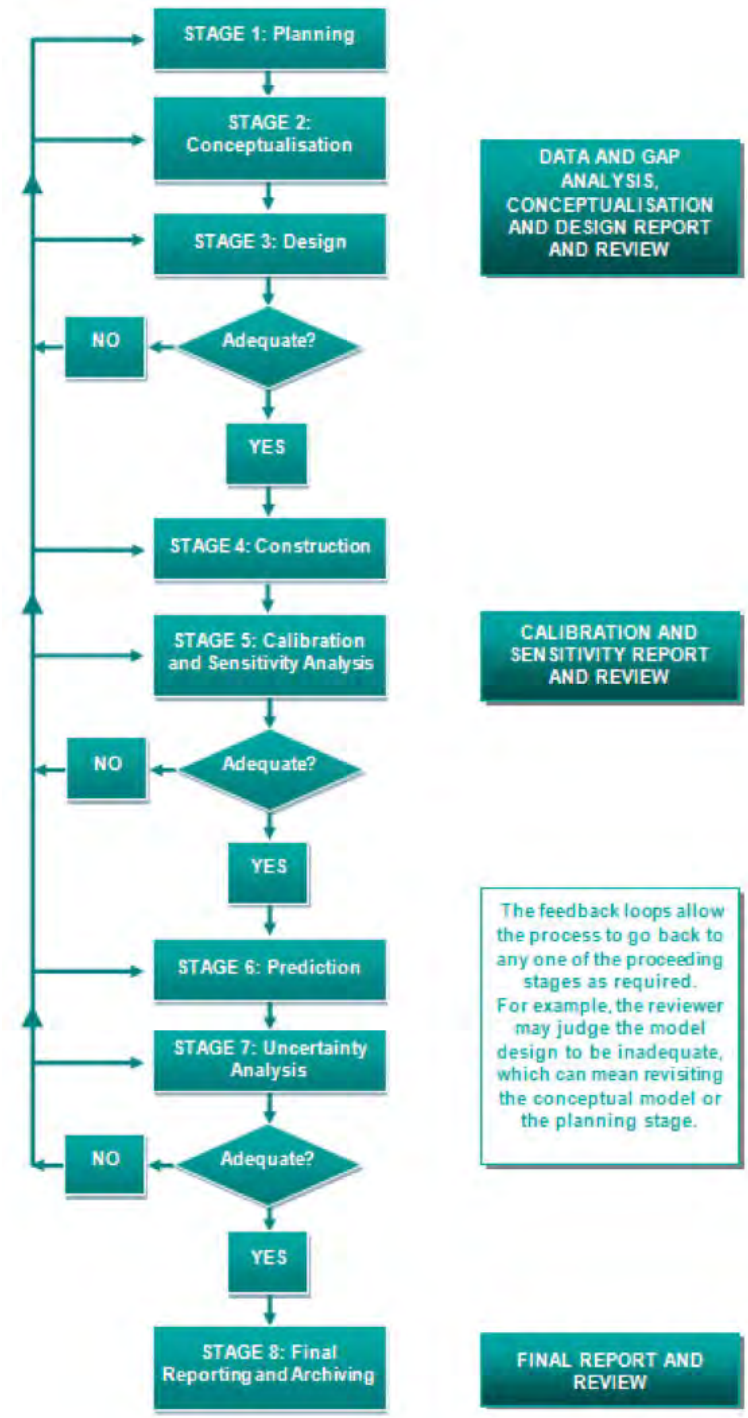


Figure 1 1 Groundwater modelling process after Barnett et al, (2012)

## 1.4. Model classification

Under the latest national best practice guidelines (Barnett, et al., 2012), the groundwater model presented is considered to be Class 2 with components that are Class 1 and Class 3. A Class 2 model is suitable for "providing estimates of dewatering requirements for mines and excavations and the associated impacts" (Barnett, et al., 2012). Table 1-1 identifies the classification criteria met by the current model.

Table 1-1 Model classification criteria (after Barnett, 2012)

| | Data | Calibration | Prediction | Key indicator | Example of use |
|---|---|---|---|---|---|
| Class 3 | Spatial and temporal distribution of groundwater head observations adequately define groundwater behaviour, especially in areas of greatest interest and where outcomes are to be reported. | Scaled RMS error or other calibration statistics are acceptable. | Length of predictive model is not excessive compared to length of calibration period. | Key calibration statistics are acceptable and meet agreed targets. | Suitable for predicting groundwater responses to arbitrary changes in applied stress or hydrological conditions anywhere within the model domain. |
| | Spatial distribution of bore logs and associated stratigraphic interpretations clearly define aquifer geometry. | Long-term trends are adequately replicated where these are important. | Temporal discretisation used in the predictive model is consistent with the transient calibration. | Model predictive time frame is less than 3 times the duration of transient calibration. | Provide information for sustainable yield assessments for high-value regional aquifer systems. |
| | Reliable metered groundwater extraction data is available. | Seasonal fluctuations are adequately replicated where these are important. | Level and type of stresses included in the predictive model are within the range of those used in the transient calibration. | Stresses are not more than 2 times greater than those included in calibration. | Evaluation and management of potentially high-risk impacts. |
| | Rainfall and evaporation data is available. | Transient calibration is current, i.e. uses recent data. | | Temporal discretisation in predictive model is the same as that used in calibration. | Can be used to design water-allocation plans. |
| | Aquifer-testing data to define key parameters. | Model is calibrated to heads and fluxes. | | Mass balance closure error is less than 0.5% of total. | Simulating the interaction between groundwater and surface water bodies to a level of reliability required for dynamic linkage to surface water models. |
| | Good quality and adequate spatial coverage of digital elevation model to define ground surface elevation. | Observations of the key modelling outcomes dataset is used in calibration. | | Model parameters consistent with conceptualisation. | |
| | Reliable land-use and soil-mapping data available. | | | Appropriate computational methods used with appropriate spatial discretisation to model the problem. | |
| Class 2 | Groundwater head observations are available but may not provide adequate coverage throughout the model domain. | Calibration statistics are generally reasonable but may suggest significant errors in parts of the model domain(s). | Transient calibration over a short time frame compared to that of prediction. | Key calibration statistics suggest poor calibration in parts of the model domain. | Prediction of impacts of proposed developments in medium value aquifers. |
| | Bore logs are available but may not provide adequate coverage throughout the model domain. | Long-term trends not replicated in all parts of the model domain. | Temporal discretisation used in the predictive model is different from that used in transient calibration. | Model predictive time frame is between 3 and 10 times the duration of transient calibration. | Evaluation and management of medium risk impacts. |

| | | | | | |
|---|---|---|---|---|---|
| Class 1 | Metered groundwater-extraction data may be available but spatial and temporal coverage may not be extensive. | Transient calibration to historic data but not extending to the present day. | Level and type of stresses included in the predictive model are outside the range of those used in the transient calibration. | Stresses are between 2 and 5 times greater than those included in calibration. | Providing estimates of dewatering requirements for mines and excavations and the associated impacts. |
| | | Seasonal fluctuations not adequately replicated in all parts of the model domain. | | Temporal discretisation in predictive model is not the same as that used in calibration. | Estimating distance of travel of contamination through particle-tracking methods. Defining water source protection zones. |
| | Few or poorly distributed existing wells from which to obtain reliable groundwater and geological information. | No calibration is possible. | Predictive model time frame far exceeds that of calibration. | Model is uncalibrated or key calibration statistics do not meet agreed targets. | Design observation bore array for pumping tests. |
| | Observations and measurements unavailable or sparsely distributed in areas of greatest interest. | Calibration illustrates unacceptable levels of error especially in key areas. | Temporal discretisation is different to that of calibration. | Model predictive time frame is more than 10 times longer than transient calibration period. | Predicting long-term impacts of proposed developments in low- value aquifers. |
| | No available records of metered groundwater extraction or injection. | Calibration is based on an inadequate distribution of data. | Transient predictions are made when calibration is in steady state only. | Stresses in predictions are more than 5 times higher than those in calibration. | Estimating impacts of low-risk developments. |
| | Climate data only available from relatively remote locations. | Calibration only to datasets other than that required for prediction. | Model validation* suggests unacceptable errors when calibration dataset is extended in time and/or space. | Stress period or calculation interval is different from that used in calibration. | Understanding groundwater flow processes under various hypothetical conditions. |
| | Little or no useful data on land-use, soils or river flows and stage elevations. | | | Transient predictions made but calibration in steady state only. | Provide first-pass estimates of extraction volumes and rates required for mine dewatering. |
| | | | | Model parameters outside the range expected by the conceptualisation with no further justification. | As a starting point on which to develop higher class models as more data is collected and used. |
| | | | | The model has not been reviewed. | |

| | |
|---|---|
| Criterion met. | Criterion met by current model study at the relevant class |
| Criterion met through higher model classification. | Criterion met in higher class |
| Criterion partially met. | Criterion not met by current model study |

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# 2 Site Characterisation

## 2.1. Location

The BP33 project is located 2.5 km south-west of the Cox Peninsula Road and approximately 33 km west of the Berry Springs township (see Figure 2-1). Two mineral leases (ML32074 and ML32346) cover the BP33 project area. The leases cover a combined area of 848 ha of vacant crown land. The proposed mining infrastructure at the BP33 project will extend over 7.2% (61.4 ha) of the combined mining lease.

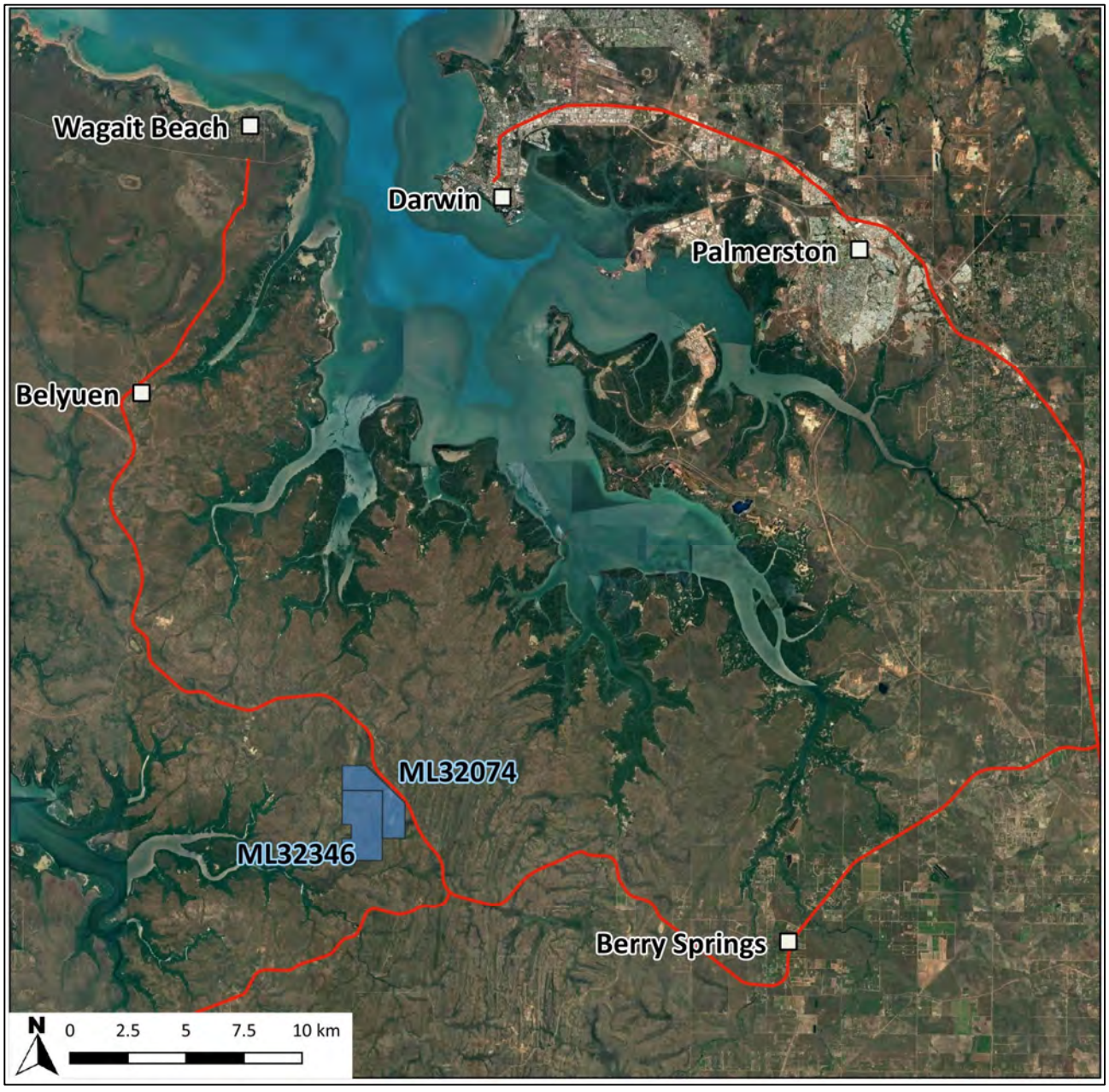



Figure 2-1 Location of the BP33 project

## 2.2. Climate

Climate data for the BP33 study area has been sourced from SILO data drill (https://www. https://www.longpaddock.qld.gov.au/silo), a national scale database of climate records for

Australia. The SILO data set has been used in preference to individual weather stations in the Darwin area because it provides a continuous rainfall and evaporation record for the study. The SILO data site was located at Latitude, Longitude: -12.70 130.80 (Decimal Degrees).

The study area has an average annual rainfall of 1530 mm and average annual potential evaporation of 2280 mm. Average maximum temperature ranges from 34.4 degrees Celsius (°C) in October to 30.9°C in June and July (Figure 2-2a). July is the coolest month with an average minimum temperature of 17.9°C. Rainfall is concentrated in the wet season with around 90% of precipitation occurring between November and March. January is the wettest month with an average rainfall total of 382 mm. Peak potential evaporation occurs between September and October, with potential evaporation being lowest during February and March (Figure 2-2b). Average monthly rainfall only exceeds potential evaporation during the wettest months (December-March). The rainfall data is presented in Figure 2-3 as annual totals with a trace of the cumulative rainfall residual which shows long-term trends in the rainfall record.

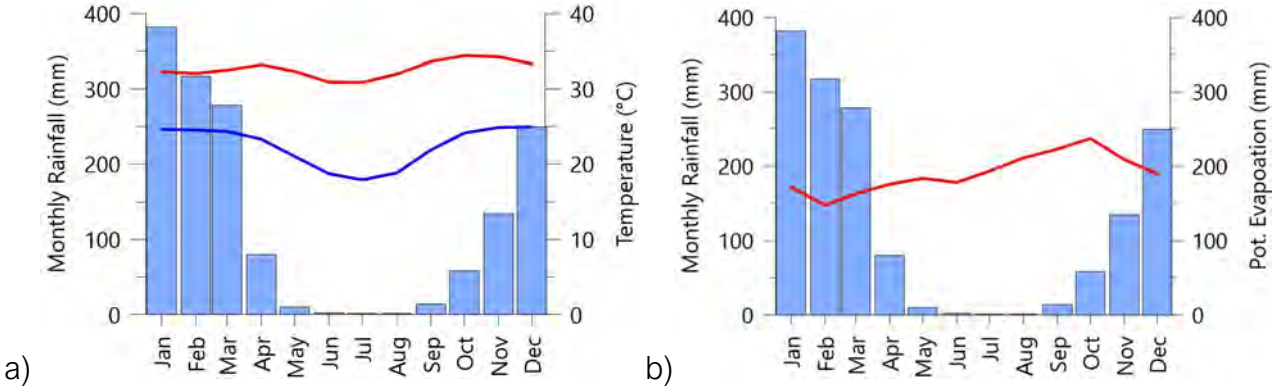



Figure 2-2 (a) Average monthly rainfall compared to average max and min temperatures and (b) average monthly rainfall compared to monthly potential evaporation for the period 1900-2020 (SILO Data Drill).

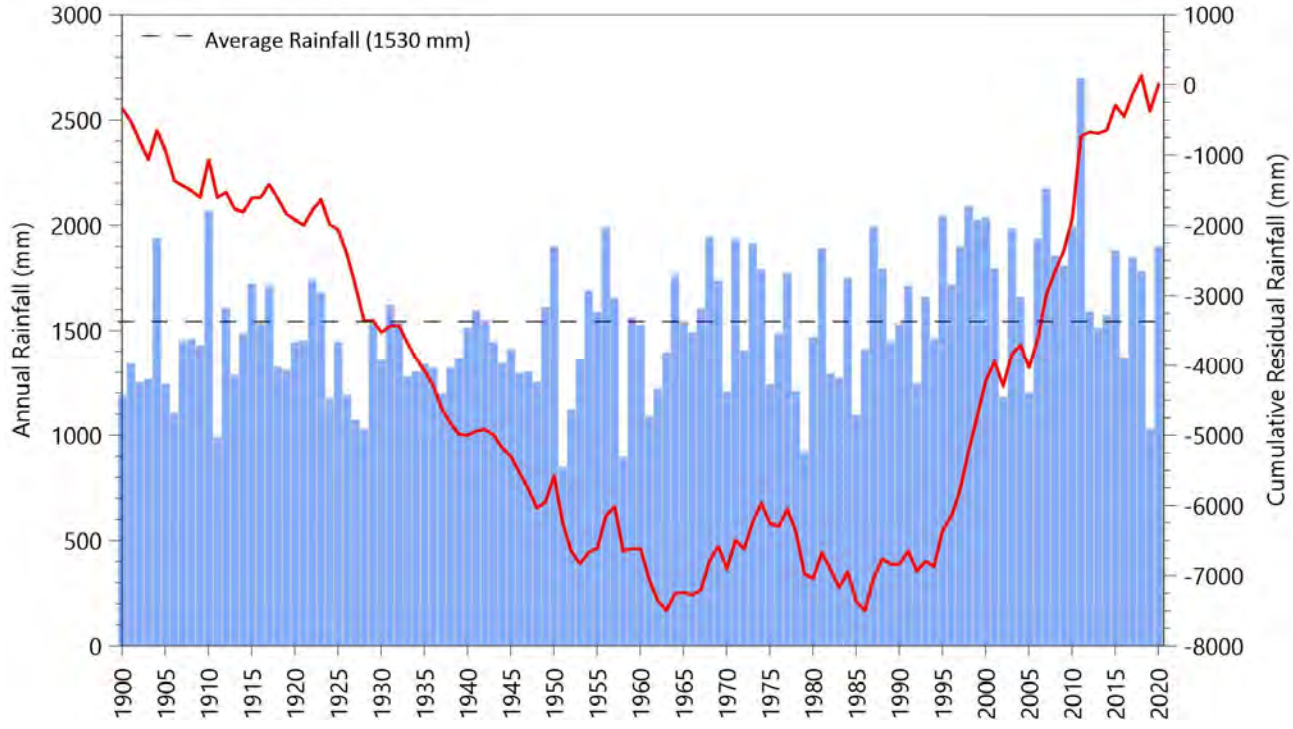



Figure 2-3 Annual rainfall totals with a trace of mass residual rainfall (1900-2020).

## 2.3. Topography and Drainage

The regional topography surrounding the BP33 site is largely subdued and flat lying. Locally BP33 is situated in a subtle valley with a south to south-west orientation (Figure 2-4). Higher elevations (40 mAHD) occur to the north-east around Observation Hill Dam (OHD). This elevated area extends to the north-west and forms a catchment divide that separates the BP33 site from the proposed GLP, located 4.5 km to the north-west. The land surface falls away from the BP33 site to the south-west with the lowest lying areas (10 mAHD) found along drainage lines running into Bynoe Harbour.

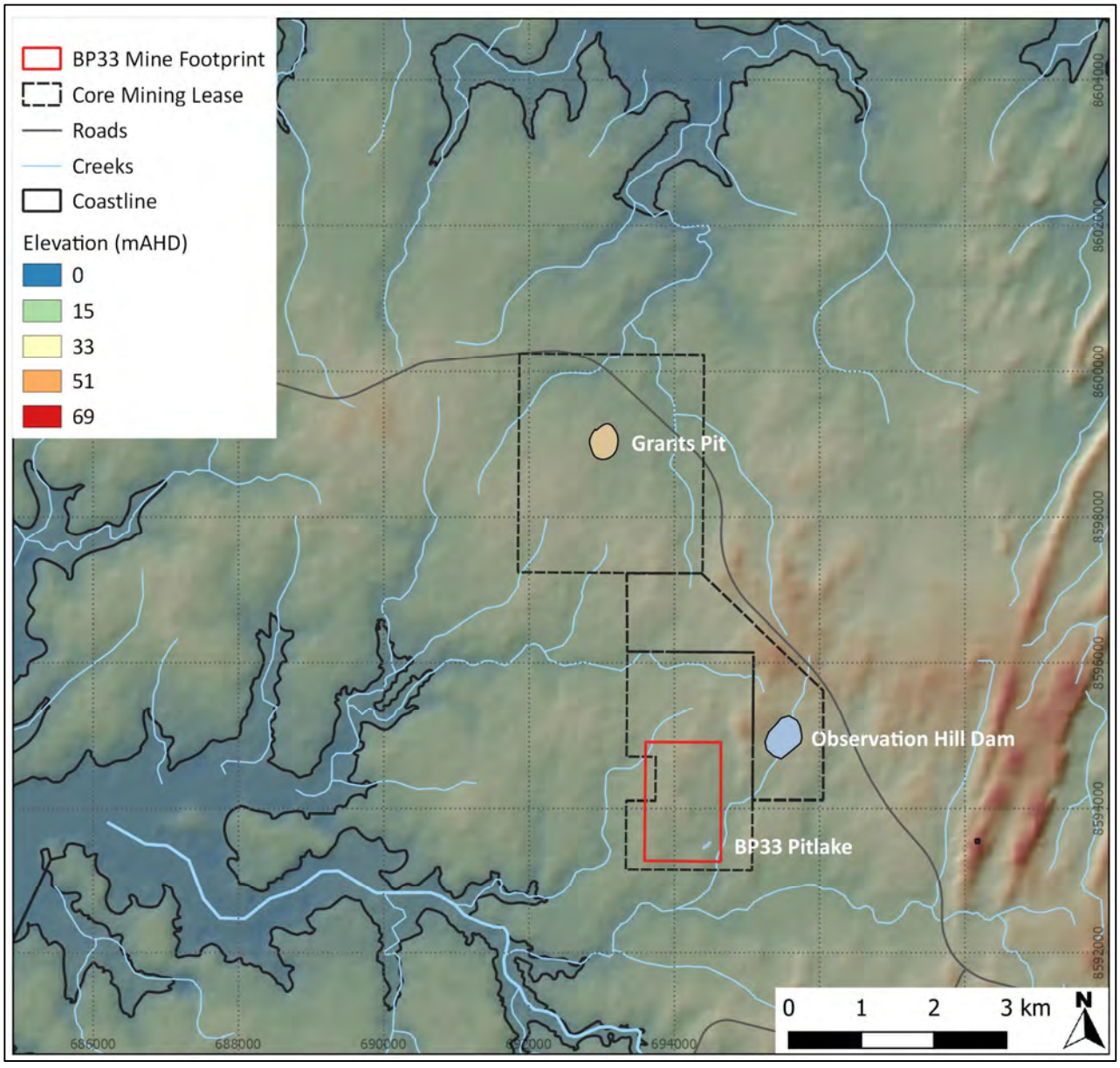



Figure 2-4 Topography of the study area with surface water drainage

BP33 is located in the Finniss River drainage basin and falls within the Bynoe Harbour catchment. There are no permanent water courses in the vicinity of BP33. The area is drained by a number of small unnamed ephemeral water courses which rise in the higher elevations to the north-west of BP33 and drain south-west into the Charlotte River and ultimately Bynoe Harbour. BP33 is located on the western edge of a small drainage line that connects OHD to

the Charlotte River. The BP33 site contains a small pre-existing pit-lake, which is a remnant of mining activities from the early 1990s. Both OHD and the BP33 pit lake contain surface water that typically persists through the dry season. While OHD is fed by a drainage line, BP33 is not connected to any channels and the water present in the pit is likely to represent a groundwater feature.

The generalised topography and drainage around the BP33 site are shown in Figure 2-4. Topographic data is derived from two sources: a LIDAR survey and the National Digital Elevation Model (DEM). The LIDAR survey data extends across the three mining tenements (ML31726, ML32074, ML32346) that encompass the Grants and BP33 projects. For areas within the model domain outside the mining tenements the LIDAR data has been merged with National scale 1 Second Hydrologically Enforced Digital Terrain Model (DTM), derived from the National DEM SRTM 1 Second and National Watercourses, Lakes and Reservoirs. (http://www.ga.gov.au/elvis/). The Shuttle Radar Topography Mission (SRTM) Digital Terrain Elevation Data (DTED) are used with the consensus view that it has a minimum vertical accuracy of 9 m absolute error at 90% confidence world-wide and the minimum vertical accuracy for Australia is 6m (Farr, et al., 2007).

## 2.4. Geology

BP33 is located in the north-west of the Pine Creek Geosyncline, a thick sequence of Proterozoic metasediments that overlies Archean basement rocks and underwent extensive folding and uplift around 1800 million years ago. After a long hiatus during which significant weathering and erosion occurred a drape of flat bedded Cretaceous and Cainozoic sedimentary formations were deposited over the Proterozoic rocks.

The lithium prospect at BP33 is hosted in a pegmatite, which is one of a swarm of complex zoned rare element pegmatites forming the 55 km long by 10 km wide West Arm–Mt Finniss pegmatite belt. The Finniss pegmatites are intruded into the early Proterozoic Burrell Creek Formation (BCF) which is distributed along the northwest margin of the Pine Creek Geosyncline. The BP33 pegmatite is north-east trending and steeply dipping, it is approximately 75 m long with a width of between 25 – 40 m (Frater, 2005). From exploration drilling the top of the BP33 pegmatite ranges in depth from 30 – 180 m below surface, with an average depth of 90 m.

The BCF is comprised of shale, siltstone, sandstone and strongly foliated phyllite with lenses of quartz pebble conglomerate. The formation is extensively weathered at surface where it often forms a laterite horizon. The underlying shale and phyllite is typically heavily weathered and decomposed into mottled clay. Exploration drilling at BP33 indicates the weathered zone is on average 60 m thick with the upper 30 m typically showing extensive weathering and the bottom 30 m showing moderate to slight weathering.

Where the BCF is not exposed it subcrops beneath a thin veneer of Tertiary and Quaternary aged sediments. These include alluvial deposits (Qa) along the drainage lines as well as colluvium (Cz) and laterite formed by in-situ weathering of the BCF. The colluvium comprises ferruginous clayey, sandy and gravelly soils. Both the colluvium and laterite deposits are typically less than 4 m in thickness (Pietsch, 1986).

The alluvial deposits centre around active drainage lines and can extend up to several kilometres in length and up to 200-300 m in width (Frater, 2005). They are typically less than 4 m in thickness but can exceed 6 m in the southern sections of the Booths drainage

(Mollemans and Hatcher, 1988) - Booths is the drainage line running south from Observation Hill dam to the immediate east of BP33. Mollemans and Hatcher (1988) describes the following three sedimentary layers in alluvial deposits around BP33/Observation Hill area:

- A-layer: Less than 0.5 m thick and may contain a thin band of pebbles (5–10 mm wide) at its base. It is essentially un-mineralised and is capped by an organic clay layer.
- B-layer. A minor gravel layer up to 1 m thick, directly overlying the C-layer or separated from it by thin bands of clayey sand.
- C-layer. This earliest layer consists of basal clayey sand or gravel up to 2.5 m thick, containing sub-angular quartz and siltstone clasts up to 200 mm in length.

Mollemans and Hatcher (1988) note that in some areas the alluvial deposits have been completely reworked with black soil, and that the bedrock under the main alluvial channel is typically heavily weathered. The 1:250 000 scale surface geology for the study area and surrounding region is presented in Figure 2-5.

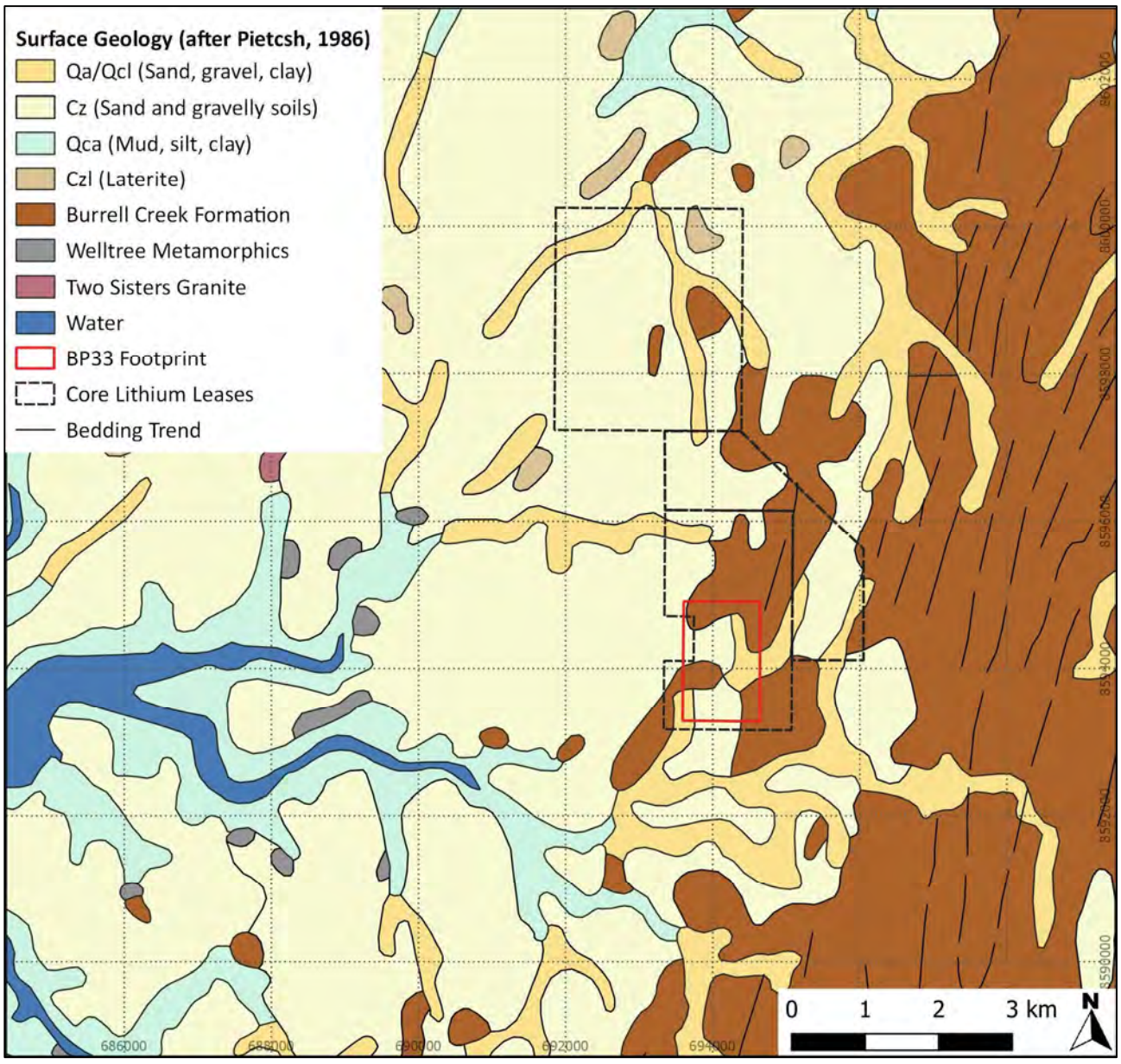



Figure 2-5 Surface geology derived from the 1:250000 scale geology coverage.

### 2.4.1. Geological structure

Phyllite is a foliated rock, and based on the discussion with Core personnel, it is understood that the foliation is striking approximately North-South (~010-015°). This is consistent with bedding trends mapped in outcropping BCF in regional geological maps (Figure 2-5).

A review of the Bynoe 1:100 000 surface geology (Pietsch, 1986) did not reveal any mapped faults or significant geological structures in the vicinity of the BP33 project area.

## 2.5. Hydrogeology

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 – 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, unweathered rock.

There is limited information available on the groundwater characteristics of the pegmatite. Anecdotal information from mineral drilling and diamond coring at BP33 suggests 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 late 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 pit/proposed mine workings and the drainage line to the east. These results and subsequent groundwater monitoring suggest groundwater within the alluvial deposits is largely ephemeral or is restricted to small areas in very close proximity to the drainage lines.

### 2.5.1. Previous studies

A preliminary groundwater investigation at the BP33 was undertaken in 2020 (Groundwater Enterprises, 2020a). The investigation involved the installation of 13 dedicated monitoring bores at seven locations around BP33. Nested bores were constructed at five sites to investigate the occurrence of shallow groundwater within alluvial deposits and the weathered top of the BCF, and its connection to the deeper, fractured rock aquifer in the BCF. Hydraulic testing (slug testing) was undertaken on all constructed bores. Monitoring of groundwater levels commenced in October 2020 with pressure loggers installed in all monitoring bores and also the BP33 pit-lake. Groundwater sampling has been undertaken at a monthly interval to collect a baseline groundwater quality data set for the aquifers at the BP33 site.

In addition to the BP33 groundwater investigation two phases of groundwater drilling have been undertaken at the GLP. A preliminary groundwater investigation was undertaken by GHD in 2017 (GHD, 2017). The investigation program involved the drilling and construction of six monitoring bores, hydraulic testing (recovery and slug tests) and water quality sampling. In 2020, five additional monitoring bores were installed at GLP in accordance with requirements under the environmental approvals process (Groundwater Enterprises, 2020b). Water level monitoring and groundwater sampling is currently undertaken monthly on these bores. The location of the BP33 and Grants monitoring bores is shown in Figure 2-6.

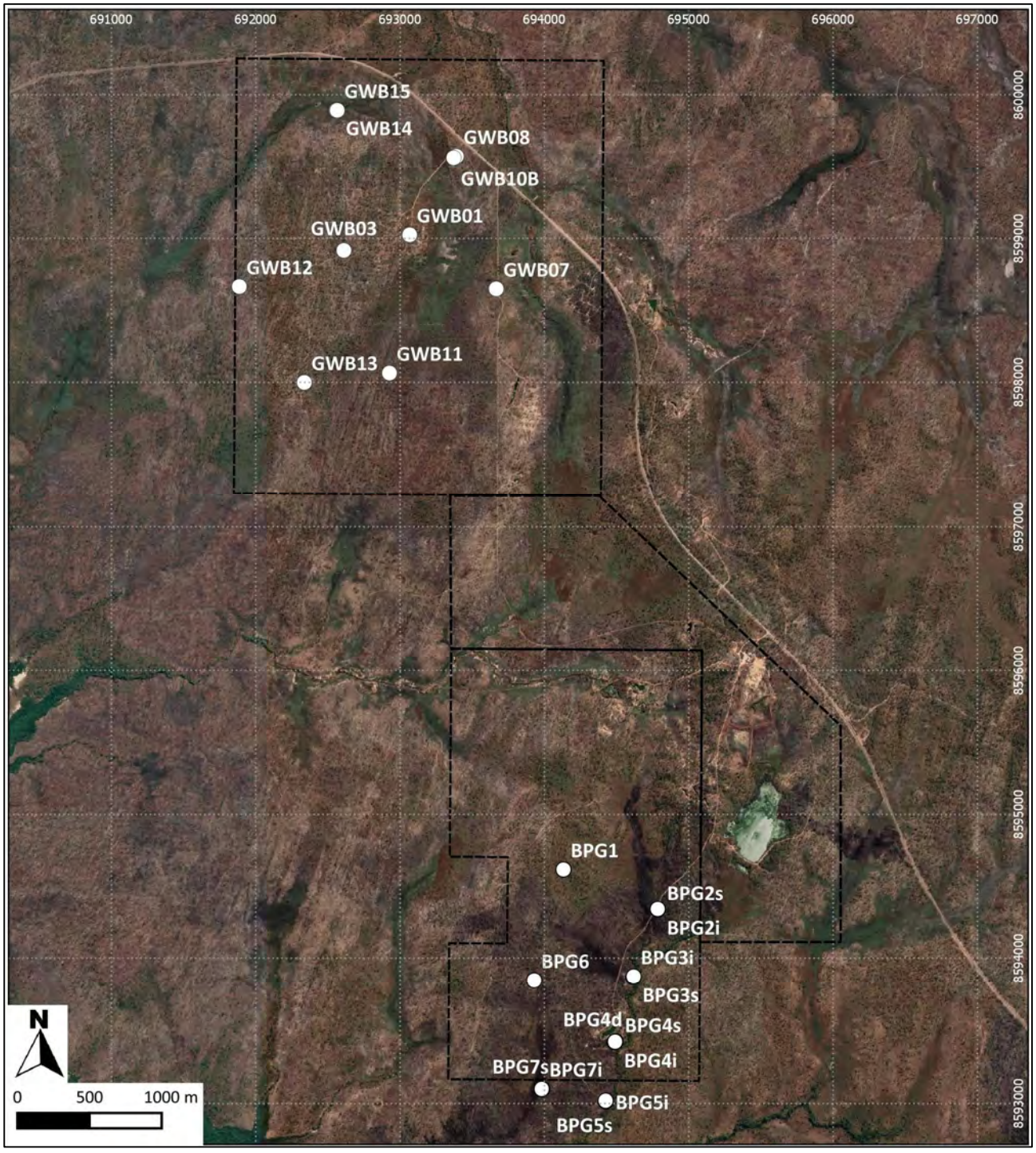



Figure 2-6 Location of GLP and BP33 monitoring bores on Core Lithium's mining leases

The BP33 project falls within regional hydrogeological and water resource mapping completed by the Water Resources Division on the Bynoe 1:100 000 map sheet in 2004 and the Cox Peninsula in 2008 (DIPE, 2004; NRETA, 2008). There are several groundwater investigations in the Greater Darwin region that provide context on groundwater occurrence in the BCF, these include:

- Karp (2010) - In 2010 the current DEPWS Water Resources Division reported on results from investigation drilling conducted in the BCF near the proposed city of Weddell (Karp, 2010). They report a yield range of < 0.1 – 2 L/s (median 0.3 L/s) from seven investigation bores constructed in the BCF. All bores encountered groundwater within fractured and weathered rocks at the base of the weathering zone. Although two bores recorded yields of 2 L/s, Karp (2010) suggests that 0.5 L/s is more characteristic of the longer-term yield for bores constructed in the BCF.
- Karp (2009) – Water Resources Division completed a groundwater investigation in the suburbs of Johnston and Zuccoli to assess water potential in the area. Six bores were drilled targeting a quartz ridge within the BCF (shown as Acacia Gap Quartzite on the geology maps), airlift yields ranged from < 0.1 – 9 L/s. The investigation identified a narrow aquifer associated with the fractured quartz ridge, elsewhere only minor and localised aquifers were intersected in siltstones of the BCF.
- Verma (1982) – Water Resources Division completed a groundwater investigation on the Cox Peninsula to the north-west of the BP33 site between 1979 and 1982. The study involved a geophysics and investigation drilling program. Two minor aquifers were identified: a shallow aquifer in the Bathurst Island Formation (Cretaceous) which extended into the weathering zone of the underlying Proterozoic rocks and a deep structurally controlled aquifer in the Proterozoic Formations. Bore yields ranged from 0.1 – 1.5 L/s indicating the aquifers have poor water supply potential. The marginal nature of the aquifers is consistent with groundwater drilling observations from Proterozoic rocks (BCF) at the BP33 site.
- Inpex EIS Hydrology and Hydrogeology of Blaydin Point (2009) – URS completed detailed groundwater investigations on the Inpex Gas site at Blaydin point and drilled around 10 investigation bores into the BCF. All bores were constructed to screen the shallower Cenozoic and Cretaceous sediments so hydraulic testing and monitoring results have limited application to the BP33 site.

### 2.5.2. Previous groundwater modelling studies

A numerical groundwater model was developed to investigate the impact of proposed mining at the GLP on the surrounding aquifer system (CloudGMS, 2018). This work was undertaken to support the Environmental Impact Statement for the GLP. The current groundwater model at BP33 encompasses the GLP model domain and features in order to assess the cumulative impacts from the broader lithium mining project.

No other published groundwater modelling studies have been identified that cover the project area.

### 2.5.3. Hydrostratigraphic units

The geological formations within the study area have been combined into three hydrostratigraphic units (HSU) for inclusion in the groundwater model. An HSU is a geological

formation or part of a formation with similar hydrogeological properties or characteristics. The hydrostratigraphic units defined for the BP33 project are presented below in Table 2-1.

Table 2-1 Hydrostratigraphic units

| Age | Name | Lithology | Hydrogeology | HSU |
|---|---|---|---|---|
| **Quaternary** | Alluvial sediments | Silty sand and gravels | Permeable, but mostly above water table. | 1 |
| **Proterozoic** | Highly to moderately weathered BCF | Saprolite (Phyllite) Mostly silt, clayey and minor sand. | 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. | 2 |
| **Proterozoic** | Fresh BCF | Blue grey fresh Phyllite. | Low permeability, locally fractured rock. | 3 |

The HSUs have been incorporated into a hydrostratigraphic model which was developed using the Leapfrog Hydro geological modelling software. Leapfrog Hydro provides a flexible platform for incorporating lithological information and generating hydrostratigraphic contacts from a variety of sources including surface geological mapping, lithological logs and surfaces generated from geophysical surveys. Each HSU in the Leapfrog model is represented as a three-dimensional object that can be continuous or discontinuous within the model domain. The hydrostratigraphic model forms the basis of FEFLOW model grid geometry, this is discussed further in Section 4.3.

### 2.5.4. Aquifer hydraulic properties

#### AQUIFER TRANSMISSIVITY / HYDRAULIC CONDUCTIVITY

Thirteen monitoring bores were constructed on site in 2020 with six bores constructed in fractured slightly weathered to fresh BCF (HSU2), five bores constructed in heavily weathered to fresh BCF with negligible fracturing (HSU3) and two bores constructed in alluvial sediments. Slug tests were completed on the installed monitoring bores, hydraulic conductivity results from Groundwater Enterprises (2020) are summarised in Table 2-2.

Table 2-2 Summary of monitoring bore hydraulic conductivity test results at BP33

| SCREENED FORMATION | NO. BORES | K MIN (m/day) | K MAX (m/day | K GEOMETRIC MEAN (m/day) |
|---|---|---|---|---|
| **Burrell Creek Formation Fresh-weathered** *Negligible fracturing* | 5 | 0.003 | 0.08 | 0.03 |
| **Burrell Creek Formation Fresh-weathered** *Fractured* | 5 | 0.27 | 2.6 | 1.0 |
| **Alluvial Deposits (silty sand)** | 1 | 0.4 | 0.4 | - |

The test results reveal 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. Bores 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.

#### STORAGE COEFFICIENTS

Specific yield is defined as the volume of water that will drain under gravity from a unit volume of rock over a long period of time. The specific yield is best estimated from the response to long-term pumping, however, no such information is available for the BCF. Values typical of weathered and fractured rocks have been adopted (0.01-0.02), these are consistent with values adopted for the numerical modelling of the Mt Todd Gold Project (GHD, 2013) which is also located in the Pine Creek Geosyncline and models the Burrell Creek Formation.

### 2.5.5. Depth to Groundwater and Water Level Fluctuation

Groundwater level monitoring has been undertaken on the BP33 bores since their installation in the dry season of 2020. Groundwater levels in the deeper fractured BCF bores ranged from 4.5 to 9.8 mBGL in the late dry season (Figure 2-7). The bores responded uniformly to wet season recharge and groundwater levels approached land surface by late January 2021. 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. The water level range observed in 2020 is consistent with the longer monitoring record available from bores at GLP (Figure 2-8). Since 2018 the annual change in groundwater levels in the deep BCF bore GWB3 at the GLP has ranged from 5.4 – 9.3 m.

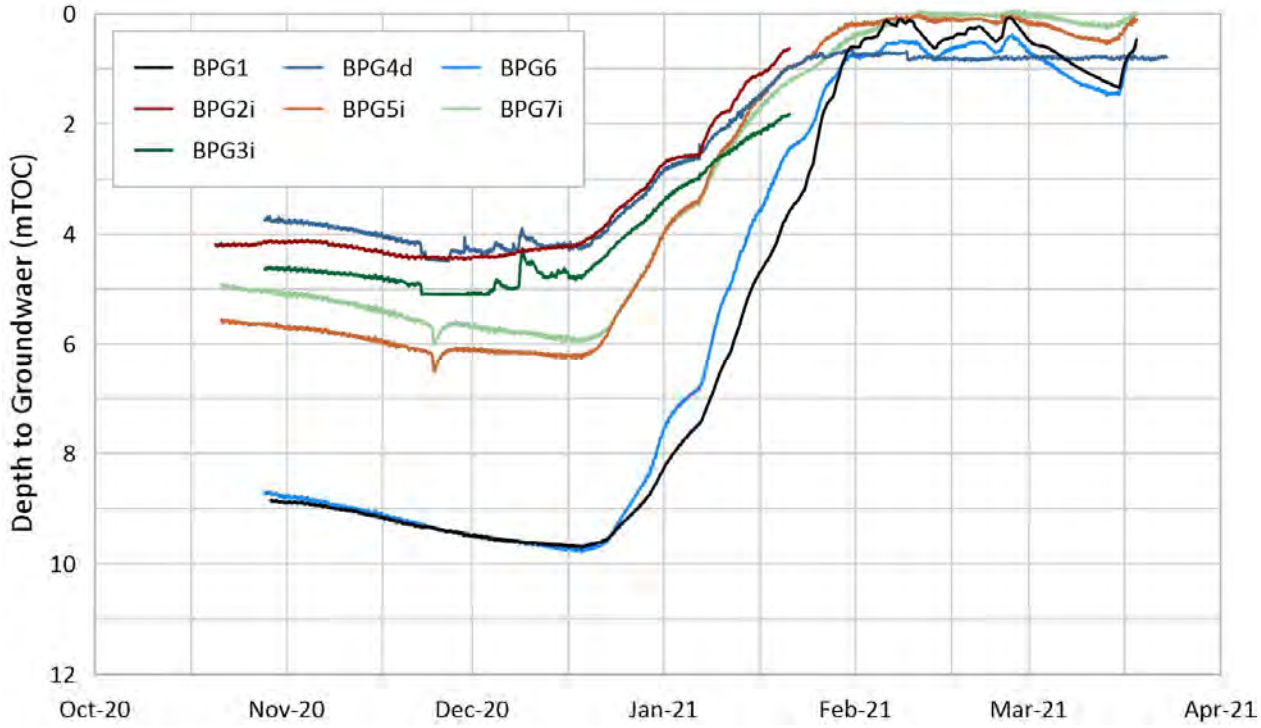



Figure 2-7 Hydrographs for BP33 Deeper Bores

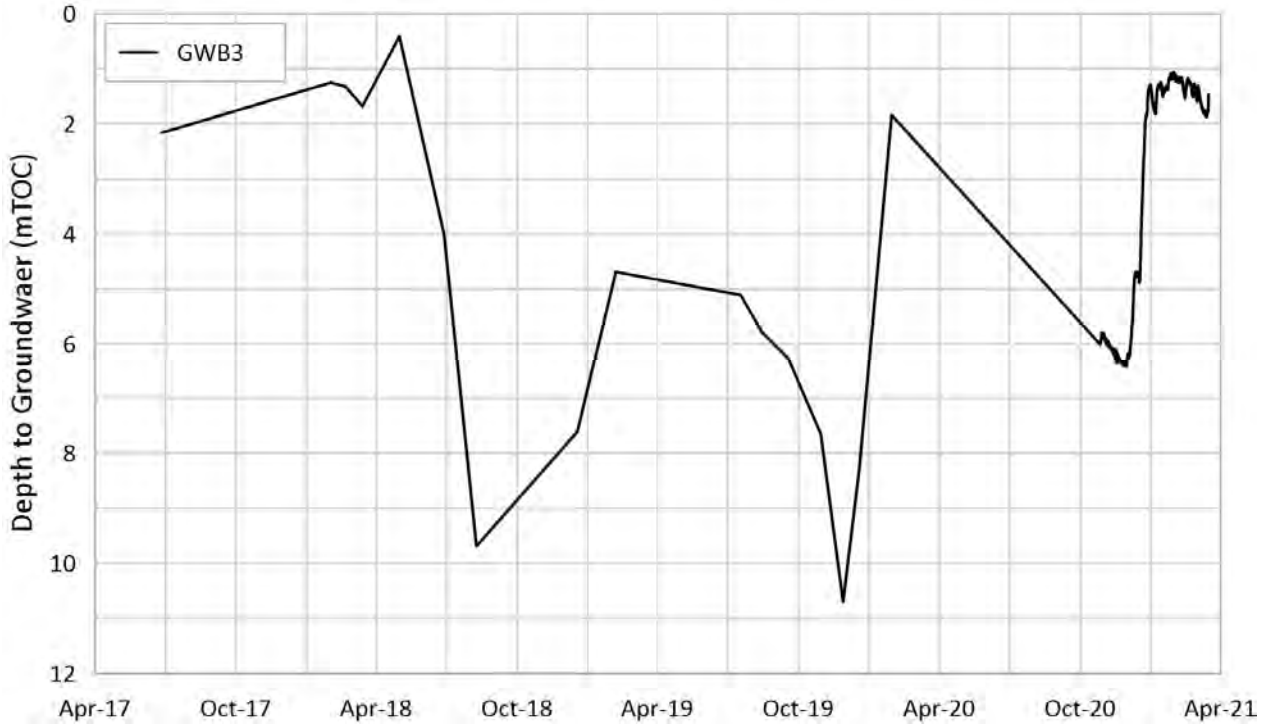



Figure 2-8 Hydrograph for GWB3 constructed in the Burrell Creek Formation at Grants deposit

Groundwater levels in the shallow bores constructed in the heavily weathered top of the BCF or alluvial sediments ranged from 4.4 – 6.6 mBGL in the late dry season (Figure 2-9). They rose steadily in response to wet season rainfall from December 2020 and plateaued by mid-February at levels around the natural surface. Alluvial sediments screened by BPG2s were dry in the late dry season and only became saturated in late December, 2020. The seasonal water level fluctuation in the shallow bores ranged from 3.1 – 5.5 m.

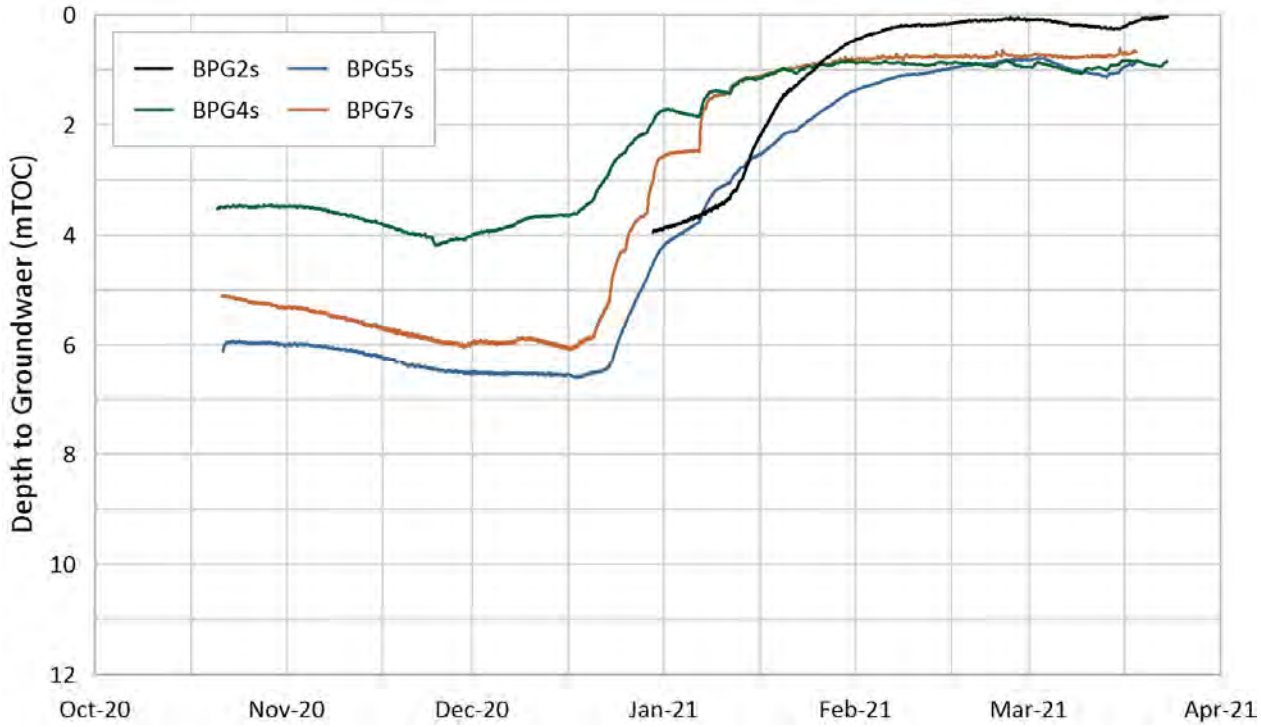



Figure 2-9 Hydrographs for BP33 Shallow Bores (depths 3.5 – 8 m)

### 2.5.6. Groundwater Flow Direction

The groundwater monitoring bores at BP33 were surveyed to a common height datum mAHD (metres Australian Height Datum). Survey levels were used with the water level monitoring data to generate two potentiometric surfaces: an end of dry season 2020 surface (Figure 2-10) and a wet season 2021 surface (Figure 2-11). These surfaces reflect the groundwater elevation in the deeper monitoring bores. However, as vertical gradients between the shallow and deep bores are predominantly less than 1 m (see Section 2.5.7) the groundwater flow pattern is also representative for shallow bores constructed in the top of the BCF.

Figure 2-10 shows that the local flow direction is south-east across the BP33 site with groundwater moving from the more elevated areas in the north-west of the site 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 (Figure 2-11). This is attributed preferential recharge occurring on the higher elevations. Water levels in the BP33 pit-lake are slightly elevated relative to the surrounding watertable surface suggesting that the pit-lake is operating as a local recharge feature.

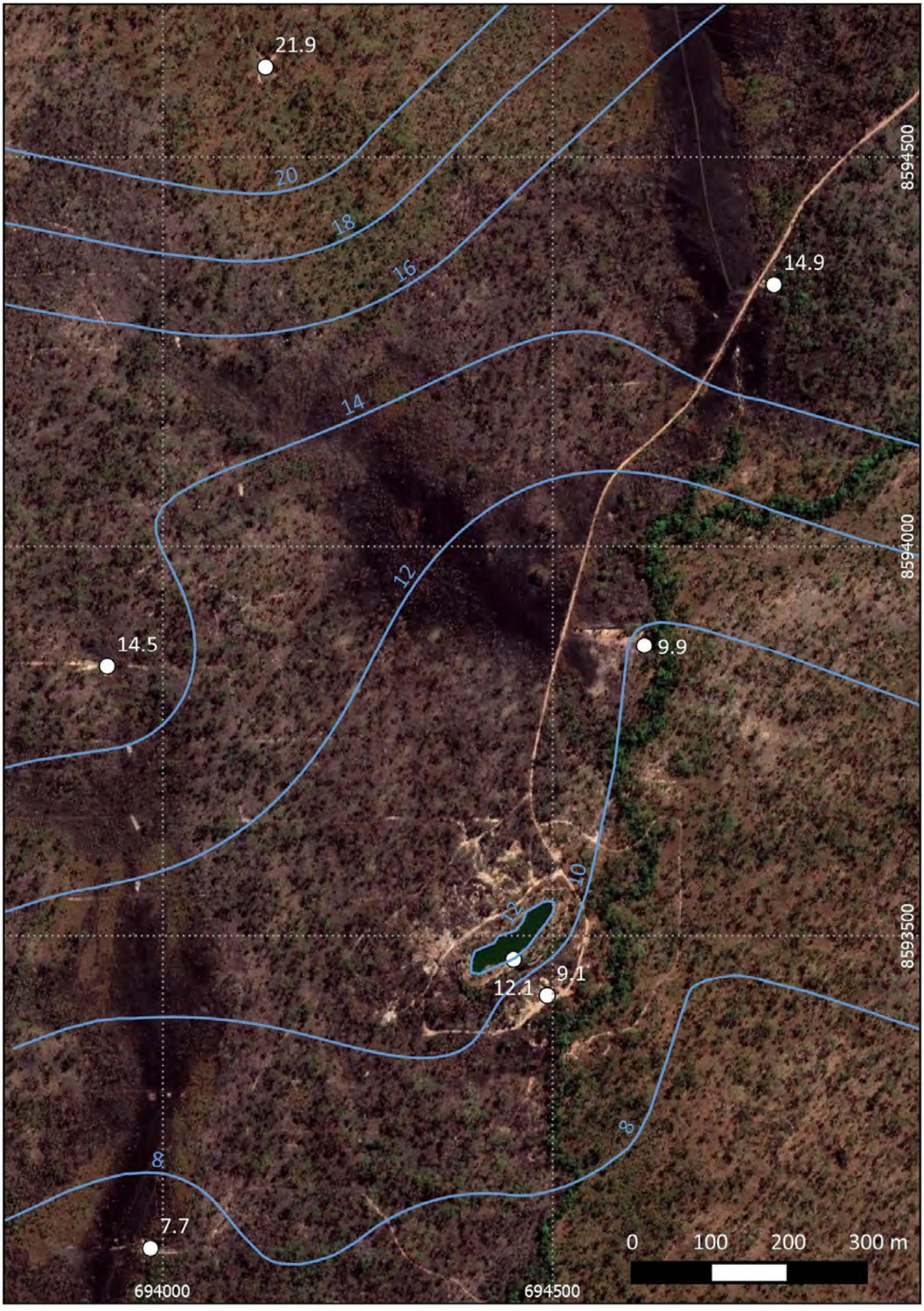



Figure 2-10 Late dry season (December 2020) potentiometric surface for the BCF aquifer

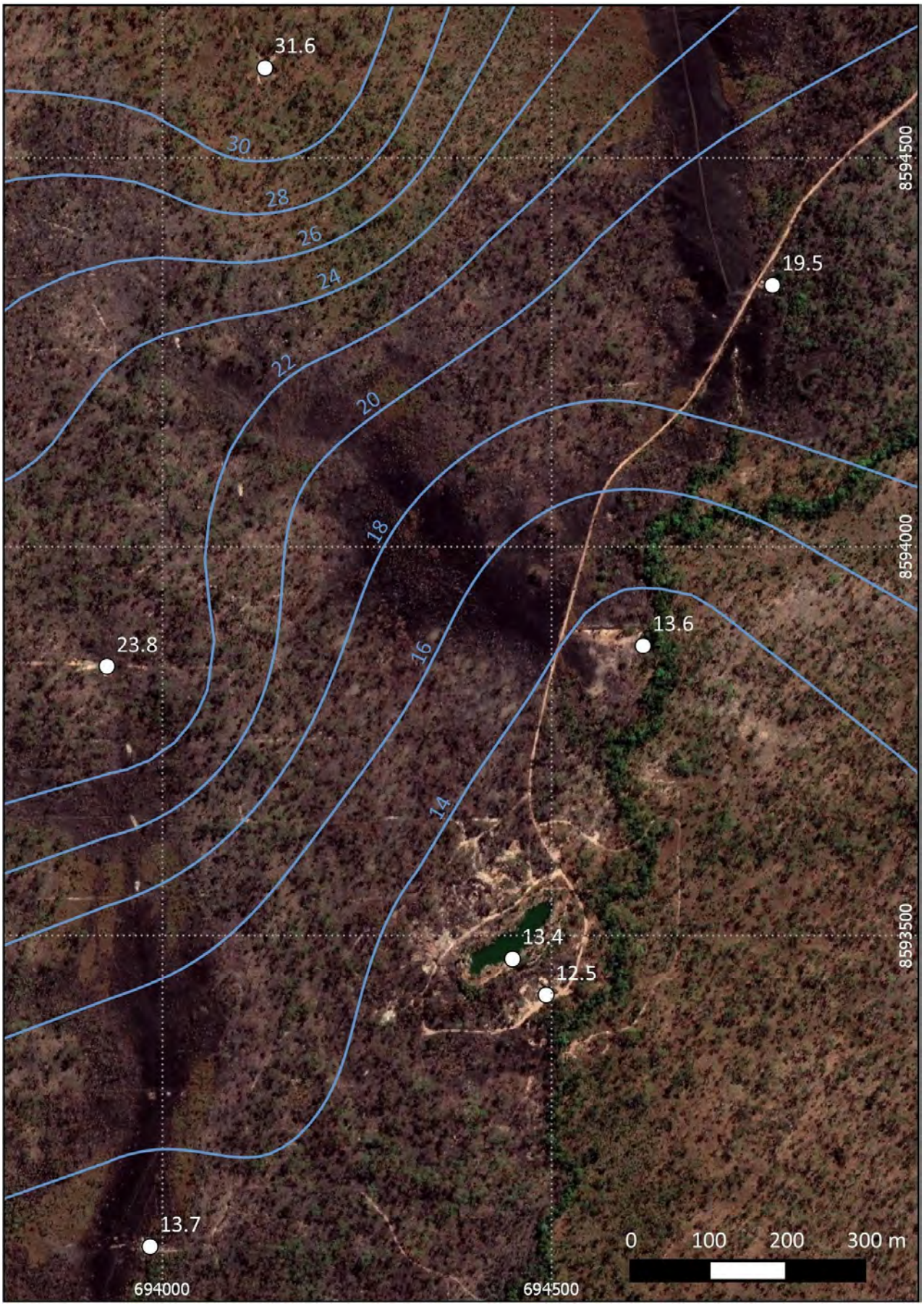



Figure 2-11 Wet season (February 2021) potentiometric surface for the BCF aquifer

### 2.5.7. Vertical groundwater gradients

There are five nested monitoring sites across the BP33 monitoring network. Deeper bores screen fracture zones in the BCF while shallow bores are variously constructed in the alluvial sediments or in the weathered top of the BCF. In most instances upward vertical gradients suggest groundwater discharge zones while downward gradients are consistent with recharge zones. With the exception of BPG4 vertical gradients at all sites up upwards (Table 2-3). The absence of downward gradients at sites around the drainage lines suggests that infiltration from seasonal surface water flows is not a dominant recharge process to the BCF. Rather, groundwater appears to be recharging preferentially on the slightly elevated areas to the north and west of the BP33 site and moving laterally to the lower lying areas around the drainage lines. This mechanism is supported by the seasonal change in gradients with the upward gradient increasing in magnitude during the wet season. The exception is monitoring site BPG4, which is located adjacent to the existing BP33 pit-lake. Vertical gradients at this site are downward, which suggests that the pit-lake is acting as a local recharge source to the surrounding BCF aquifer.

Table 2-3 Dry season and wet season vertical groundwater gradients across the BP33 site.

| BORE ID | SCREENED INTERVAL (mBGL)* | FORMATION SCREENED | DRY SEASON RWL (mAHD) | GRADIENT (m) | WET SEASON RWL (mAHD) | GRADIENT (m) |
|---|---|---|---|---|---|---|
| BPG2i | 22.3 – 28.3 | Burrell Creek Deep | 14.89 | - | 19.49 | + 0.51 |
| BPG2s | 2.5 – 3.5 | Alluvial | Dry | | 18.98 | |
| BPG3i | 41.8 – 48.8 | Burrell Creek Deep | 9.88 | - | 12.82 | + 2.43 |
| BPG3s | 3.5 – 4.5 | Alluvial | Dry | | 10.39 | |
| BPG4d | 47 – 109 | Burrell Creek Deep | 9.07 | - 0.92 | 12.53 | - 0.13 |
| BPG4s | 5 – 8 | Burrell Creek Shallow | 9.99 | | 12.66 | |
| BPG5i | 49.3 -55.3 | Burrell Creek Deep | 6.25 | + 0.6 | 12.47 | + 1.03 |
| BPG5s | 5 – 8 | Burrell Creek Shallow | 5.66 | | 11.44 | |
| BPG7i | 46.2 – 52.2 | Burrell Creek Deep | 7.65 | + 0.21 | 13.65 | + 0.98 |
| BPG7s | 4 - 7 | Burrell Creek Shallow | 7.44 | | 12.67 | |

### 2.5.8. Groundwater quality

Groundwater sampling has been undertaken on a monthly basis on the BP33 monitoring bores with six sampling rounds completed since the bores were constructed in September 2020. Groundwater samples have been analysed for major ions, dissolved and total metals, and nutrients.

The groundwater quality in the deep monitoring bores (screening slightly weathered to fresh BCF) is slightly acidic to neutral (pH 4.4 – 7) and fresh with an EC range of 60 – 330 µS/cm. The wet season samples are marginally fresher (25 µS/cm) than those collected at the end of the dry season, which likely reflects the influx of lower conductivity rainfall from wet season recharge. Spatially, groundwater from the two northern monitoring bores BPG1 and BPG2i has a lower EC (average 60 – 70 µS/cm) than the central and southern sites (average 200 – 310 µS/cm). Groundwater quality in the five shallow bores constructed in the weathered top

of the BCF and the alluvial deposits is fresh (EC 20 – 130 µS/cm) and mildly acidic (4.7 – 6.8 pH).

The groundwater quality samples have been compared against the ANZECC 2000 water quality guideline for 95% freshwater ecosystem protection. All bores periodically exceed guideline values for aluminium, zinc and copper. The deep BCF bores, with the exception of the northern sites BPG1 and BPG2i, have elevated concentrations of arsenic (0.017 - 0.34 mg/L) and exceed the guideline value. Groundwater from shallow BCF bore BPG4s, located adjacent to the pit-lake, exceeds guideline values for arsenic, lead and nickel. All other dissolved metal and nutrient concentrations are below guideline values.

## 2.6. Existing Groundwater Users

Existing bores and groundwater users within 10 km of the BP33 site were identified using NRMaps (DEPWS, 2021), results are summarised in Table 2-4.

Excluding monitoring bores drilled for the lithium project there are six registered groundwater bores within 10 km of the BP33 site. 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 2-4 Registered bores within 10 km of the BP33 project

| BORE ID | Easting GDA94 Z52 | Northing GDA94 Z52 | Distance from BP33 Project (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 |

## 2.7. Environmental Receptors

### 2.7.1. Groundwater Dependant Ecosystems Atlas

Groundwater dependent ecosystems (GDEs) have been identified using the GDE Atlas, a national dataset of Australian GDEs developed by the Bureau of Meteorology (BOM, 2021) to assist groundwater management and planning. Figure 2-12 maps the terrestrial ecosystem layer in the vicinity of BP33. This layer shows the potential for ecosystems that rely on the subsurface presence of groundwater – including vegetation ecosystems such as forests and riparian vegetation. Four mapped categories are presented: known GDEs based on regional studies and high, medium and low GDE potential based on remote sensing and image analysis.

The GDE Atlas maps an area of medium GDE potential (shown in green in Figure 2-12) along the drainage lines to the immediate east and south of BP33.

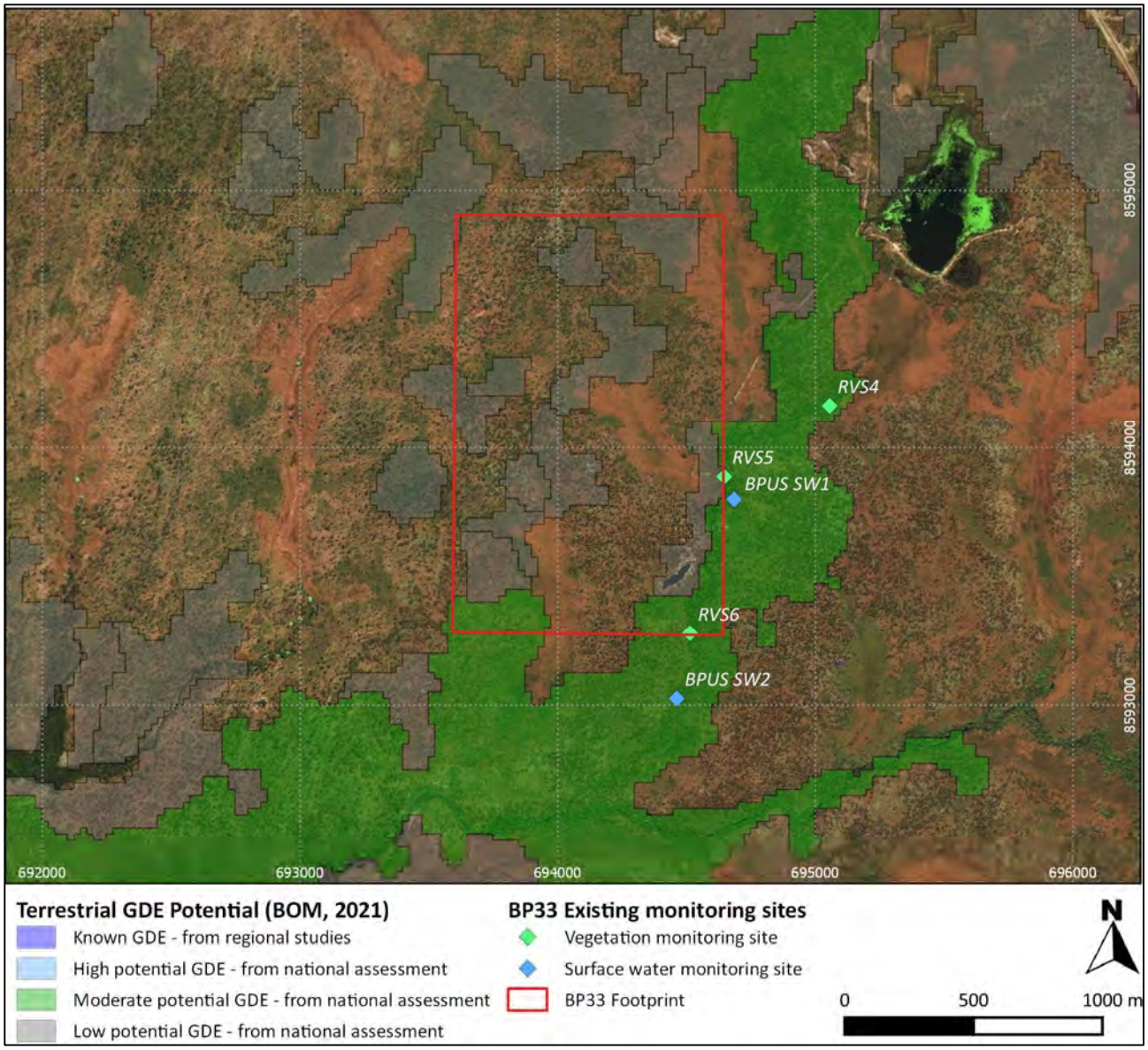



Figure 2-12 GDE classes within and surrounding the BP33 project area.

### 2.7.2. Field Surveys

EcOz Environmental Consultants (EcOz) was engaged by Core Lithium to map riparian vegetation communities and collect baseline information on community structure and condition along the drainage line downstream of OHD. The field survey (EcOz, 2019) mapped 3.6 hectares of GDE vegetation within the riparian zone of the drainage line. Three vegetation monitoring sites were established (see Figure 2-12 for locations) as part of the survey. At the time of surveying in June 2019, pools of water were observed around the northern two monitoring sites, RVS4 and RVS5.

As part of the Environmental Impact Assessment (EIS) for the Grants Lithium mine EcOz established two surface water monitoring sites on the drainage line south of OHD: BPUS SW1 and SW2 (Figure 2-12). The sites have been monitored at a quarterly frequency since October 2017. Surface water flows at the monitoring sites generally cease early in the dry season (April/May). Anecdotal information suggests that in wetter years pools of surface water persist throughout the dry season.

## 2.8. Mining activities

The proposed mine at BP33 comprises three components that will interact with the groundwater system:

- Box-cut;
- Decline and
- Stopes

The relationship between the mine components is presented below in Figure 2-13.

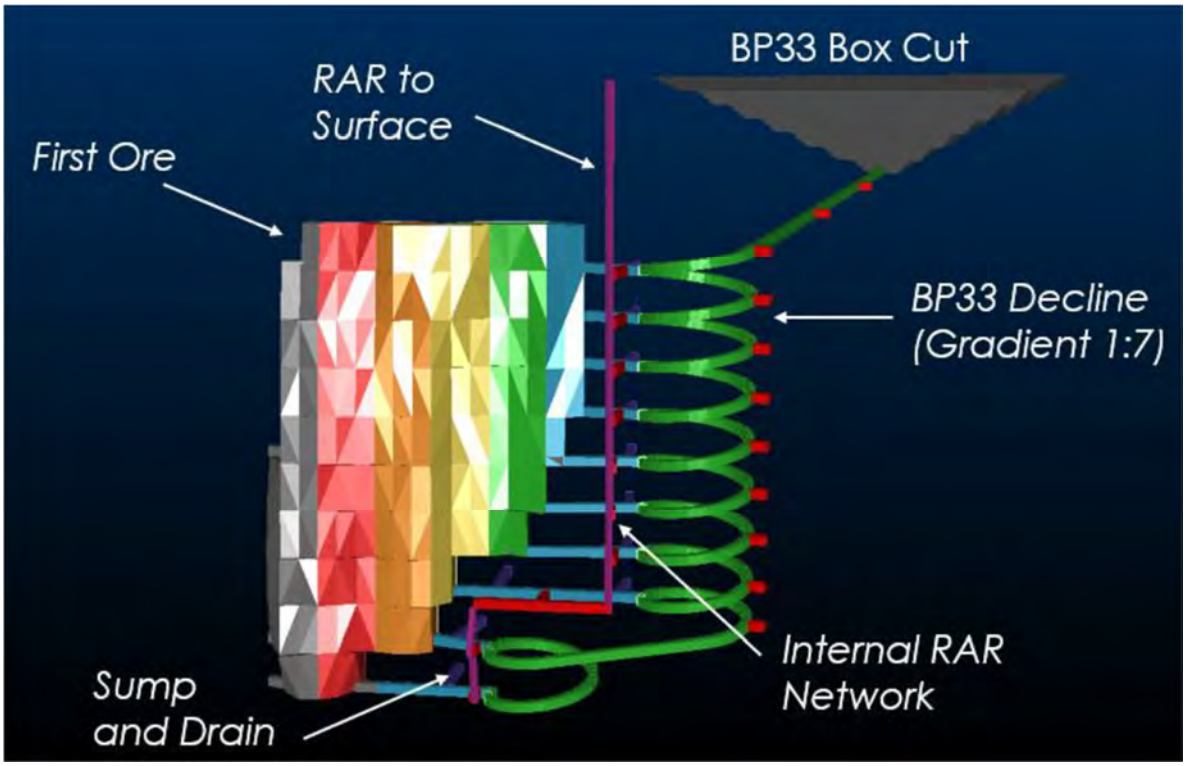



Figure 2-13 Relationship between the BP33 underground design for life of mine.

### 2.8.1. Box-cut description

To provide geotechnical stable conditions for development of the underground portal, a box-cut will be excavated. The box-cut will cover an area of six hectares and will be excavated to at least 10 m below the oxidised waste rock, a depth of 60-70 m.

A 2 metre high safety bund with a base width of 7.3 m will surround the box-cut excavation. The bund is a safety measure and will prevent surface water run-off entering the box-cut excavation. On the western side of the box-cut, a contour drain will capture surface water run-off from the adjacent elevated areas to reduce the risk of water build up behind the safety bund. A sump and pump system in the base of the box-cut will be used for dewatering of rainfall and groundwater inflows.

### 2.8.2. Underground mine description

A portal installed near the base of the box-cut and a 400m decline will be used 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 10 production levels (five 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.

### 2.8.3. BP33 mining schedule and underground development

The BP33 underground workings are represented using time varying seepage face boundary conditions. The schedule has been simplified by assuming that development occurs based on the excavation of the box-cut and five underground stope horizons (refer to Figure 2-14).

Table 2-5 Underground mine development schedule used in the groundwater model.

| Component | Interval | Period (Months) |
|---|---|---|
| Box-cut | 20 to -40 | 17 to 20 |
| UG stope horizon 1 | -90 to -150 | 31 to 36 |
| UG stope horizon 2 | -150 to -210 | 37 to 42 |
| UG stope horizon 3 | -210 to -270 | 43 to 48 |
| UG stope horizon 4 | -270 to -330 | 49 to 54 |
| UG stope horizon 5 | -330 to -360 | 54 to 59 |

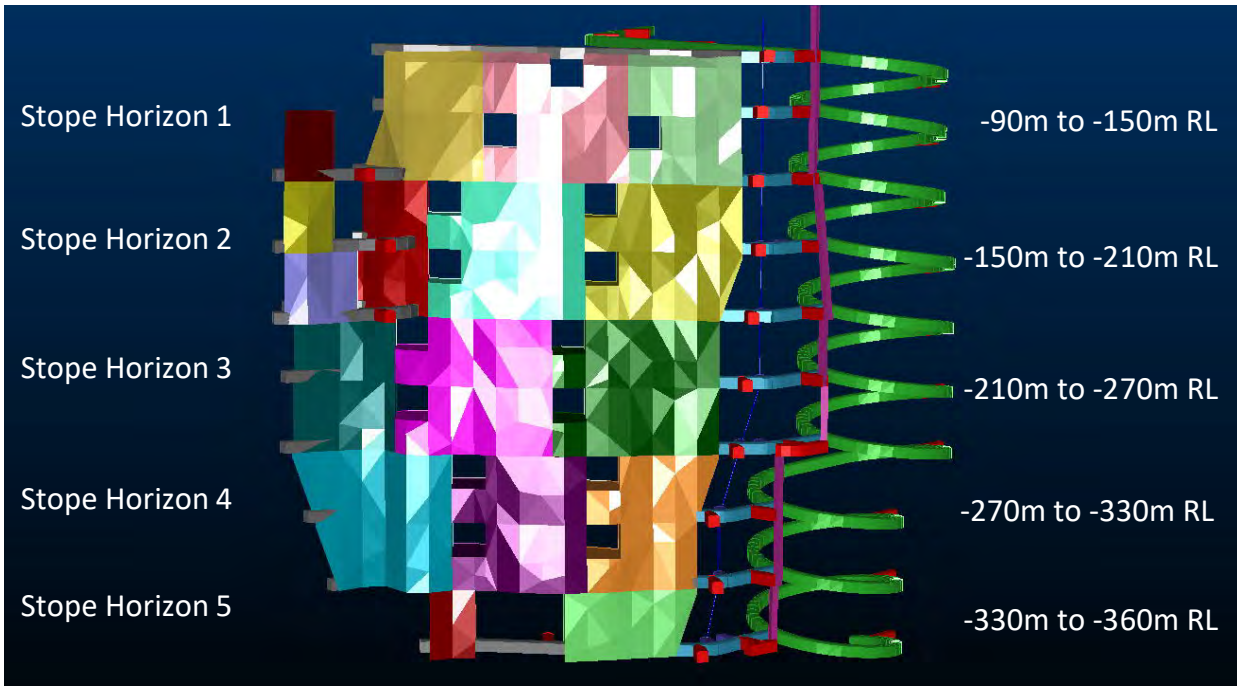



Figure 2-14 BP33 underground stope horizons.

### 2.8.4. Mining and underground development schedule

Mining at BP33 is expected to take 48 months and commence at or near the end of mining at the GLP. The timing of the various components considered in the modelling is presented in Figure 2-15.

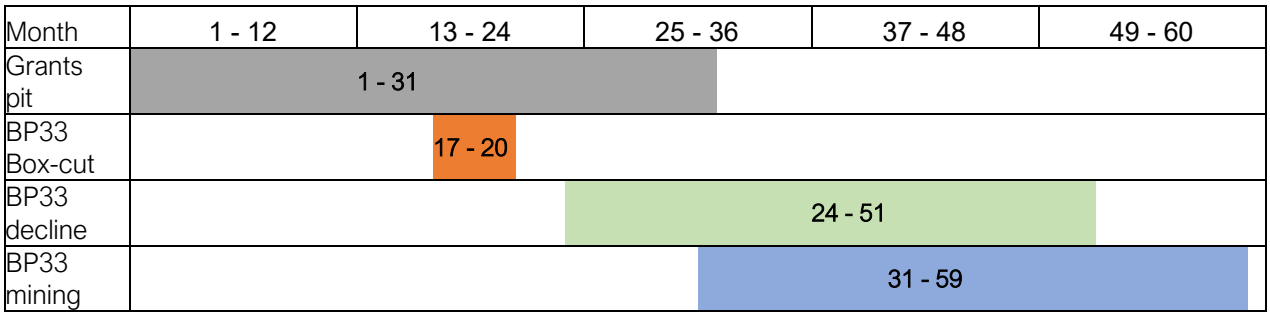



Figure 2-15 Mining plan used to schedule the various components in the groundwater model.

### 2.8.5. BP33 box-cut and underground mine closure

On the completion of underground mining activities at BP33 the mine workings will be rehabilitated in the following fashion:

- The stopes will be left largely as voids with a small proportion of backfill (estimated at between 5 - 6% of the void volume). The backfill material will comprise of fresh waste rock reclaimed from the BP33 underground mining process. It is assumed that the infill material will have a higher storage coefficient of 10% relative to the undisturbed host rock storage coefficient of 1%.
- The decline will be left as 100% open void.
- The portal at the base of the box-cut will be plugged with concrete.
- The mine shafts will be partially plugged with concrete with remaining void filled with backfill material. It is assumed the backfill with have the same material properties as the waste rock used in the stopes.
- The box-cut will be backfilled with oxide mine waste from BP33. This is effectively the same material that will be removed during the excavation of the box-cut. The oxide waste will be stored onsite in a waste rock dump and subsequently used to re-fill the box-cut void at the end of mining. It is assumed that the infill material will have a higher storage coefficient of 10% relative to the undisturbed weathered Burrell Creek Formation, which has a modelled specific yield of 1.5%).

# 3 Conceptual model

## 3.1. Introduction

The development of a conceptual model is one of the most important steps in groundwater modelling (Barnett et al, 2012). The conceptual model establishes the basic design principles for a groundwater model and identifies any key knowledge gaps to guide future investigations.

At this stage of the modelling process, a decision is made on what processes to include (or exclude) and what simplifying assumptions should be made to achieve the modelling objective(s). These decisions will strongly influence the mathematical model and ultimately the modelling outcome.

## 3.2. Groundwater system extents

Similar geological / hydrogeological conditions (Burrell Creek Formation) extend well beyond the expected impact of the Finniss Lithium Project, therefore in order to build a functional numerical groundwater model, the modelled groundwater system extents have been taken from hydrological features such as surface water catchment divides and surface water drainage features.

The extents of the groundwater model are presented below in Figure 3-1. The model domain has adequate lateral extents to prevent the interaction between areas showing potential changes to the groundwater system due to mining activities and the model boundaries (approximately 3 – 4 km separation).

The geometry and layering of the groundwater model are based on the following criteria:

- The western and eastern boundaries roughly correspond with surface water drainage divides, assuming that the groundwater surface is a subdued reflection of the topography, then these will correspond to groundwater divides.
- The western boundary also corresponds with a geological contact between the BCF to the east and the Welltree Metamorphics to the west.
- The northern boundary coincides with drainage features, which are assumed to be tidal and forms a constant head.
- The southern boundary coincides roughly with surface water drainage divides and is likely to form a local no-flow boundary.

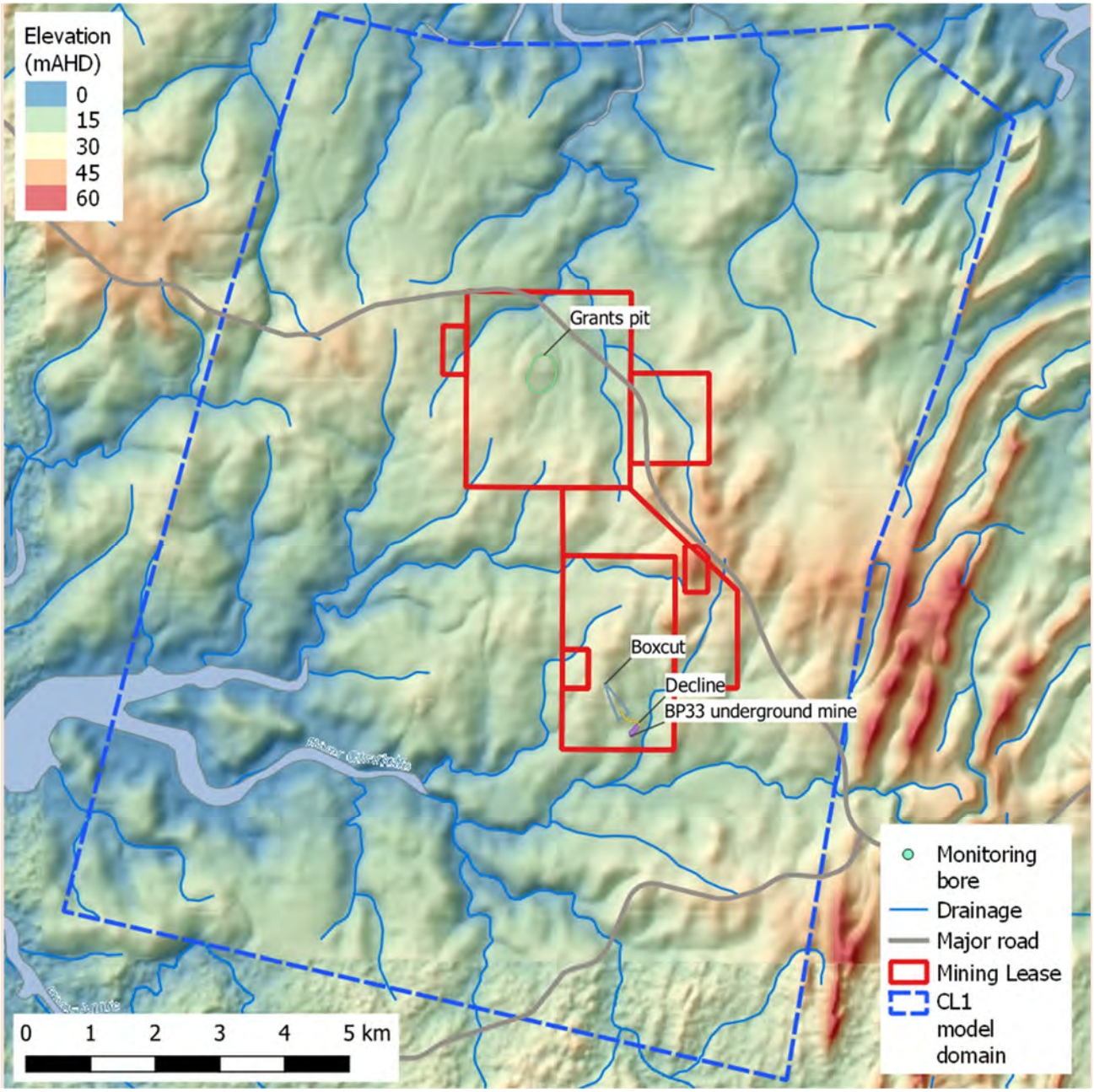



Figure 3-1 Core Lithium groundwater model domain.

## 3.3. Hydraulic characteristics

The BCF comprises heavily weathered shale, siltstone and strongly foliated phyllite with lenses of quartz pebble conglomerate. Investigation bores at BP33 intersected a thin cover of Quaternary sediments overlying the BCF. These sediments range in thickness from 2 – 4.5 m and comprise of silty sands with minor laterite horizons. With the exception of one site (BPG2s) the Quaternary sediments were unsaturated during the late dry season.

Low yielding localised fractured and weathered aquifers are present in the BCF typically occurring at the base of the weathered zone. Discrete aquifers also occur where drilling intersects fracture zones within the fresh BCF. The most permeable sediments occur in the Cenozoic sands and gravels, and the laterised top of the Burrell Creek Formation. However, the potential of these deposits to store and transmit groundwater is not significant due to their

limited saturated thickness. The permeability of the BCF is relatively low with hydraulic testing indicating hydraulic conductivity values of around 0.03 m/d for unfractured BCF and 1 m/day for fractured BCF. The storage characteristics are unknown, however, the specific yield is expected to be low and in the order of 0.01. In the absence of site data the specific yield is based on typical values for weathered and fractured rocks and is consistent with values adopted for other groundwater modelling studies undertaken in similar hydrogeological environments (i.e. the Burrell Creek Formation).

## 3.4. Groundwater flow dynamics

Groundwater flows in a south-easterly direction across the BP33 site, moving from more elevated terrain in the north-west of the site to lower lying areas along the drainage line in the south-east. The groundwater flow direction does not vary significantly between the wet season and dry season, however, groundwater gradients steepen in the north-west during the wet season suggesting that preferential recharge occurs in the elevated areas. Groundwater levels in the lower lying areas rise rapidly in response to wet season recharge before plateauing as they approach ground level. The groundwater level response suggests that BCF aquifer effectively fills up to capacity in the lower lying areas during the wet season. Vertical gradients suggest that the lateral movement of groundwater from elevated areas, rather than direct recharge from rainfall or surface water, drives the water level response in the lower lying areas.

Regionally, there is limited groundwater level and elevation data. However, the watertable around the study area is likely to broadly mirror the topography. A catchment divide occurs in the north of the site, which separates the BP33 site from mine activities at the GLP 4.5 km to the north-west. A groundwater divide is inferred along the catchment divide with groundwater around BP33 moving generally in a southerly direction toward Bynoe Harbour.

## 3.5. Recharge

Two mechanisms provide recharge to the aquifers of the study 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) (Lerner et al., 1990).

Groundwater level monitoring data suggests that direct recharge is likely to be the dominant mechanism across the BP33 site.

Estimates of recharge rates are based on the watertable fluctuation method (WFM) (Healy, 2010). Based on the water level monitoring data an annual water level variation of 9 m is assumed for bores in the elevated areas (BPG1 and BPG6). For the bores in the lower lying areas the annual variation in groundwater level is assumed to be between 3 – 6 m. A specific yield range of 0.01 – 0.02 is adopted in the recharge estimate. The WFM approach estimates recharge rates at between 30 – 120 mm/year for the lower lying areas and 90 – 180 mm/year for the more elevated areas.

## 3.6. Groundwater Discharge

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; and
- 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 1110 mm for an annual rainfall of 1720 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.

## 3.7. Water budget

### 3.7.1. Catchment water budget

The saturated water balance should satisfy the following flux equation:

$$REg - \Delta Ly - \Delta D - EVT - A = \Delta S$$

Where:

- REg = gross recharge to the saturated zone
- ΔLy = net horizontal flow of groundwater across the model boundaries
- ΔD = net drainage from groundwater to surface water
- EVT = evapotranspiration from the groundwater
- A = groundwater abstraction
- ΔS = change in groundwater storage

That is the sum of the fluxes is equal to the change in groundwater storage in the aquifer. All fluxes vary in space and time. Some values can be measured directly, for example, the discharge from extraction wells, whereas other values have to be indirectly evaluated by appropriate methods or models.

The absolute value of these fluxes is likely to contain error due to spatial lumping, parameter estimation and various assumptions used in the calculations. However, the input parameters such as aquifer geometry, transmissivity and specific yield are considered to be reasonable and the underflow and storage values determined are also reasonable. However, due to the nature of the recharge processes analytical estimates are likely to be accurate to only an order of magnitude and are expressed as long-term averages.

## 3.8. Summary hydrogeological conceptualisation

Groundwater flow around the BP33 site occurs in a fractured and weathered aquifer within the BCF. The pegmatite, which hosts the lithium resource, has limited spatial extent and negligible primary porosity. It is expected to operate as a fractured rock aquifer with similar or lower permeability than the surrounding host rock (BCF). Alluvial deposits occur around drainage lines and from in-situ weathering of the BCF but are thin (< 4.5 m), discontinuous and typically only saturated during the wet season.

The weathering profile in the BCF is significant to the groundwater dynamics. Based on examination of numerous boring logs, the top 3 m of material is generally completely weathered, very highly fractured, or unconsolidated. The weathering profile generally extends from 30 to 60 m below land surface. Weathering is often associated with increased fracturing, infilling of fractures with clay or mineralisation, or oxidation. The degree of weathering decreases with depth. The alluvium and uppermost weathered portion of bedrock have the potential to transmit reasonable volumes of groundwater, especially during rain events. However, they are generally unsaturated except in the immediate vicinity of the local streams and surface water bodies. Also, the infilling and mineralisation along fractures in the weathered zone above 30 m depth has the potential to cause a decrease in their transmissivity.

Groundwater flow in the BCF aquifer is away from slightly elevated areas in the north-west and toward lower lying areas along the drainage line in the east and south of the site. The regional groundwater gradient is toward the south and the groundwater flow direction generally mimics the topography. A groundwater flow divide is inferred along the topographic divide located in the north of the BP33 site.

Streams in the area are inferred to act as the discharge points. Topographic highs and surface water ponds, including the existing BP33 pit-lake and proposed dams/water storages, act as recharge areas. Groundwater recharging in the vicinity of the BP33 mine and its infrastructure is expected to migrate offsite, either as discharge to surface water features or through evapotranspiration losses.

Table 3-1 Summary of key features of the hydrogeological conceptualisation

| ASPECT FEATURE(S) | DESCRIPTION |
|---|---|
| Hydrostratigraphy | Groundwater is present in the weathered and fractured Burrell Creek Formation. The thin veneer of alluvial sediments is predominantly unsaturated across the site with groundwater only present during the wet season. |
| Flow dynamics | Groundwater generally flows from north to south and locally from areas of higher topography to areas of lower topography such as drainage features. |
| Recharge processes | Recharge primarily occurs as diffuse recharge. This hypothesis implies that preferential recharge is not significant. |
| | Total recharge fluxes were estimated at 16.7 GL/year, which (for an assumed total recharge area of 167.5 $km^2$), equate to rates of approximately 100 mm per year, or $2.7\times10^{-4}$ m/d. |
| Discharge processes | Diffuse discharge also occurs via streambed seepage (unquantified) and via evapotranspiration from shallow groundwater. The fluxes were estimated at 4 GL/year respectively. |
| | Total discharge fluxes were estimated to range from 17 to 18 GL/year, which (for an assumed total discharge area of 167.5 $km^2$), equate to rates of approximately 90 – 104 mm per year, or $4\times10^{-4}$ to $7\times10^{-4}$ m/d. |

# 4 Groundwater flow model design

## 4.1. Introduction

## 4.2. Model platform

The FEFLOW (Finite Element subsurface FLOW and transport system v 7.3.6) modelling code was developed by DHI-WASY GmbH (Diersch, 2015). This code is an industry standard groundwater modelling tool to study groundwater level behaviour within groundwater systems.

FEFLOW handles a broad variety of physical processes for subsurface flow and transport modelling, and simulates groundwater level behaviour indirectly by means of a governing equation that represents Darcy groundwater flow processes.

FEFLOW provides the capability to explicitly model recharge processes and surface water/groundwater interactions. Rejected recharge is an important mechanism in Top End groundwater systems and adequately characterising this process is critical if the model is to accurately assess the impacts from the mining development. The ability of FEFLOW to explicitly model rejected recharge and surface water/groundwater interactions are major reasons for its selection as the preferred modelling code for the BP33 groundwater model.

## 4.3. Model domain and grid

### 4.3.1. Model domain

The 3D finite difference model domain is roughly centred on the Core mining activities and covers an area of 167.5 km$^2$ which is about two and a half times the area of the GLP model (77.2 km$^2$). The mesh has been refined within the footprint of GLP pit and the BP33 box-cut and underground workings. The model domain is discretised into a mesh consisting of 12089 elements per layer.

The final FEFLOW mesh extents are summarised in Table 4-1 and the model domain is presented below in Figure 4-1.

Table 4-1 Core Lithium project numerical flow model domain specifications.

| | |
|---|---|
| **X min** | 685624 |
| **X max** | 700337 |
| **Y min** | 8588042 |
| **Y max** | 8604892 |
| **Model area** | 167.5 km$^2$ |
| **Map projection** | GDA94 / MGA zone 52 |

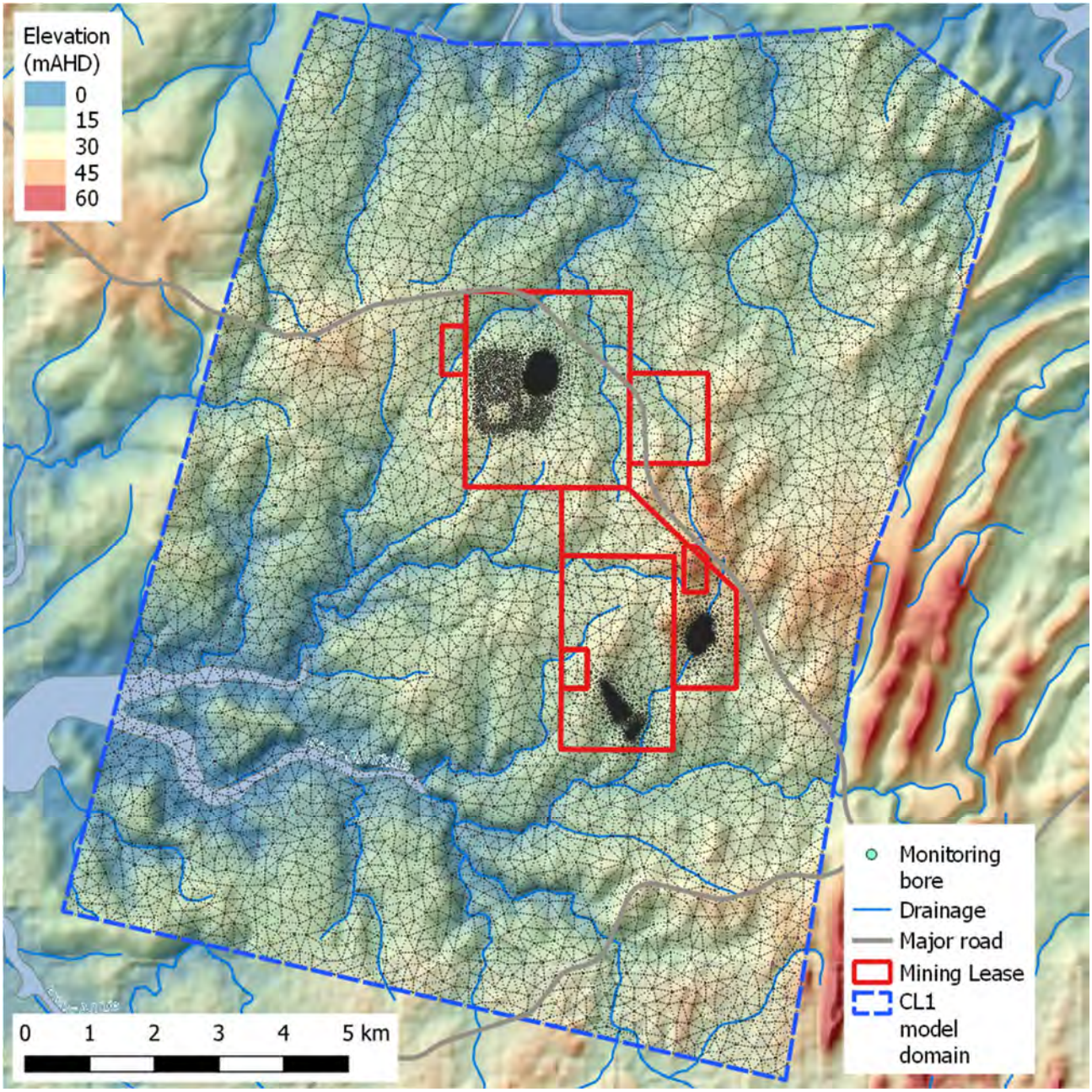



Figure 4-1 Core Lithium Project FEFLOW groundwater model domain and grid.

### 4.3.2. Boundary conditions

The boundary conditions (BCs) are defined at nodes along the boundary or within the model domain. There are four main boundary conditions available in FEFLOW.

- Head BCs – this type of BC prescribes a head at the boundary node. The head can be fixed at a prescribed value or assigned to a time series file.
- Flux BCs - this type of BC describes a constant or time varying flux across the outer boundary of the model. A time varying flux can be specified as a mean step-accumulated discharge (e.g. $m^3/d$). A positive value implies an inflow to the model cells.

- Well BCs - this type of BC is applied to nodes and represent a time-constant or time-varying local injection or abstraction of water at a single node or at a group of nodes. No well BCs are currently employed in the CL1 model.
- Zero flux BCs - This is a flux BC that specifies no-flow, which is the default at the edges of the model domain.
- Seepage face BCs - A seepage face is a specified head BC with a zero-flux inflow constraint applied. This means the BC can discharge groundwater from the model domain, but no inflow to the model domain can occur.

The locations of the boundary conditions at the extents of the model domain are depicted above in Figure 4-1.

### 4.3.3. Areal flux distributions (recharge and ET)

The recharge is applied to the model as a Parameter Expression using the In / outflow on top / bottom areal flux distribution.

The Parameter Expression is a user-defined expression linking the time- varying values of recharge to the In / outflow on top / bottom parameter, based on the dependencies of other parameters, in this case the recharge reference distribution, maximum evapotranspiration flux, extinction depth and reference distribution. Scaling factors are applied to the time-varying rainfall values using the recharge zones and the distribution of ET based on the vegetation mapping.

The ET function is determined using an estimate of the potential evaporation rate, an estimate of root depth or depth of capillary rise where vegetation is absent and the extent of persistent vegetation.

The ground surface along the drainage features is represented by seepage face boundary conditions.

### 4.3.4. Representation of the pit during mining

Dewatering of the GLP pit during excavation is simulated using seepage face boundary conditions that are activated sequentially in time. A seepage face is a specified hydraulic-head boundary condition with a zero-flux inflow constraint applied. This means the boundary condition can discharge groundwater from the model domain, but no inflow to the model domain can occur. The implication of using seepage face boundary conditions to represent the pit is that the inflow to the pit is a predicted output of the modelling.

The seepage face requires a reference elevation, which in this case has been determined from the planned progression of the pit-levels over the life of mine (CloudGMS, 2018).

### 4.3.5. Post closure pit-lake representation

The development of the pit-lake post mine closure is represented by the IfmLake module developed by DHI.

IfmLake is an IFM plug-in which allows the incorporation of lakes within a FEFLOW model. The plug-in calculates the development of water levels from internal fluxes (received or discharged by the lake from the groundwater model) and/or external fluxes (such as rainfall and evaporation defined by the user). The plug-in dynamically adjusts the horizontal extent of the lake depending on water level and surface elevation.

IfmLake uses the pit-lake bathymetry ("IfmDTM"), the external net inflow into the lake ("InflowExtMM" such as evaporation and rainfall) and a function describing the water level vs the lake volume f(Volume).

If the water level in the lake is higher than the surface level at a node, a third kind boundary condition is set at this node with a value identical to the lake water level (in mAHD). Additionally, a head boundary constraint is set with a value identical to the nodal value of the reference distribution "IfmDTM". This constraint limits the value (href - hgw) to the actual water depth at the node (href – dtm). This is useful if the groundwater level drops below the base of the lake.

InflowExtMM represents an external net inflow into the pit-lake (such as evaporation and rainfall). This rate is given in mm/d and the area of the lakes is taking into account during the simulation (in principle the area of the lake is determined at the beginning of each time step).

The level of the lake is calculated using an empirical function f(Volume) relating lake water level to pit-lake storage volume. The Volume stored in the pit-lake at the end of the time step is calculated by *Volume_end* = *Volume_begin* + (*InflowGW* + *InflowExtMM*)*dT.

### 4.3.6. Vertical discretisation / model layers

A total of three model layers were used to represent the groundwater flow system. The layers coincide with the upper completely weathered / laterised horizon, the moderately /highly weathered zone to 30-40 metres below ground levels and the slightly weathered / fresh rocks.

The fresh basement rocks are discretised using slices corresponding to the underground stope horizons (-90m, -150m, -210m, -270m, -330m and -360m) presented previously in Figure 2-14.

## 4.4. Transient model design & construction

### 4.4.1. Simulation period and time stepping

The period from 01/01/2010 to 01/06/2021 (40179 – 44348d) was selected as the period for parameter estimation. This period was selected because it provides a reasonable 'warm-up' period prior to the period of available groundwater levels. The FEFLOW simulation time, equation solver and numerical settings are presented in Table 4-2.

Table 4-2 FEFLOW simulation specification settings

| | |
|---|---|
| **Model code** | FEFLOW |
| **Software version** | 7.3.6 (x64) |
| **Mesh** | |
| Element geometry | Triangle prism |
| Free surface | 3D phreatic surface (fixed mesh) |
| **Head limits for unconfined conditions** | |
| Top of model domain | Unconstrained head |
| **Storage change in phreatic top layer** | Extend storage of unconfined layer to water table |
| Bottom of model domain | Unconstrained head |
| **Numerical parameters** | |
| Time stepping | Adams-Bashforth/Trapezoid rule (AB/TR) predictor-corrector |
| **Error tolerance** | |
| Euclidian L2 integral (RMS) norm | 5e-03 |
| Maximum number of iterations per timestep | 12 |
| Equation System Solver | Preconditioned conjugate-gradient method |

### 4.4.2. Error tolerance

The Error tolerance (units: $10^{-3}$) is defined as the averaged absolute error (change in the primary variable) divided by the maximum value occurring in initial or boundary conditions. For the averaging process over all nodes, the default Euclidian L2 integral (RMS) norm was used and set to a value of 5.

### 4.4.3. Transient model initial heads

Initial heads for the transient model were obtained by running the model for a 11.5 year warm-up period starting 01/01/2010 and ending 1/6/2021.

# 5 Parameter estimation

## 5.1. Parameter Estimation Approach & Criteria

Calibration or parameter estimation is the process, subsequent to model design and construction, of determining a set of parameters, boundary conditions and stresses that produce simulated heads and fluxes in order to match field-measured values within a pre-established range of error, so that the model can be accepted as a good representation of the physical system of interest. Finding this set of values from a set of observed heads amounts to solving the inverse problem.

During the calibration process, important model parameters are adjusted, within realistic limits, to produce the best match between simulated and observed data. The process begins with an initial estimation of parameters (hydraulic conductivity horizontal and vertical, specific yield, recharge, boundary conditions, etc.) for each active element in the model mesh. Adjustment of parameters can be done manually through trial and error or automatically.

Regardless of the technique employed all parameter optimisation methods require:

- selection of a number of parameters to be estimated;
- an objective function, that is, a function of the measured values, defined such that its value is to be minimised; and

- constraints that limit the range of possible values of the estimated parameters.

### 5.1.1. Measure of 'goodness of fit'

The 'goodness of fit' of the modelled to the observed data is often measured using a simple statistic. Statistics used in this study to describe the fit of final model output values to observed values include:

The root mean squared error (RMS):

$$RMS = \sqrt{\frac{\sum_{i=1}^{n}\left(W_i * \left(y_i - f(x_i)\right)\right)^2}{n}}$$

Where:

$W_i$ is the i'th observation weighting
$y_i$ is the *i*'th observed value
$f(x_i)$ is the i'th predicted value

The scaled root mean squared error (SRMS) is the RMS divided by the range of measured heads and expressed as a percentage. Weights are sometimes introduced to account for different levels of confidence in different measurements.

$$SRMS = \frac{100}{H}\sqrt{\frac{\sum_{i=1}^{n}\left(W_i * \left(y_i - f(x_i)\right)\right)^2}{n}}$$

Where:

$W_i$ are weights between 0 and 1; and
*H* is the range of measured heads across the model domain.

## 5.2. Parameter estimation results

### 5.2.1. Recharge

The final scaling factor for the recharge was 0.08 which is an average rate of 128 mm/yr. This value is consistent with the recharge determined in similar environments and independent estimates of recharge using the hydrograph fluctuation method (30-180 mm, Section 3.5).

### 5.2.2. Hydraulic conductivity and specific yield

The hydraulic conductivity and specific yield parameter fields were defined for individual layers representing the hydrostratigraphic units developed in the Leapfrog model. The final hydraulic conductivity values are presented below in Table 5-1:

Table 5-1 Final calibrated model parameters.

| LAYER | HSU | HYDRAULIC COND. | SPECIFIC YIELD |
|---|---|---|---|
| **1** | Zone 1 laterite / completely weathered rocks | 0.1 | 0.015 |
| **2** | Zone 2 extremely / highly / moderately weathered rocks | 0.05 | 0.015 |
| **3** | Zone 3 slightly weathered to fresh rocks | 0.02 | 0.01 |

## 5.3. Water balance

### 5.3.1. Total catchment water budgets

The water balance for the entire model domain is presented below in Table 5-2. The imbalance is 342 $m^3$ which is less than 0.001% of the inflows / outflows and several orders of magnitude less than the target criteria of <1%.

The water budget indicates that 19.6 GL/yr enters the model domain as recharge through rainfall. This is equivalent to an annual recharge rate of 117 mm based on a model domain area of 167.5 $km^2$. And is slightly higher but consistent with the range of values presented in Section 3.5.

Nearly all of the groundwater leaving the model domain 19.8 GL/yr (or 118 mm/yr) is through interception by evapotranspiration. The evapotranspiration component is consistent with the estimate provided in Section 3.6.

Table 5-2 Model domain natural water budget for the period 2010 – 2018

| COMPONENT | OUT (-) [$M^3$] | IN (+) [$M^3$] | OUT [GL/YR] | IN [GL/YR] |
|---|---|---|---|---|
| **Dirchlet** | 3.25E06 | 3.25E+00 | 0.3 | 0.0 |
| **Neumann** | 0.00E+00 | 0.00E+00 | 0.0 | 0.0 |
| **Cauchy** | 0.00E+00 | 0.00E+00 | 0.0 | 0.0 |
| **Wells** | 0.00E+00 | 0.00E+00 | 0.0 | 0.0 |
| **Distributed Sink(-) / Source(+)** | 2.25E+08 | 2.28E+08 | 19.6 | 19.8 |
| **Storage Capture(-) / Release(+)** | 2.04E+08 | 1.98E+08 | 17.8 | 17.2 |
| **Totals** | 4.29E+08 | 4.29E+08 | | |
| **Imbalance** | | 6.38E+02 | | |

**Note: The imbalance is equivalent to 1.5e-4%.**

## 5.4. Transient model performance

Barnett et al (2012) recommend that the groundwater model acceptance should be based on a number of measures that may not be specifically related to model calibration. These measures are required to demonstrate that a groundwater model is robust, simulates the water balance as required and is consistent with the conceptual model. The four measures recommended by Barnett et al (2012) are presented below in Table 5-3. The performance of the Finnis Lithium Project BP33 model is discussed in the following sections.

Table 5-3 Recommended groundwater model performance measures (after Barnett, 2012)

| PERFORMANCE MEASURE | CRITERION |
|---|---|
| **Model convergence** | |
| The model must converge in the sense that the maximum change in heads between iterations is acceptably small. | The iteration convergence criterion should be one or two orders of magnitude smaller than the level of accuracy required in head predictions. Typically, of the order of centimetres or millimetres. |
| **Water balance** | |
| The model must demonstrate an accurate water balance, at all times and in steady state. The water balance error is the difference between total predicted inflow and total predicted outflow, including changes in storage, divided by either total inflow or outflow and expressed as a percentage. | A value less than 1% should be achieved and reported at all times and cumulatively over the whole simulation. Ideally the error should be much less. An error of >5% would be unacceptable, and usually indicates some kind of error in the way the model has been set up. |
| **Qualitative measures** | |
| The model results must make sense and be consistent with the conceptual model. Contours of heads, hydrographs and flow patterns must be reasonable, and similar to those anticipated, based either on measurements or intuition.<br>Estimated parameters must make sense, and be consistent with the conceptual model and with expectations based on similar hydrogeological systems. | Qualitative measures apply during calibration, when comparisons can be made with historical measurements, but also during predictions, when there is still a need for consistency with expectations. There is no specific measure of success. A subjective assessment is required as to the reasonableness of model results, relative to observations and expectations. The modeller should report on relevant qualitative measures and discuss the reasons for consistency and inconsistency with expectations. |
| **Quantitative measures** | |
| The goodness of fit between the model and historical measurements can be quantified, using statistics such as RMS, SRMS, MSR and SMSR for trial-and-error calibration and the objective function in automated calibration. | Quantitative measures only apply during calibration. Statistics of goodness of fit are useful descriptors but should not necessarily be used to define targets. Targets such as SRMS < 5% or SRMS < 10% may be useful if a model is similar to other existing models and there is good reason to believe that the target is achievable. Even if a formal target is not set, these measures may provide useful guides. |

### 5.4.1. Model convergence

Section 4.4.2 documents that the dimensionless error criterion in FEFLOW is used for the automatic time-stepping process.

On completion of the transient model runs, the model log was queried and it was confirmed that all timesteps converged to a value less than the error criterion of $5 \times 10^{-3}$.

### 5.4.2. Water balance

The water balance for the entire model domain is presented above in Table 5-2. The imbalance is about 0.00015%, which is several orders of magnitude less than the Class 2 target criteria of <1%.

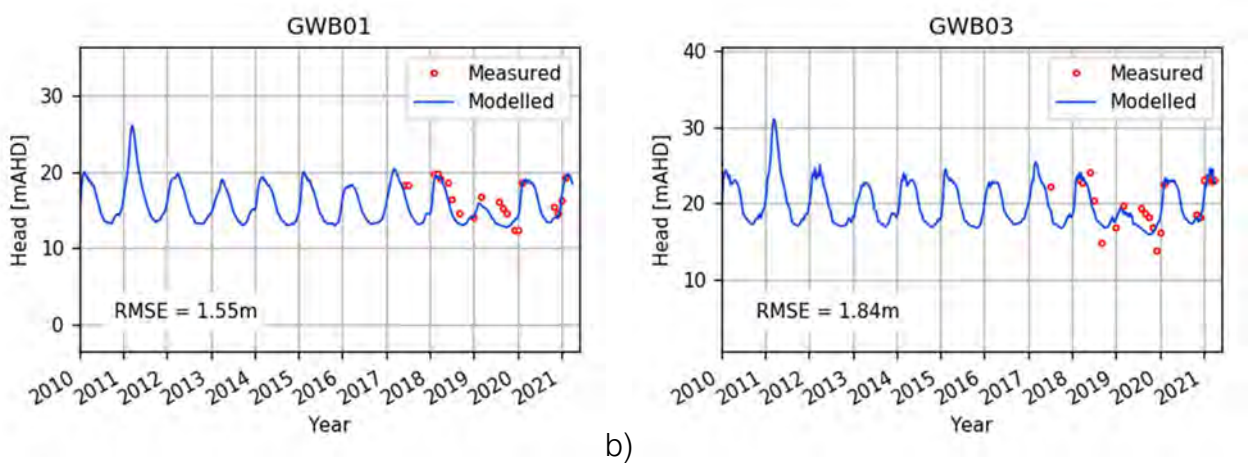
### 5.4.3. Qualitative performance

The final estimated parameters are considered to be consistent with the conceptual model and with expectations based on similar hydrogeological systems.

The modelled water budget is also considered to be consistent with the conceptual model.

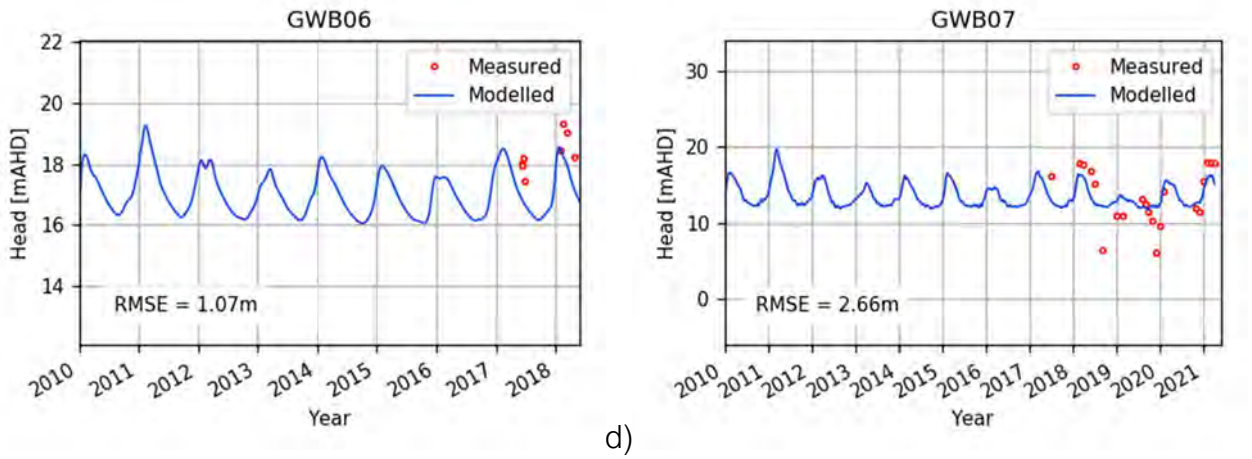
The contours of heads, hydrographs and flow patterns are reasonable, and similar to those anticipated, based on observed measurements. Generally, the absolute modelled groundwater levels are in reasonably good agreement with the observed values. Long term trends in the groundwater levels are generally reproduced. The modelled vertical gradient between GWB08 / GWB10 and GWB06 / GWB07 are also generally reproduced.

The modelled and observed heads at selected sites are presented below in Figure 5-1 to Figure 5-12.



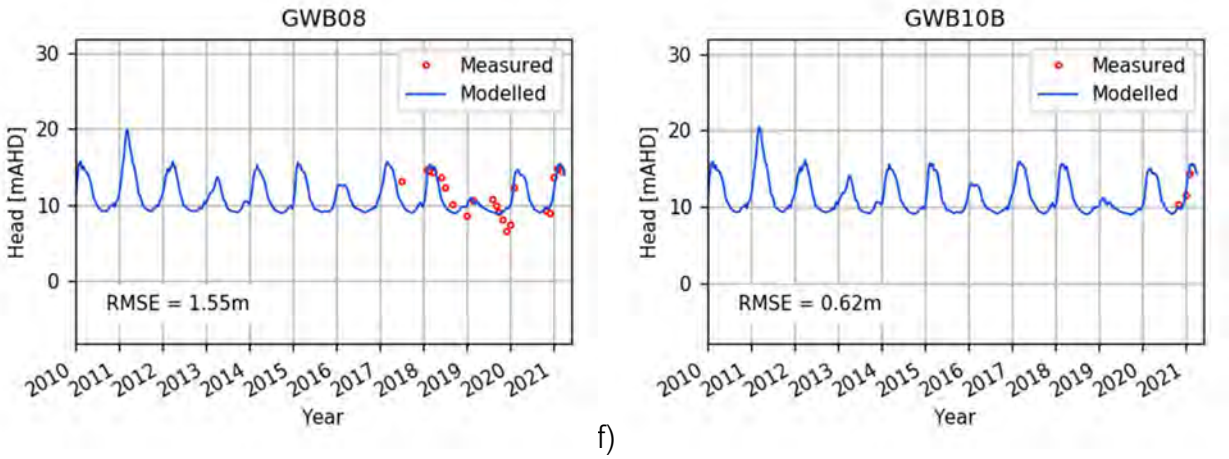

a) b)

Figure 5-1 Comparison between observed and simulated groundwater levels at a) GWB01 (RN040093) b) GWB03 (RN040094).



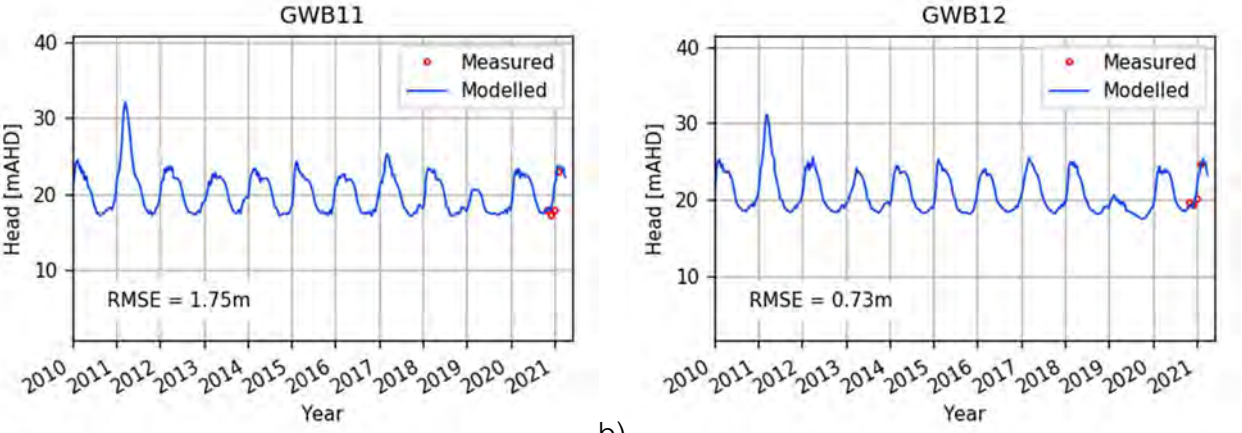

c) d)

Figure 5-2 Comparison between observed and simulated groundwater levels at a) GWB06 (RN040095), b) GWB07 (RN040096).



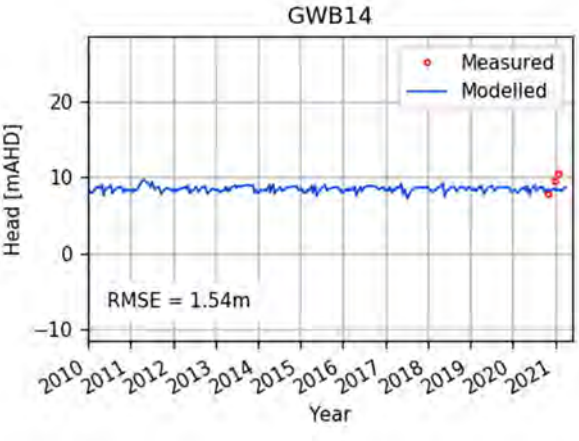

e) f)

Figure 5-3 Comparison between observed and simulated groundwater levels at a) GWB08 (RN040097) and b) GWB10B (RN040098).



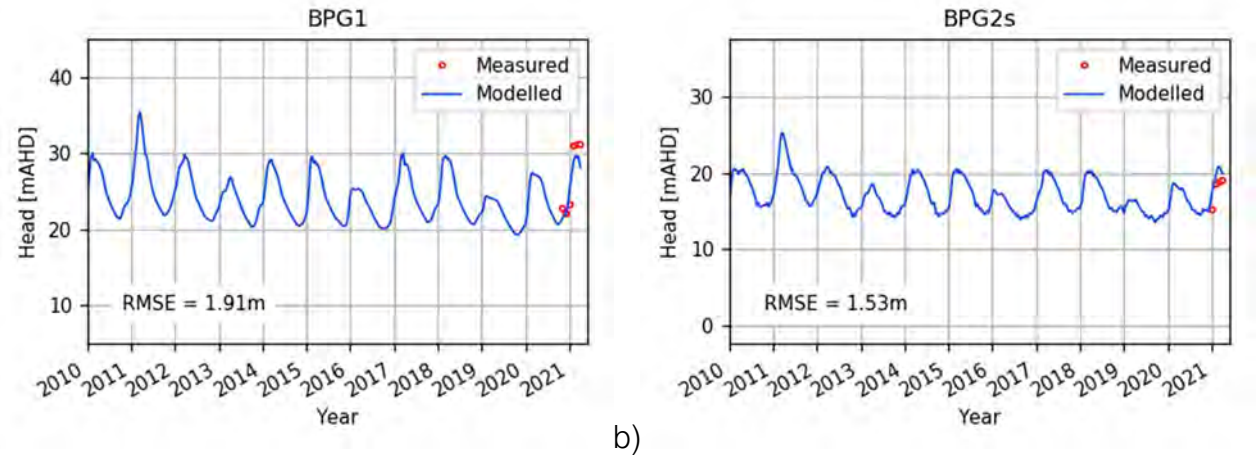

a) b)

Figure 5-4 Comparison between observed and simulated groundwater levels at a) GWB11 (RN041837) and b) GWB12 (RN041839).



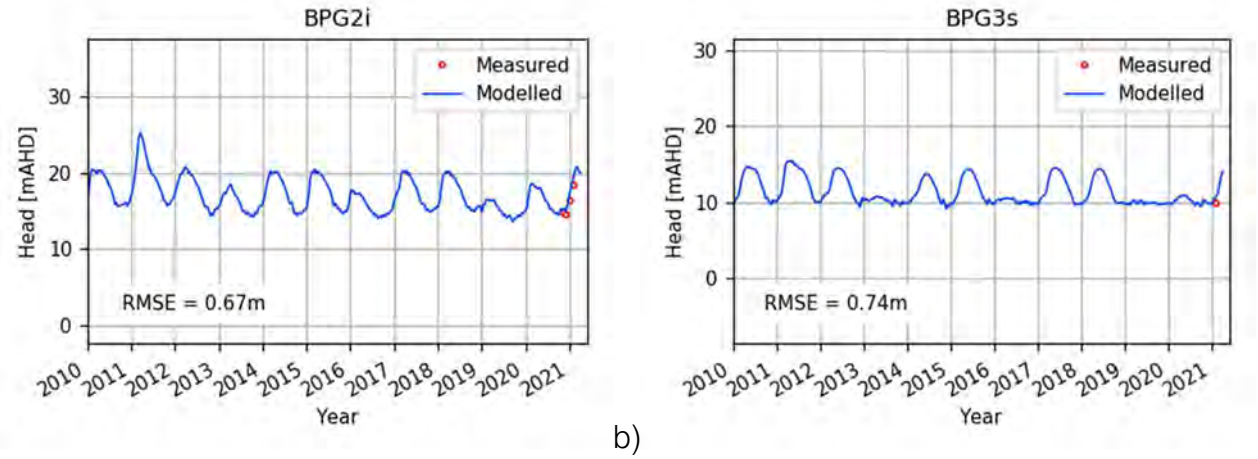

a)

Figure 5-5 Comparison between observed and simulated groundwater levels at a) GWB14 (RN041834).



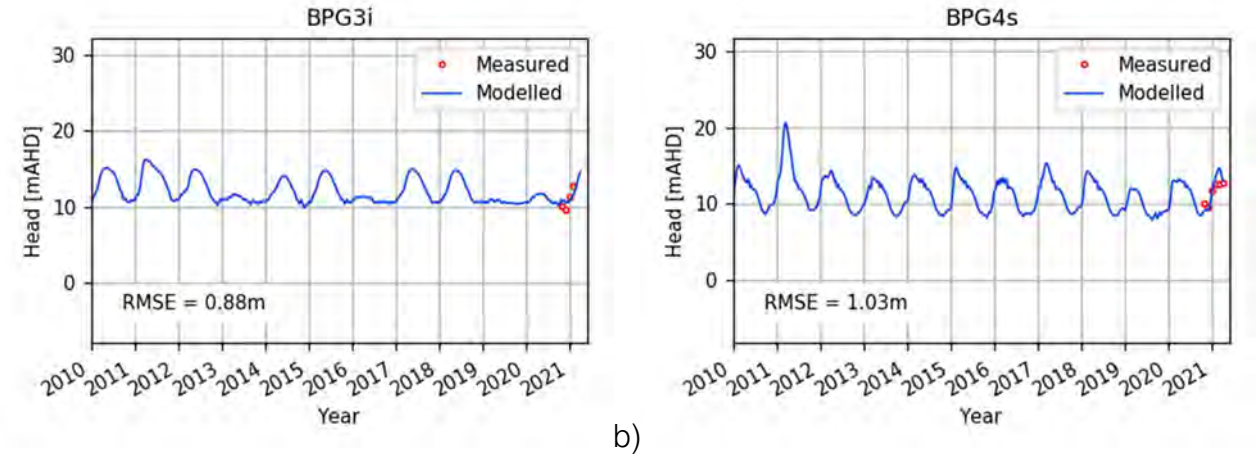

a) b)

Figure 5-6 Comparison between observed and simulated groundwater levels at a) BPG1 (RN041833) and b) BPG2s (RN041792).



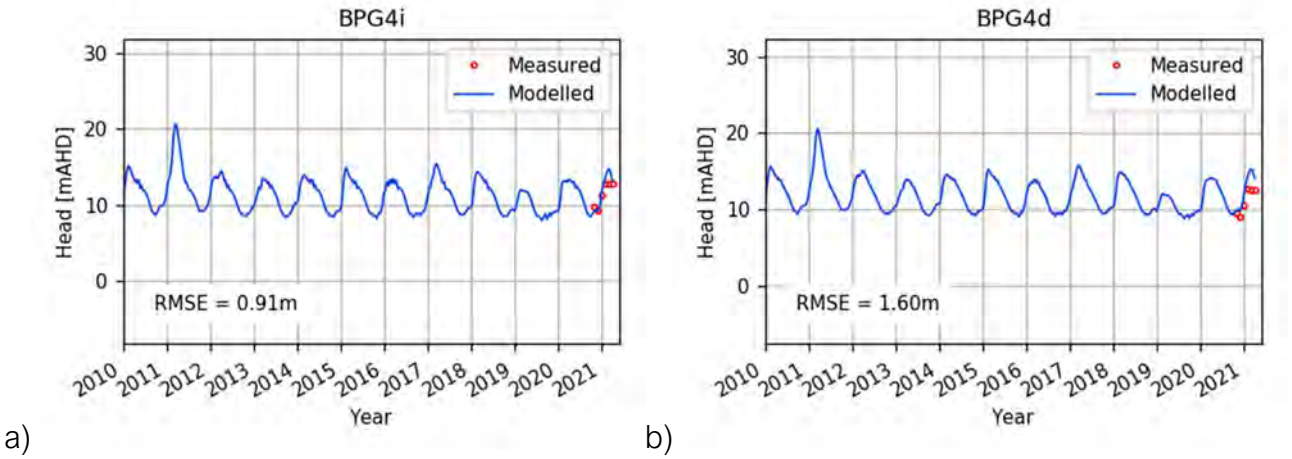

a) b)

Figure 5-7 Comparison between observed and simulated groundwater levels at a) BPG2i (RN041791) and b) BPG3s (RN041794).



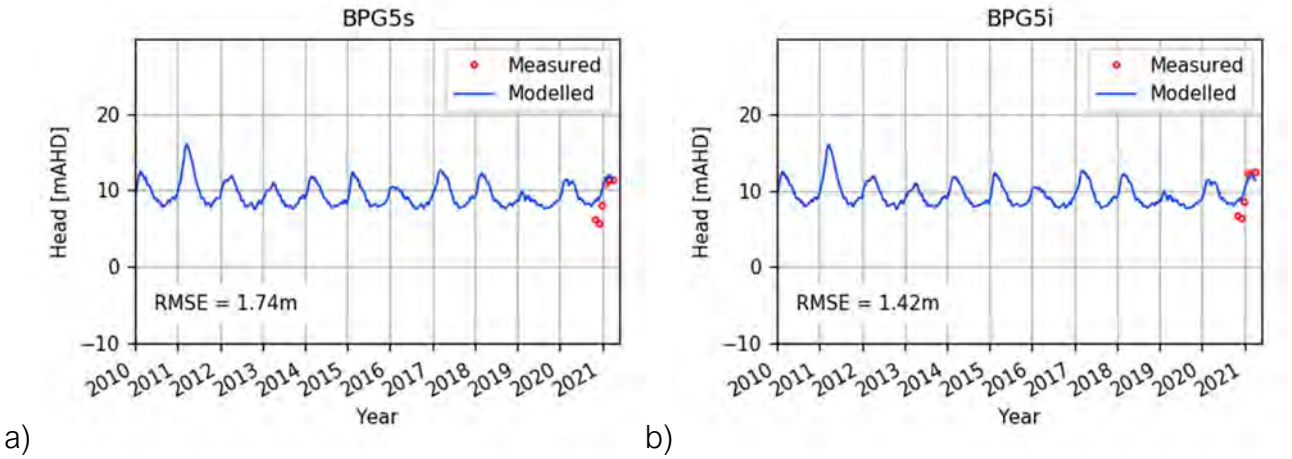

a) b)

Figure 5-8 Comparison between observed and simulated groundwater levels at a) BPG4s (RN041832) and b) BPG4i (RN041831).



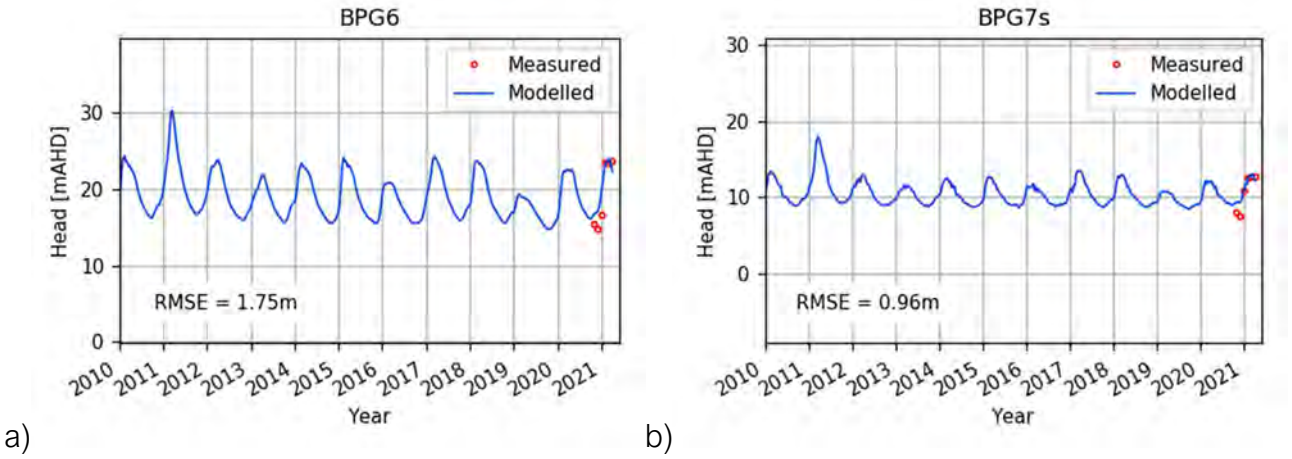

a) b)

Figure 5-9 Comparison between observed and simulated groundwater levels at a) BPG4d (RN041830) and b) BPG5s (RN041795).




a) b)

Figure 5-10 Comparison between observed and simulated groundwater levels at a) BPG5i (RN041796) and b) BPG6 (RN041799).




a) b)

Figure 5-11 Comparison between observed and simulated groundwater levels at a) BPG7s (RN041797) and b) BPG7s (RN041797).

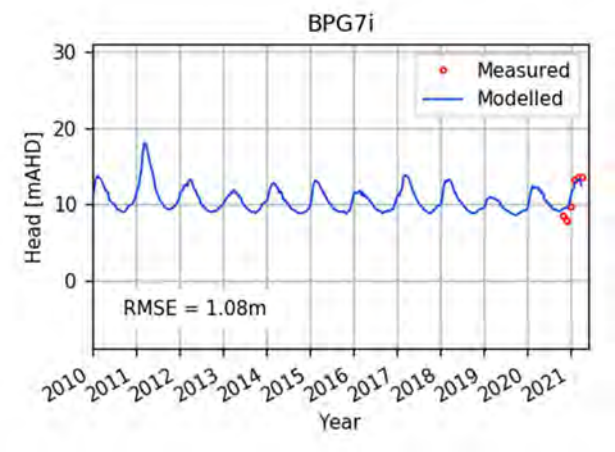



Figure 5-12 Comparison between observed and simulated groundwater levels at a) BPG7s (RN041798).

The modelled and measured heads are also presented as a scatter plot in Figure 5-13. Points below the line indicate the model is underestimating the observed value, whereas points above the line indicate the model is overestimating the groundwater levels. The scatter plot is distributed along the 1:1 fit and point are distributed either side of the line indicating no systemic bias of modelled results.

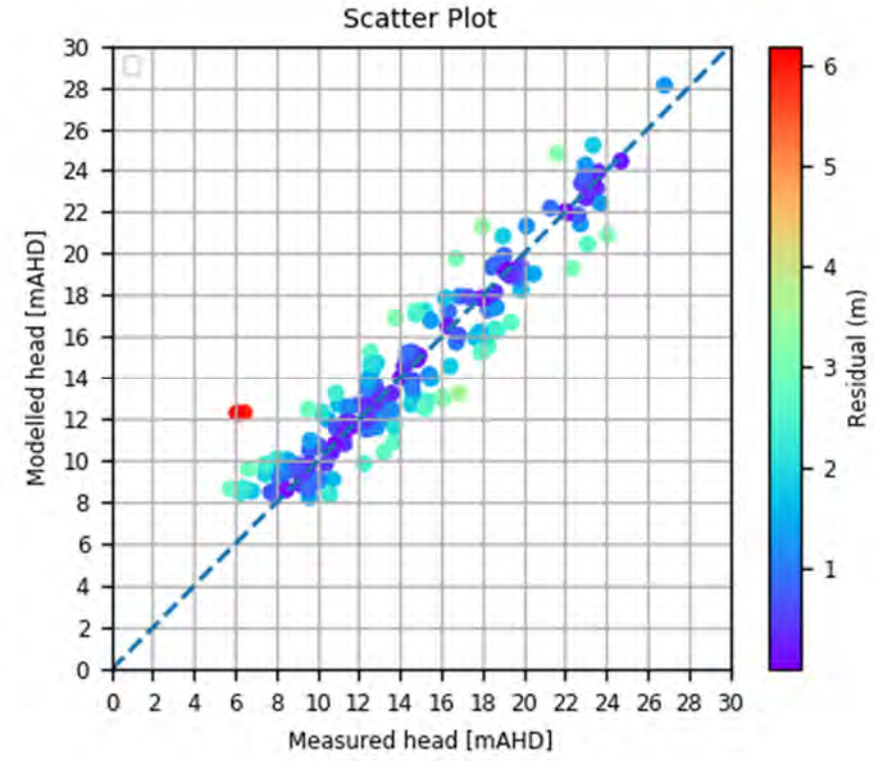



Figure 5-13 Scatter plot of modelled vs measured heads. The point colour indicates the magnitude of the residuals (i.e. the absolute difference between measured and modelled heads).

### 5.4.4. Quantitative performance

At the conclusion of the parameter estimation process the final standard error (RMS) of 1.67 metres. Maximum observed head was 31.2 metres, minimum observed head is 5.75 metres.

The maximum head range of the observed heads is 25.5 metres, therefore, the scaled root mean squared (SRMS) is 6.6% (slightly above the nominal target SRMS of 5%).

Statistical descriptions of the goodness of fit between the observed and modelled groundwater levels are presented in Table 5-4.

Table 5-4 Analysis of residuals using final estimated parameters.

| METRIC | ALL OBS. |
|---|---|
| **Number of residuals with non-zero weight** | 171 |
| **Mean value of non-zero weighted residuals** | 0.08 |
| **Maximum weighted residual** | 6.2 |
| **Minimum weighted residual** | 3.6 |
| **Standard variance of weighted residuals** | 2.8m |
| **Standard error of weighted residuals (RMS)** | 1.67m |
| **Scaled standard error (SRMS)** | 6.6% |

# 6 Forecast model results

This section investigates the impacts of the BP33 box-cut and underground workings, and the cumulative impacts of the Grants Lithium Project (GLP) pit development over the life of the mine and post closure during the development of the pit-lake. The scenarios considered are summarised below:

- Life of mine (60 months – 5 years)
- Post closure (70 years)

## 6.1. Life of mine (LoM) forecast

The life of mine (LoM) forecast scenario was designed to investigate the effect of the BP33 box-cut and underground workings development on groundwater flow dynamics in the area including cumulative impacts from the GLP pit. The following assumptions were made for the predictive model runs:

- All model parameters were taken from the calibrated model;
- Pit shell elevations were applied to the model as detailed in Section 2;
- Passive groundwater dewatering via sumps, with no groundwater dewatering from production bores;
- The model was run for a forecast period of 60 months from the end of the calibration period (Month 0) to the projected end of the mining (Month 59).
- Initial conditions were taken from the final heads of the calibrated model corresponding to 44348d (01/06/2021);
- The time series climatic inputs from the period 1900 – 2000 were repeated to obtain the 100 year time series used to calculated recharge for the forecast post closure model.

## 6.2. Groundwater levels LoM and 60 months post closure

The groundwater level response for bores installed around the BP33 project and the GLP are presented for the 5 year (60 month) life of mine period and an additional 5 years (60 month) post closure period.

### 6.2.1. BP33 groundwater levels

The life of mine (LoM) groundwater levels in the bores around the BP33 box-cut, decline and underground workings are presented below in Figure 6-1 through to Figure 6-7. On the basis of these hydrographs, and the drawdown plot presented in **Error! Reference source not found.**, it is estimated that groundwater levels around BP33 will recover to pre-mining levels within 3 years of mine activities finishing.

These predictions assume that the underground mine and decline are left predominantly as mine voids and that the box-cut is backfilled with material that has a specific yield of 10%. This is a substantially higher storage value than adopted in the modelling for the undisturbed, weathered Burrell Creek Formation (Sy = 1.5%). The higher storage value has been adopted to account for the disturbance of the backfill material during excavation. Currently the storage properties of the backfill material are unknown, however, higher storage properties associated with the voids between backfilled waste rock will result in a greater period of recovery.

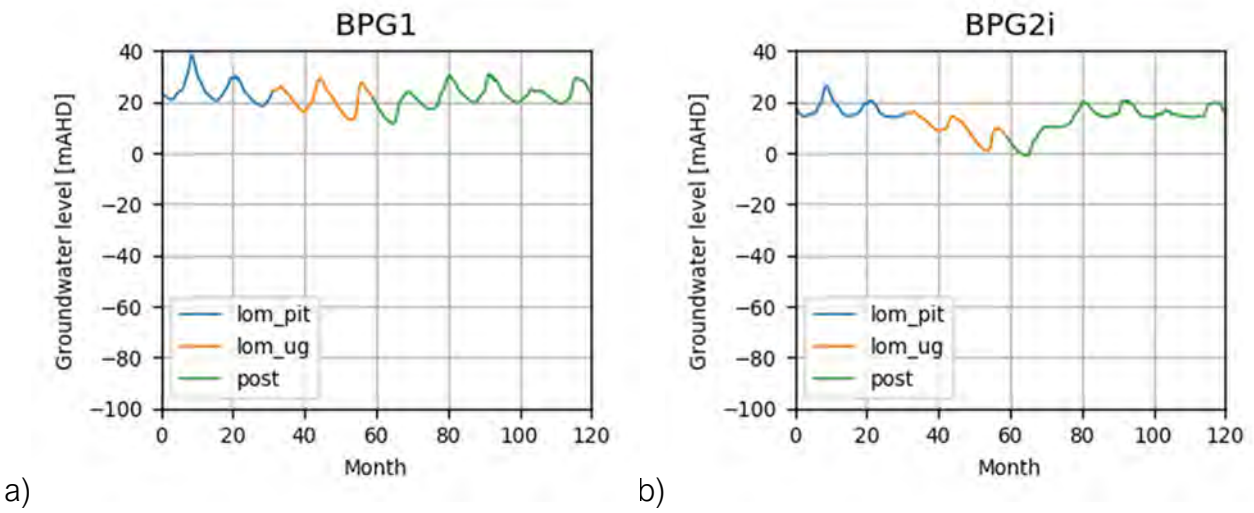



Figure 6-1 Groundwater response during LoM to 60 months post mining at bores a) BPG1 and b) BPG2i.

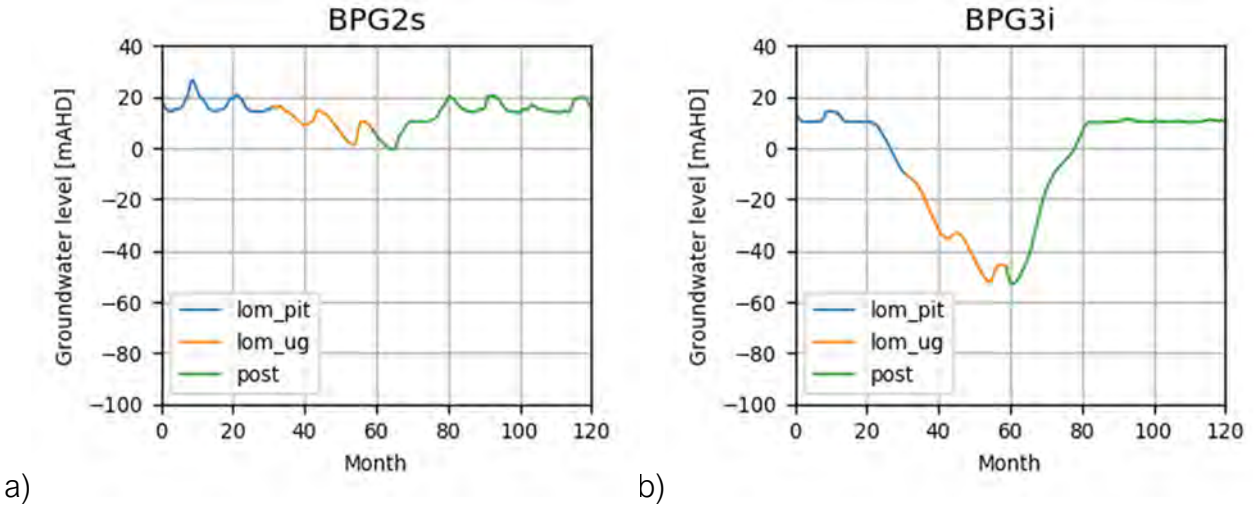



Figure 6-2 Groundwater response during LoM to 60 months post mining at bores a) BPG2s and b) BPG3i.

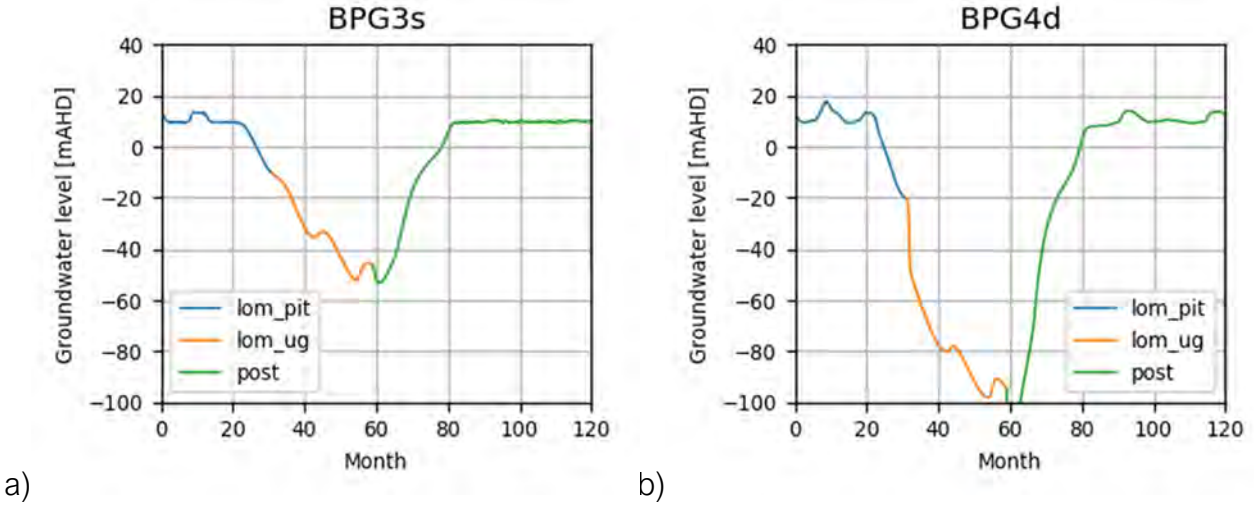



Figure 6-3 Groundwater response during LoM to 60 months post mining at bores a) BPG3s and b) BPG4d.

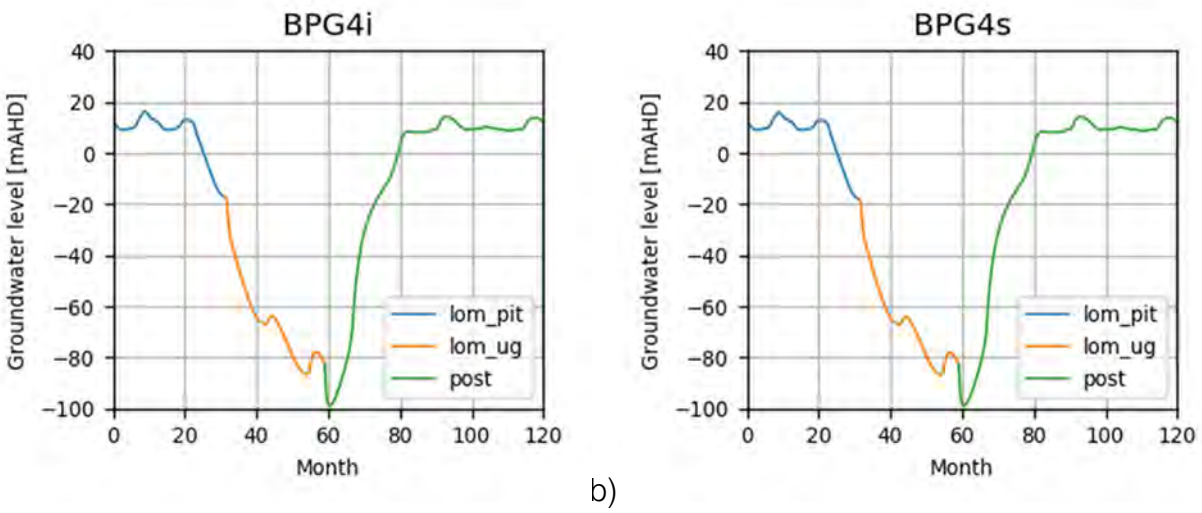



Figure 6-4 Groundwater response during LoM to 60 months post mining at bores a) BPG4i and b) BPG4s.

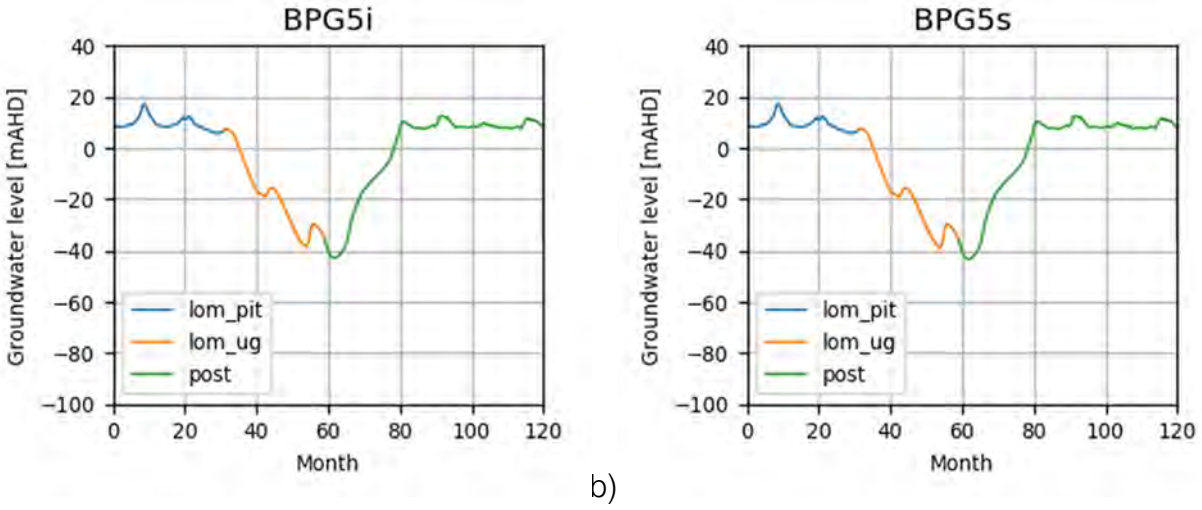



Figure 6-5 Groundwater response during LoM to 60 months post mining at bores a) BPG5i and b) BPG5s.

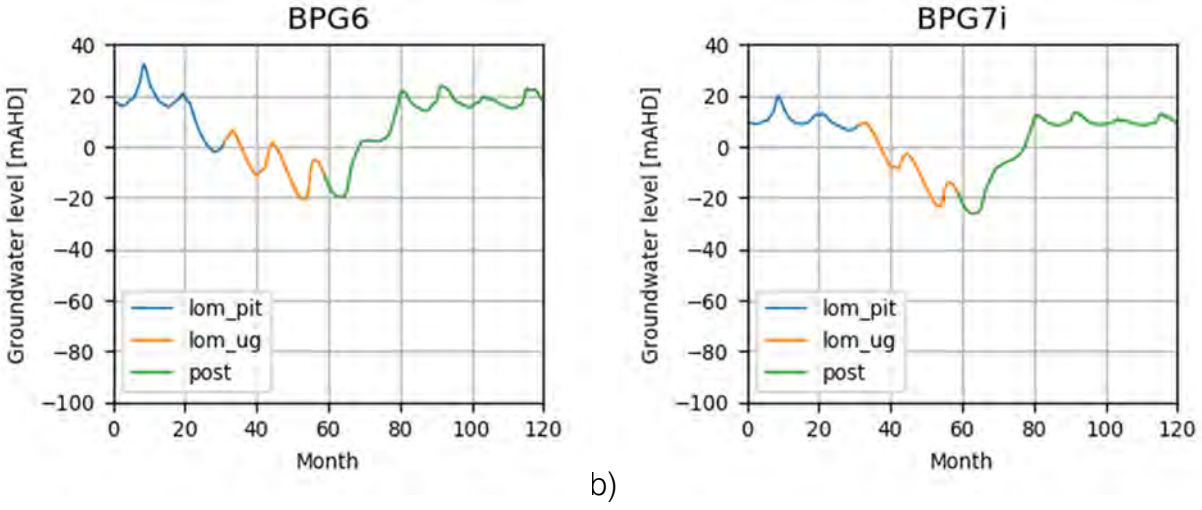
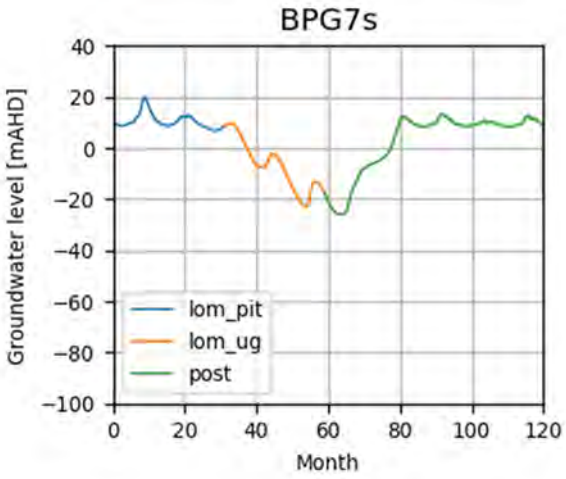



Figure 6-6 Groundwater response during LoM to 60 months post mining at bores a) BPG6 and b) BPG7i.




a)

Figure 6-7 Groundwater response during LoM to 60 months post mining at bore a) BPG7s.

### 6.2.2. Grants groundwater levels

The life of mine (LoM) groundwater levels in the bores around the GLP pit are shown in Figure 6-8 through to Figure 6-12.

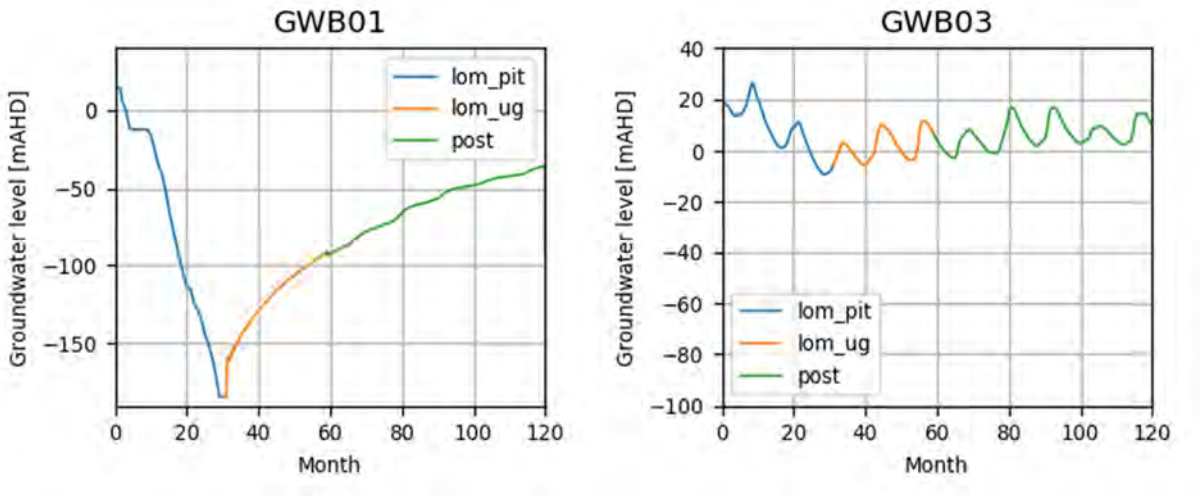



Figure 6-8 Groundwater response during LoM to 60 months post mining at existing observation bores a) GWB01 and b) GWB03.

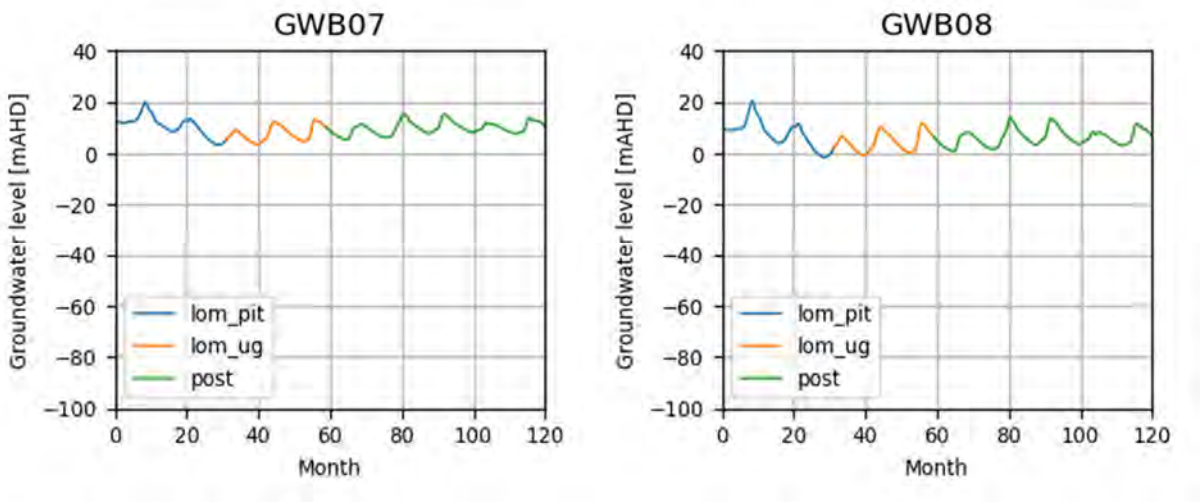



Figure 6-9 Groundwater level response during LoM and 60 months post mining at existing observation bores a) GWB07 and b) GWB08.

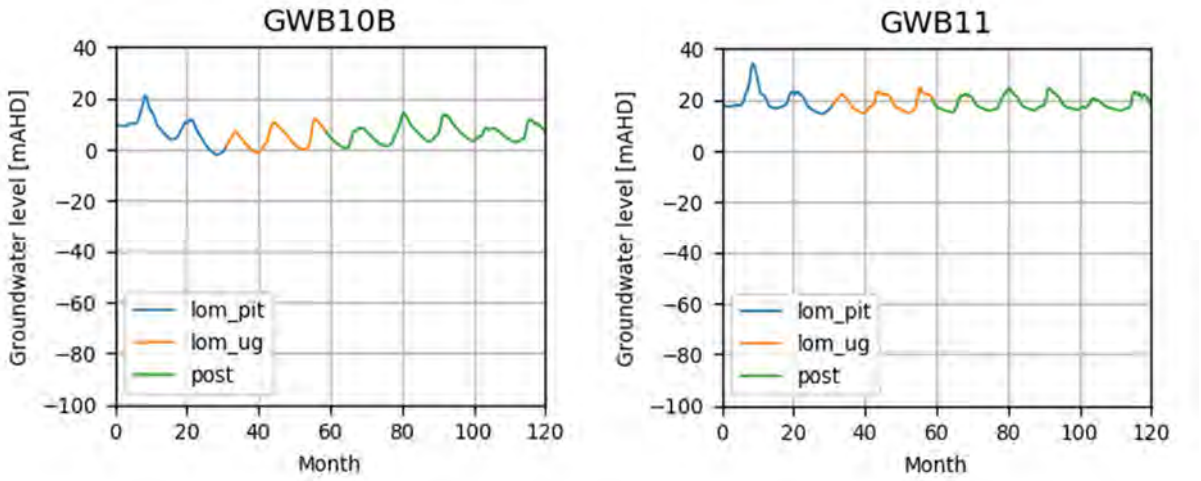



Figure 6-10 Groundwater level response during LoM and 60 months post mining at existing observation bores a) GWB10b and b) GWB11.

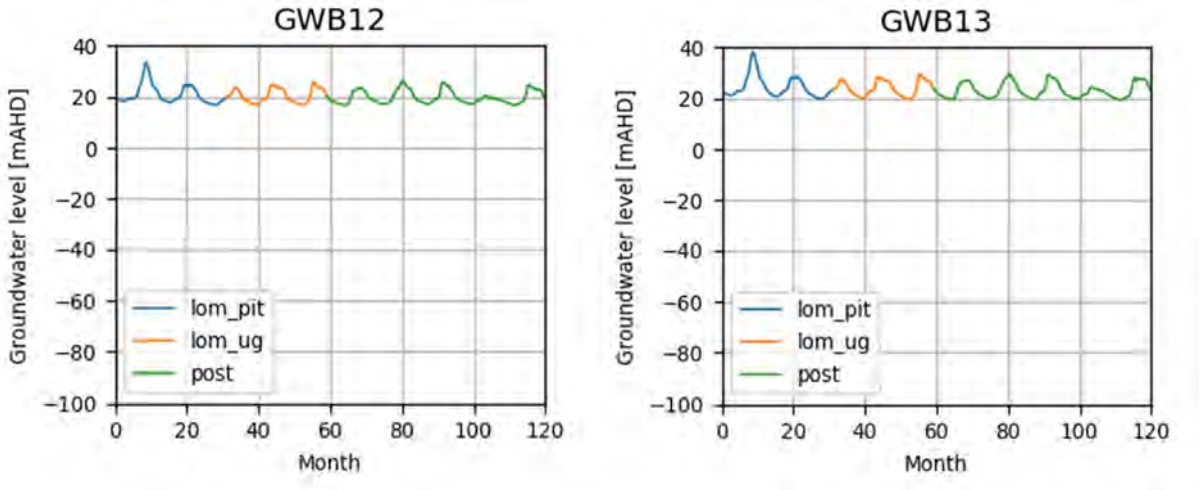
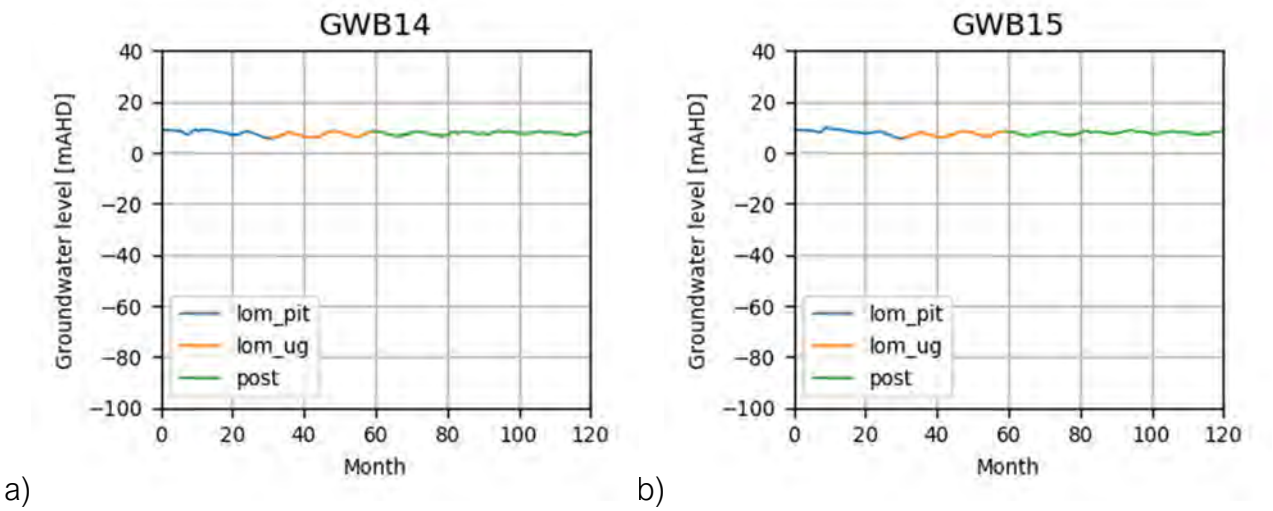



Figure 6-11 Groundwater level response during LoM and 60 months post mining at existing observation bores a) GWB12 and b) GWB13.




a) b)

Figure 6-12 Groundwater level response during LoM and 60 months post mining at existing observation bores a) GWB14 and b) GWB15.

### 6.2.3. Groundwater drawdown contours

The LoM forecast drawdown impacts at the end of the 30 month mining period at the GLP pit, and at the end of underground mining at BP33 (month 60), are presented below in Figure 6-13 and Figure 6-14 respectively.

The predicted drawdown cone resulting from the pit dewatering at the GLP extends towards the mining lease boundary in the north, west and east. In the south-west the 0.1 m drawdown contour approaches the upstream end of an ephemeral drainage line. In all other respects the drawdown is similar to the original GLP model (CloudGMS, 2018) in that it is contained within the mining lease.

The drawdown cone associated with the BP33 mine activities extends beyond the eastern and southern edges of the mining lease. This drawdown is associated with excavation of the box-cut. The drawdown also extends below the areas identified with moderate potential for GDEs. Anecdotally there is some indication that surface pools of water along the drainage line persist through some dry seasons suggesting there is some groundwater dependence. However, the extent of dependence of the GDEs on groundwater is not currently characterised. These ecosystems are likely facultative GDEs, with an infrequent or partial dependence on groundwater.

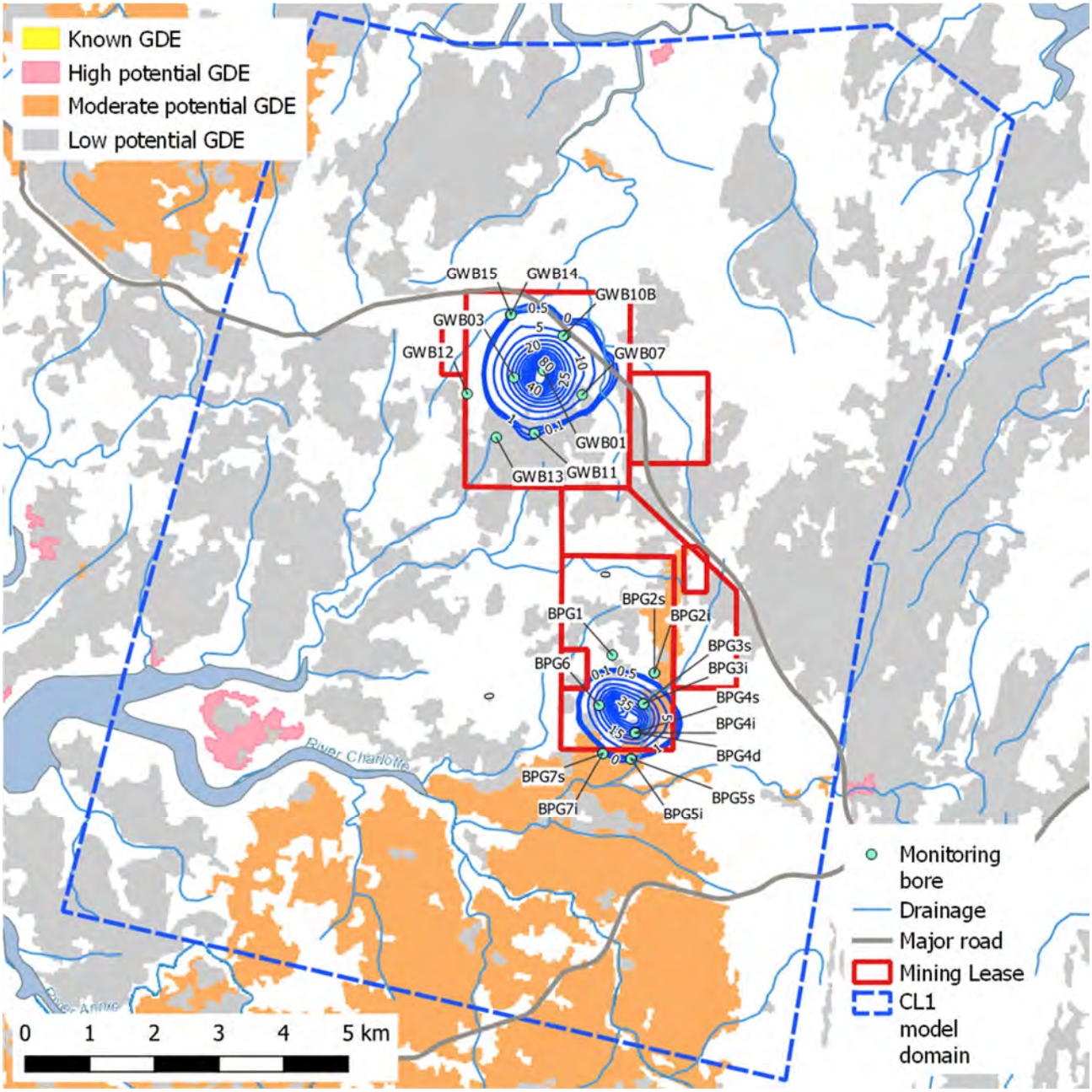



Figure 6-13 Cumulative LoM final drawdown contours after 30 months of mining at the end of mining at Grants pit and after excavation of the box cut and decline at BP33.

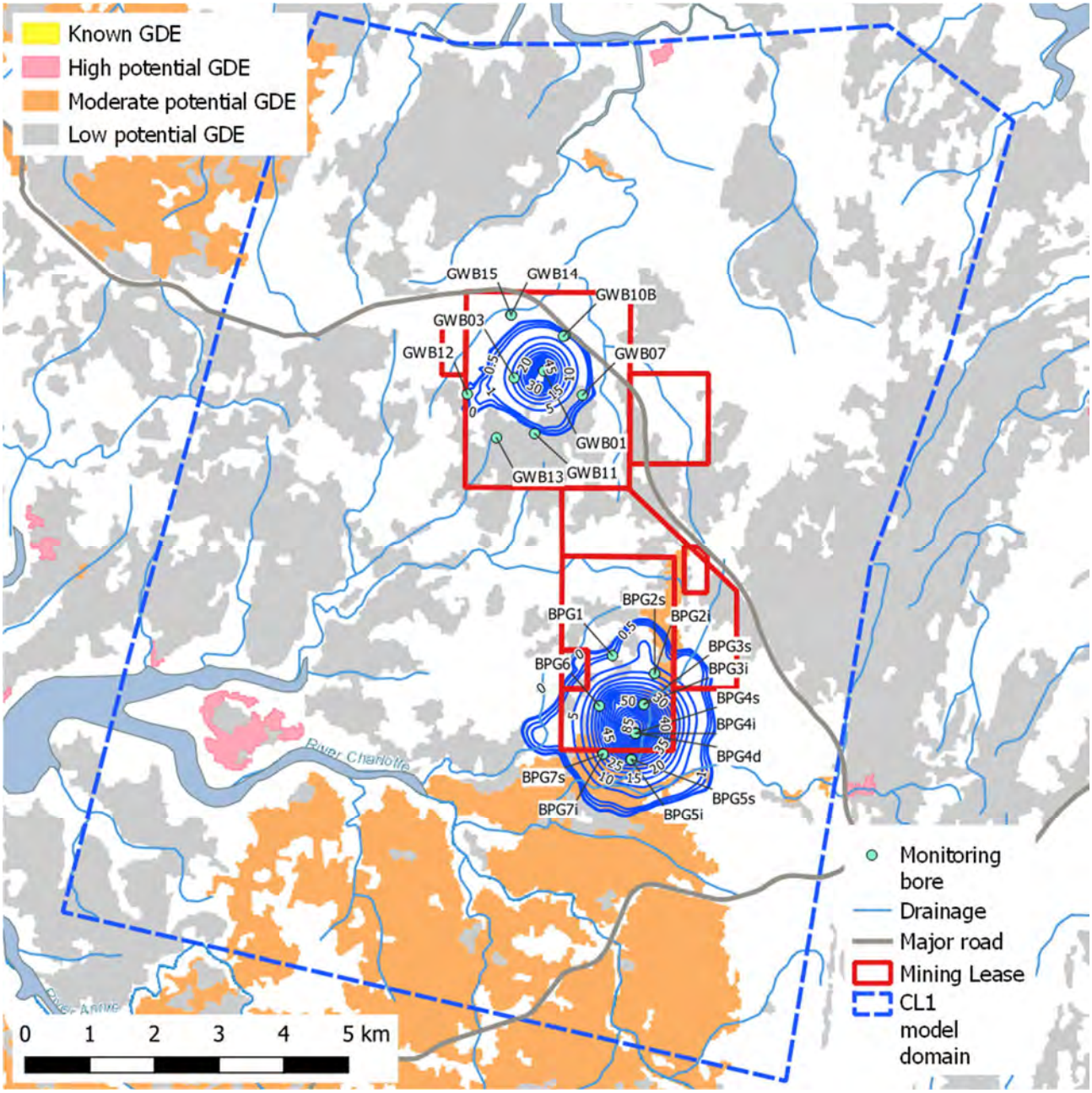



Figure 6-14 Cumulative LoM final drawdown contours after 60 months of mining (30 months recovery at the Grants pit).

### 6.2.4. Life of Mine inflows

The BP33 box-cut, decline and underground mine workings inflows have been determined during the life of mine and are presented below. Inflows to the mine components, expressed as kL/month, are presented below for the box-cut, decline, underground, Grants pit and as total cumulative inflows in Figure 6-15a, Figure 6-15b, Figure 6-16a, Figure 6-16b and Figure 6-17 respectively. Inflows to these components of the BP33 project are briefly described below:

- Inflows at the BP33 box-cut increase from commencement of excavation in month 17 and reach a peak in month 20 at about 2400 kL/d (28 L/s). Inflows to the box-cut steadily

decline to less than 330 kL/d (4 L/s) in month 50 to the end of mining. BP33 box-cut inflows as kL/month over the LoM are presented graphically in Figure 6-15a.

- Inflows from the BP33 decline increase from commencement of excavation in month 23 and reach a peak in month 47 at about 2900 kL/d (34 L/s). Inflows to the decline are steady to the end of mining. BP33 decline inflows as kL/month over the LoM are presented graphically in Figure 6-15b.
- Inflows at BP33 underground increase from commencement of mining in month 31 and reach a peak in month 58 at about 3860 kL/d (45 L/s). Inflows to the underground mine as kL/month over the LoM are presented graphically in Figure 6-16a.
- At the end of mining at Grants Pit, groundwater discharges to the pit and it fills to form a pit lake. The inflows to the pit lake decline steadily from around 2800 kL/d to 2500 kL/d as the groundwater gradient towards the pit reduces as the pit lake fills.

Total cumulative inflows are presented in Table 6-1 and graphically in Figure 6-17.

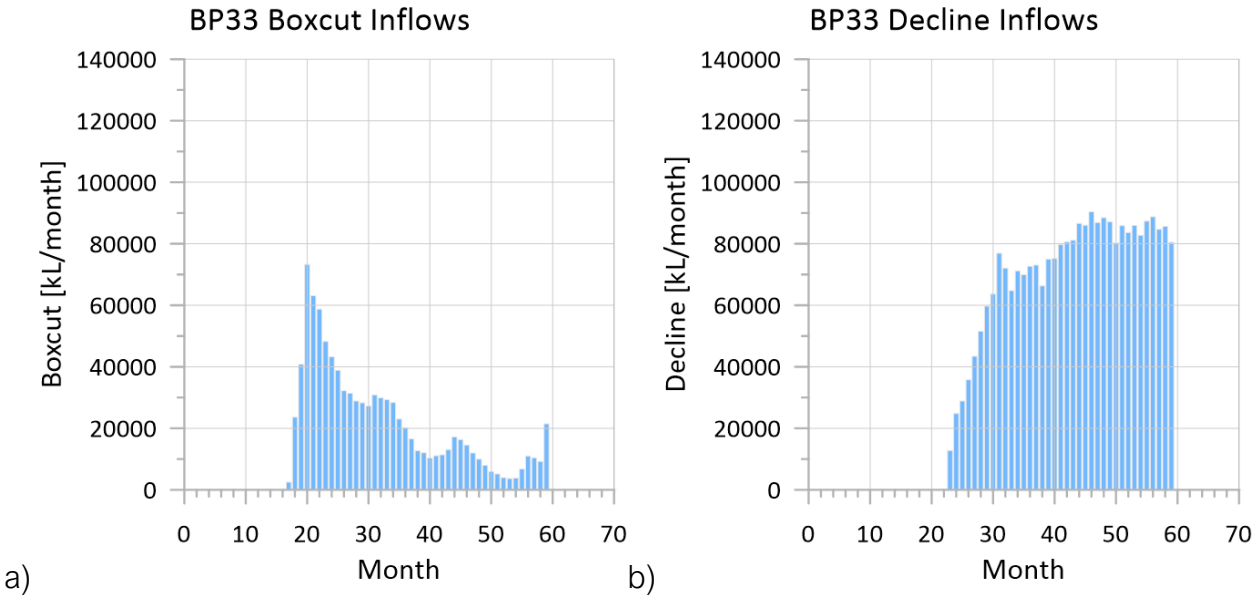



Figure 6-15 Predicted a) BP33 box-cut and b) BP33 decline inflows (kL/month) during life of mine.

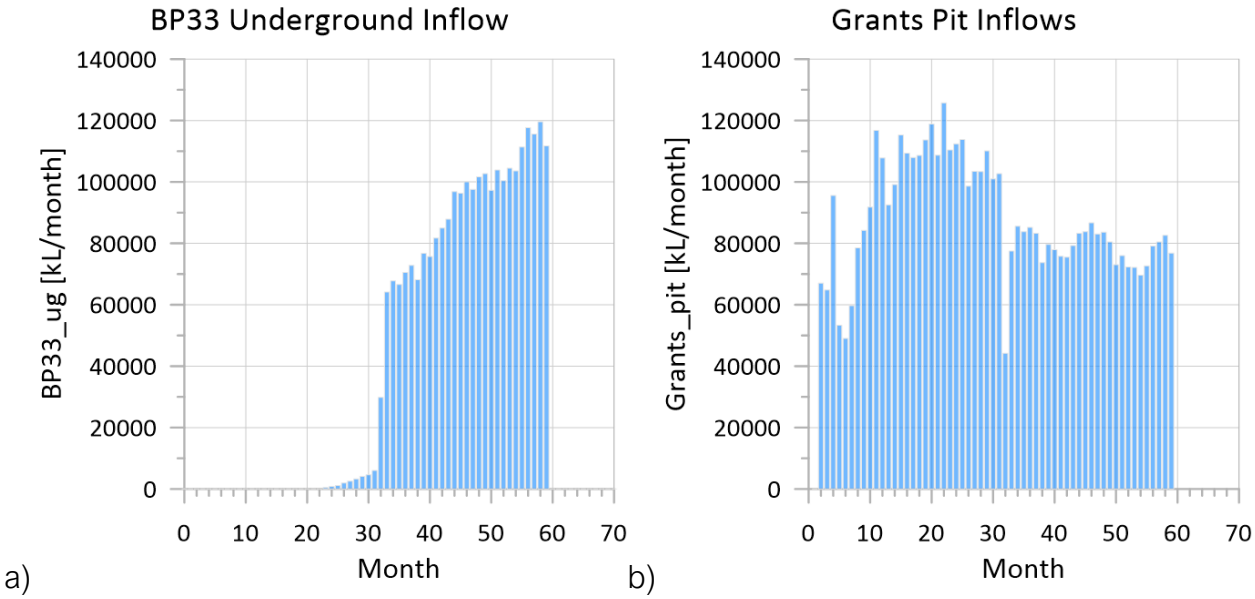



Figure 6-16 Predicted a) BP33 underground mine and b) Grants pit inflows (kL/month) during life of mine.

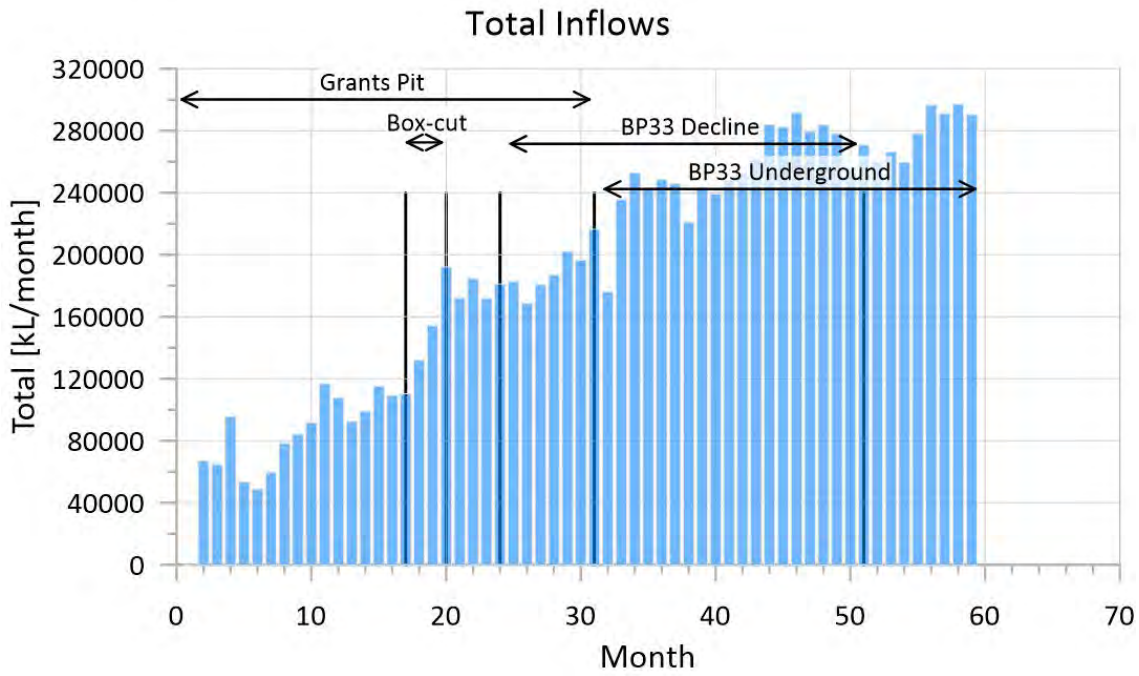



Figure 6-17 Predicted total inflows during life of mine.

Table 6-1 Monthly life of mine inflows expressed as kL/m and kL/d.

| Month | Box-cut kL/m | Decline kL/m | BP33 kL/m | Grants_pit kL/m | Total kL/m | Box-cut kL/d | Decline kL/d | BP33 kL/d | Grants_pit kL/d | Total kL/d |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 67064 | 67064 | 0 | 0 | 0 | 2313 | 2313 |
| 3 | 0 | 0 | 0 | 64814 | 64814 | 0 | 0 | 0 | 2091 | 2091 |
| 4 | 0 | 0 | 0 | 95615 | 95615 | 0 | 0 | 0 | 3187 | 3187 |
| 5 | 0 | 0 | 0 | 53352 | 53352 | 0 | 0 | 0 | 1721 | 1721 |
| 6 | 0 | 0 | 0 | 49063 | 49063 | 0 | 0 | 0 | 1635 | 1635 |
| 7 | 0 | 0 | 0 | 59675 | 59675 | 0 | 0 | 0 | 1925 | 1925 |
| 8 | 0 | 0 | 0 | 78546 | 78546 | 0 | 0 | 0 | 2534 | 2534 |
| 9 | 0 | 0 | 0 | 84228 | 84228 | 0 | 0 | 0 | 2808 | 2808 |
| 10 | 0 | 0 | 0 | 91801 | 91801 | 0 | 0 | 0 | 2961 | 2961 |
| 11 | 0 | 0 | 0 | 116758 | 116758 | 0 | 0 | 0 | 3892 | 3892 |
| 12 | 0 | 0 | 0 | 107839 | 107839 | 0 | 0 | 0 | 3479 | 3479 |
| 13 | 0 | 0 | 0 | 92555 | 92555 | 0 | 0 | 0 | 2986 | 2986 |
| 14 | 0 | 0 | 0 | 99139 | 99139 | 0 | 0 | 0 | 3541 | 3541 |
| 15 | 0 | 0 | 0 | 115280 | 115280 | 0 | 0 | 0 | 3719 | 3719 |
| 16 | 0 | 0 | 0 | 109359 | 109359 | 0 | 0 | 0 | 3645 | 3645 |
| 17 | 2460 | 0 | 0 | 107947 | 110407 | 79 | 0 | 0 | 3482 | 3562 |
| 18 | 23604 | 0 | 0 | 108618 | 132221 | 787 | 0 | 0 | 3621 | 4407 |
| 19 | 40771 | 0 | 0 | 113704 | 154476 | 1315 | 0 | 0 | 3668 | 4983 |
| 20 | 73286 | 0 | 0 | 118844 | 192130 | 2364 | 0 | 0 | 3834 | 6198 |
| 21 | 63130 | 0 | 0 | 108698 | 171828 | 2104 | 0 | 0 | 3623 | 5728 |
| 22 | 58761 | 0 | 0 | 125776 | 184537 | 1896 | 0 | 0 | 4057 | 5953 |
| 23 | 48185 | 12784 | 455 | 110375 | 171799 | 1606 | 426 | 15 | 3679 | 5727 |

| Month | Box-cut kL/m | Decline kL/m | BP33 kL/m | Grants_pit kL/m | Total kL/m | Box-cut kL/d | Decline kL/d | BP33 kL/d | Grants_pit kL/d | Total kL/d |
|---|---|---|---|---|---|---|---|---|---|---|
| 24 | 43239 | 24765 | 818 | 112408 | 181229 | 1395 | 799 | 26 | 3626 | 5846 |
| 25 | 38860 | 28834 | 1136 | 113848 | 182677 | 1254 | 930 | 37 | 3673 | 5893 |
| 26 | 32168 | 35780 | 1978 | 98655 | 168581 | 1111 | 1236 | 68 | 3408 | 5823 |
| 27 | 31371 | 43365 | 2584 | 103449 | 180769 | 1044 | 1443 | 86 | 3443 | 6016 |
| 28 | 28838 | 51537 | 3263 | 103374 | 187012 | 961 | 1718 | 109 | 3446 | 6234 |
| 29 | 28283 | 59718 | 4072 | 110117 | 202190 | 912 | 1926 | 131 | 3552 | 6522 |
| 30 | 27236 | 63658 | 4652 | 100963 | 196509 | 908 | 2122 | 155 | 3365 | 6550 |
| 31 | 30883 | 76921 | 6010 | 102677 | 216491 | 973 | 2424 | 189 | 3236 | 6823 |
| 32 | 29933 | 72053 | 29855 | 44247 | 131841 | 989 | 2380 | 986 | 1461 | 5816 |
| 33 | 29288 | 64754 | 64173 | 77468 | 158214 | 976 | 2158 | 2139 | 2582 | 7855 |
| 34 | 28354 | 71165 | 67763 | 85556 | 167282 | 915 | 2296 | 2186 | 2760 | 8157 |
| 35 | 23008 | 69933 | 66596 | 83784 | 159537 | 767 | 2331 | 2220 | 2793 | 8111 |
| 36 | 20160 | 72646 | 70536 | 85207 | 163341 | 650 | 2343 | 2275 | 2748 | 8016 |
| 37 | 16569 | 73032 | 72861 | 83281 | 162461 | 534 | 2356 | 2350 | 2686 | 7926 |
| 38 | 12711 | 66278 | 68172 | 73707 | 147161 | 454 | 2367 | 2435 | 2633 | 7889 |
| 39 | 12006 | 74965 | 76751 | 79676 | 163722 | 387 | 2418 | 2476 | 2570 | 7851 |
| 40 | 10324 | 75223 | 75718 | 77916 | 161264 | 344 | 2507 | 2524 | 2597 | 7972 |
| 41 | 11062 | 79692 | 81707 | 75777 | 172461 | 357 | 2571 | 2636 | 2445 | 8009 |
| 42 | 11359 | 80639 | 84983 | 75525 | 176982 | 368 | 2616 | 2756 | 2449 | 8189 |
| 43 | 13112 | 81125 | 87892 | 79243 | 182130 | 435 | 2689 | 2913 | 2626 | 8663 |
| 44 | 17237 | 86615 | 96818 | 83283 | 200670 | 556 | 2794 | 3123 | 2686 | 9159 |
| 45 | 16315 | 86021 | 96304 | 83791 | 198641 | 544 | 2867 | 3210 | 2793 | 9414 |
| 46 | 14591 | 90378 | 100015 | 86668 | 204983 | 471 | 2915 | 3226 | 2795 | 9407 |
| 47 | 11999 | 86905 | 97591 | 83031 | 196496 | 400 | 2897 | 3253 | 2768 | 9318 |
| 48 | 9967 | 88453 | 101643 | 83661 | 200062 | 322 | 2853 | 3279 | 2699 | 9153 |
| 49 | 7952 | 87133 | 102692 | 80434 | 197777 | 257 | 2811 | 3313 | 2595 | 8976 |
| 50 | 5973 | 80319 | 97299 | 73026 | 183591 | 206 | 2770 | 3355 | 2518 | 8849 |
| 51 | 5129 | 85857 | 103858 | 76006 | 194844 | 165 | 2770 | 3350 | 2452 | 8737 |
| 52 | 3976 | 83656 | 100367 | 72319 | 187999 | 133 | 2789 | 3346 | 2411 | 8679 |
| 53 | 3686 | 85923 | 104493 | 72162 | 194102 | 119 | 2772 | 3371 | 2328 | 8590 |
| 54 | 3805 | 82766 | 103582 | 69605 | 190154 | 127 | 2759 | 3453 | 2320 | 8659 |
| 55 | 6766 | 87381 | 111356 | 72671 | 205502 | 218 | 2819 | 3592 | 2344 | 8973 |
| 56 | 11015 | 88778 | 117682 | 79157 | 217474 | 355 | 2864 | 3796 | 2553 | 9568 |
| 57 | 10382 | 84717 | 115563 | 80439 | 210661 | 346 | 2824 | 3852 | 2681 | 9703 |
| 58 | 9238 | 85649 | 119611 | 82602 | 214498 | 298 | 2763 | 3858 | 2664 | 9583 |
| 59 | 21424 | 80428 | 111741 | 76822 | 213592 | 699 | 2624 | 3646 | 2507 | 9476 |

## 6.3. 70 year post closure forecast

The post closure impacts scenario was based on the life of mine scenario with the following additional assumptions / settings:

- Initial heads were taken from the final time step of the LoM scenario;
- The post closure model runs for an additional 70 years;
- IfmLake module (CloudGMS, 2018 s4.3.5) was used to simulate the filling of the pit void.
- Removing the seepage face boundary conditions associated with the underground mine.
- Material properties of the elements representing the underground mine and decline were adjusted to reflect the void space remaining at the end of mining.
- Material properties of the elements representing the box-cut backfill are an order of magnitude greater than the in-situ basement rocks to characterise voids between backfill material (i.e Sy = 10%).

The post closure period of 70 years was determined from previous modelling (CloudGMS, 2018).

The seasonal nature of recharge meant that a steady state model of the system was not deemed appropriate to assess the post closure impacts. The model was run to an approximate dynamic equilibrium which is represented as a stabilisation of groundwater levels, pit-lake levels and inflows to the pit.

### 6.3.1. Groundwater drawdown contours

Drawdown contours are presented at 3 years post closure and 70 years post closure in Figures 6-18 and Figure 6-18. Around BP33 the watertable surface is predicted to recover to pre-mining levels within 3 years of the mine closure (Figure 6-18). No long-term changes to the watertable surface are predicted after mine closure and rehabilitation.

At the GLP, the pit lake operates as a groundwater sink and will result in 0.5 m drawdown with a radial extent of approximately 750 m around the pit lake. The change in watertable surface resulting from the mining activities and the pit lake extends marginally beyond the western boundary of the mining lease. The predicted area of watertable change does not extend beneath ephemeral drainage lines. As a consequence, the development of the legacy pit lake is not anticipated to affect groundwater availability to riparian zone vegetation.

### 6.3.2. Impacts to existing users and environmental receptors from drawdown

Based on the forecast scenarios, over the 70 year period considered by the groundwater flow modelling no watertable drawdown impacts are predicted beyond the BP33 mining lease or underneath the ephemeral water course that drain the BP33 site.

No impacts are predicted to existing groundwater users - the nearest of which is over 4 km from the site – or long-term impacts on groundwater dependent ecosystems from the underground dewatering activities. For the life of the mine to around 3 years post closure impacts are predicted on groundwater availability in areas of the BP33 lease.

At BPG2, located on the northern edge of the impacted moderate potential GDE areas, the depth to groundwater is likely to be below the depth accessible by vegetation for around 3 to 4 years (from month 30 to month 70-80).

The groundwater modelling sites BPG3 and BPG4, located on the edge of the moderate potential GDE areas, show that depth to groundwater in the weathered BCF is likely to be below the depth accessible by vegetation for approximately 5 years (from month 20 to month 80).

Figure 6-14 indicates that the maximum area affected is around 1.8 km$^2$. However, this area will reduce if a particular drawdown value is assumed to represent the depth to groundwater that vegetation can no longer access (e.g. drawdown of 5 m at the end of mining impacts an area of 1.15 km$^2$, which corresponds to a reduction of 36% from the maximum predicted area).

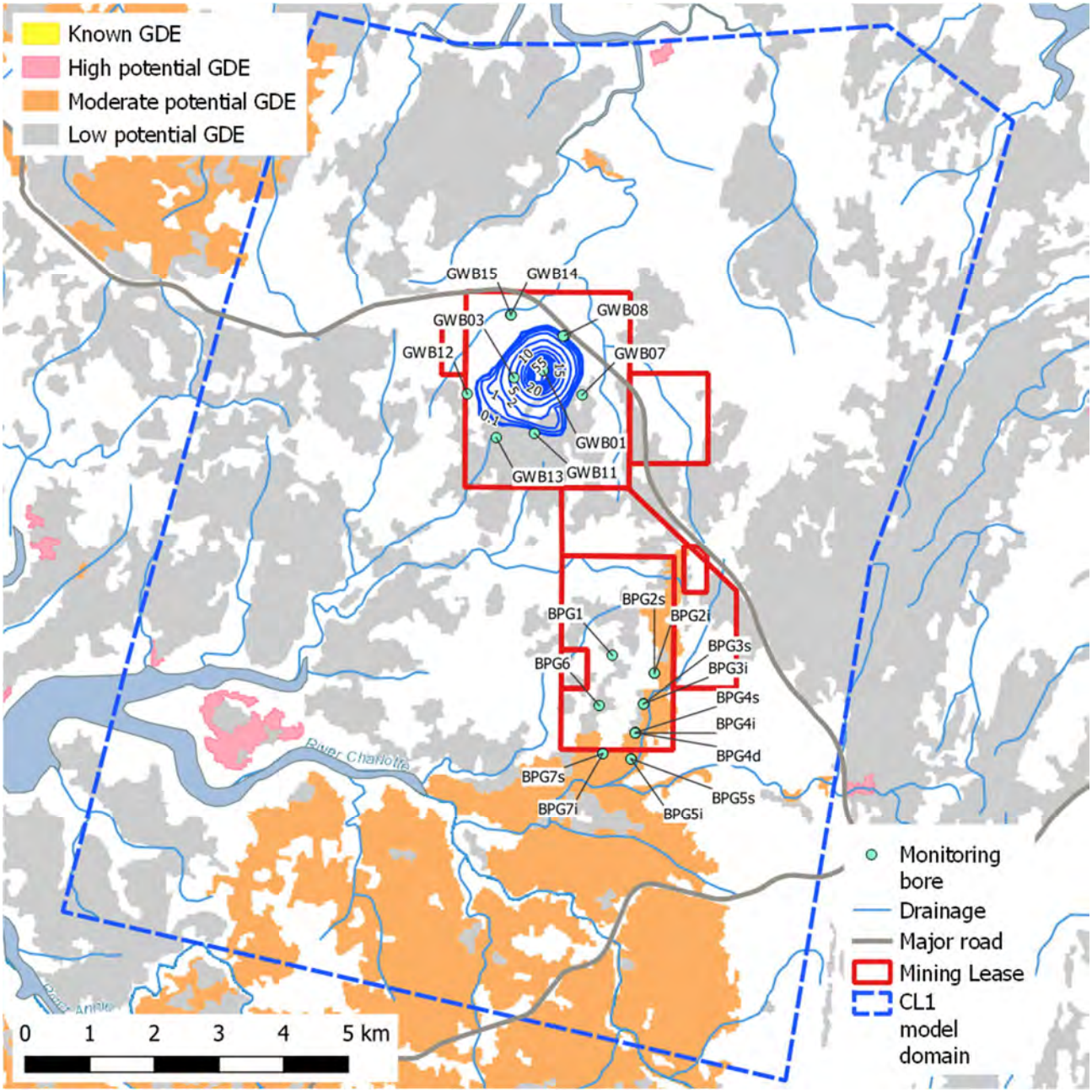



Figure 6-18 Post closure drawdown contours after 3 years of recovery (month 92).

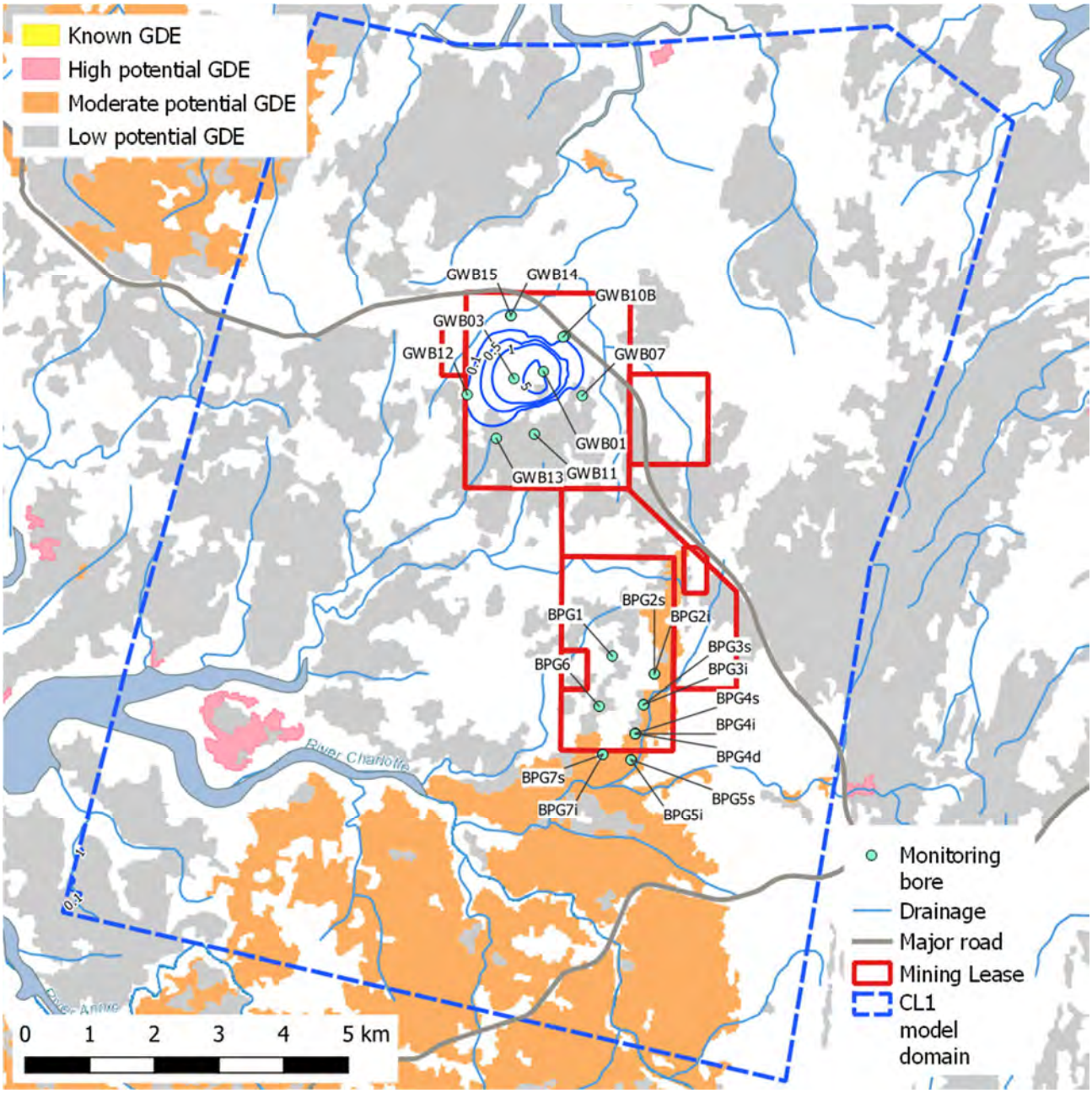



Figure 6-19 Post closure final drawdown contours after 70 years of recovery.

## 6.4. Particle tracking from the BP33 WRD

Forward particle tracks or streamlines can simulate the advective transport of solutes and are determined by releasing a number of particles from seeding points (in this case the nodes beneath the box-cut waste rock dump), into the groundwater flow field. The particles move along the hydraulic gradient (downgradient) until exiting the model at an outflowing boundary (or ending up in a zone without significant flow velocity). In this way forward particle tracks help visualize groundwater flow and can be used to determine the fate of solutes leaching into the groundwater system. Backward particle tracking can be used to delineate areas of contribution and capture zones. The use of streamlines assumes steady-state flow conditions.

Random-Walk Particle-Tracking (RWPT) solutions can be obtained by incorporating dispersive processes to the standard advective particle tracking. RWPT solutions are theoretically consistent with advection - dispersion equation solutions.

Table 6-2 Random walk particle tracking dispersive parameters.

| PARAMETER | VALUE | UNIT |
|---|---|---|
| **Effective porosity** | 0.02 | [-] |
| **Longitudinal dispersivity** | 10 | [1/m] |
| **Transverse dispersivity** | 1 | [1/m] |

### 6.4.1. EoM particle tracking

The fate of particles seeded beneath the box-cut waste rock dump (WRD) at the end of mining (EoM) at month 60 are presented below in Figure 6-20.

The majority of particles terminate at the decline and underground mine to the east of the WRD as the groundwater gradient is towards these features. A small proportion of particles beneath the western portion of the WRD are not captured and terminate to the west of the proposed mine footprint.

Note that the analysis assumes that no additional recharge (associated with leakage from the waste rock) is assigned within the footprint of the WRD. Including additional recharge may result in a mound developing beneath the WRD and a greater proportion of the particles terminating to the west.

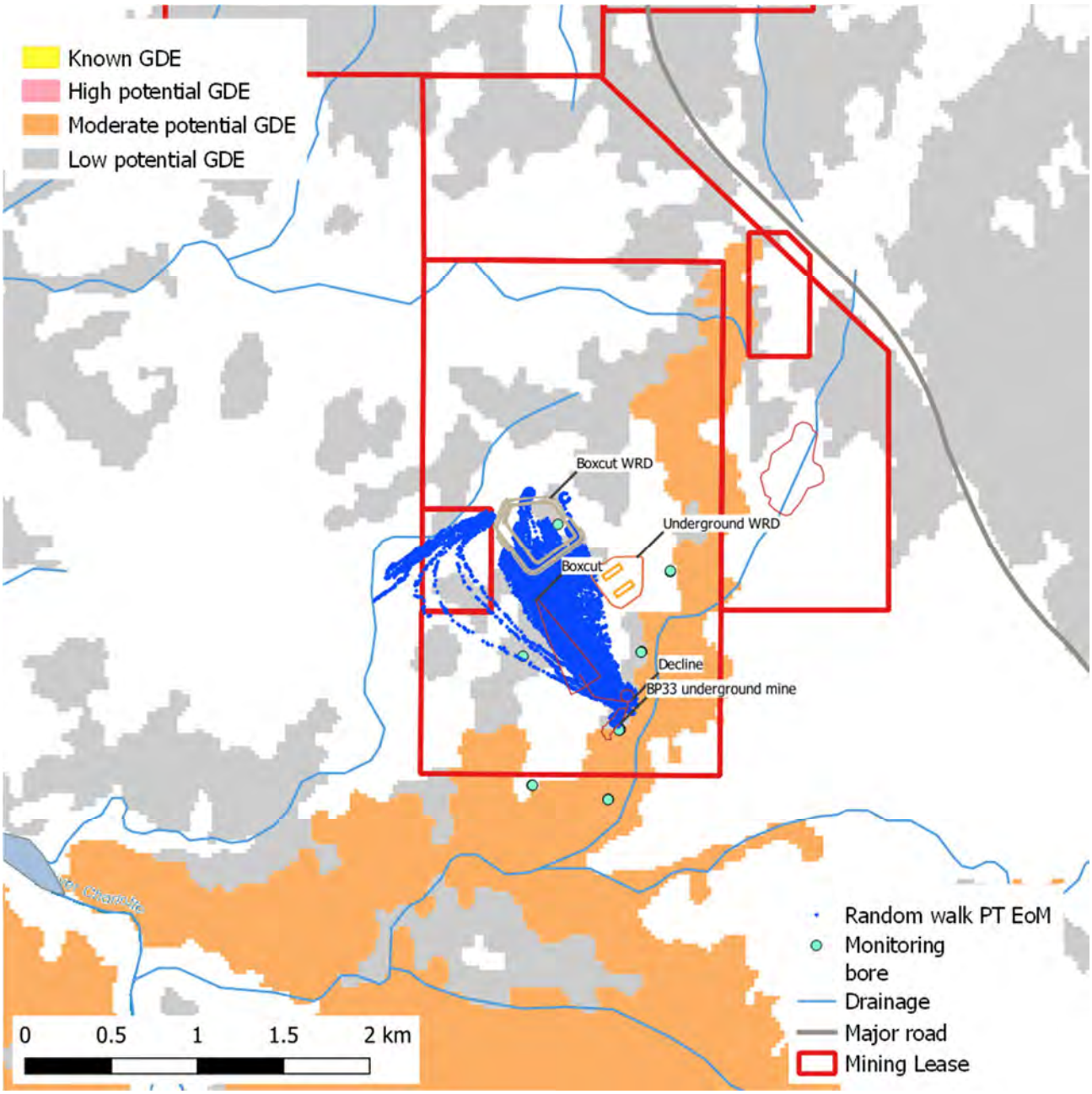



Figure 6-20 Random walk particle tracking at the EoM (month 60).

### 6.4.2. Post closure particle tracking

Random walk particle tracking has also been used to investigate the fate of particles beneath the proposed box-cut waste rock dump following closure of the mine (Figure 6-21). The parameters used to calculate the particle tracks are consistent with those used to determine particle tracking for EoM.

The particle tracks are different to those determined for the EoM with the particles distributed roughly evenly to the east and west of the box-cut WRD. The recovery of groundwater within the box-cut and underground workings has resulted in the return of the natural gradient towards the drainage lines to the east and west.

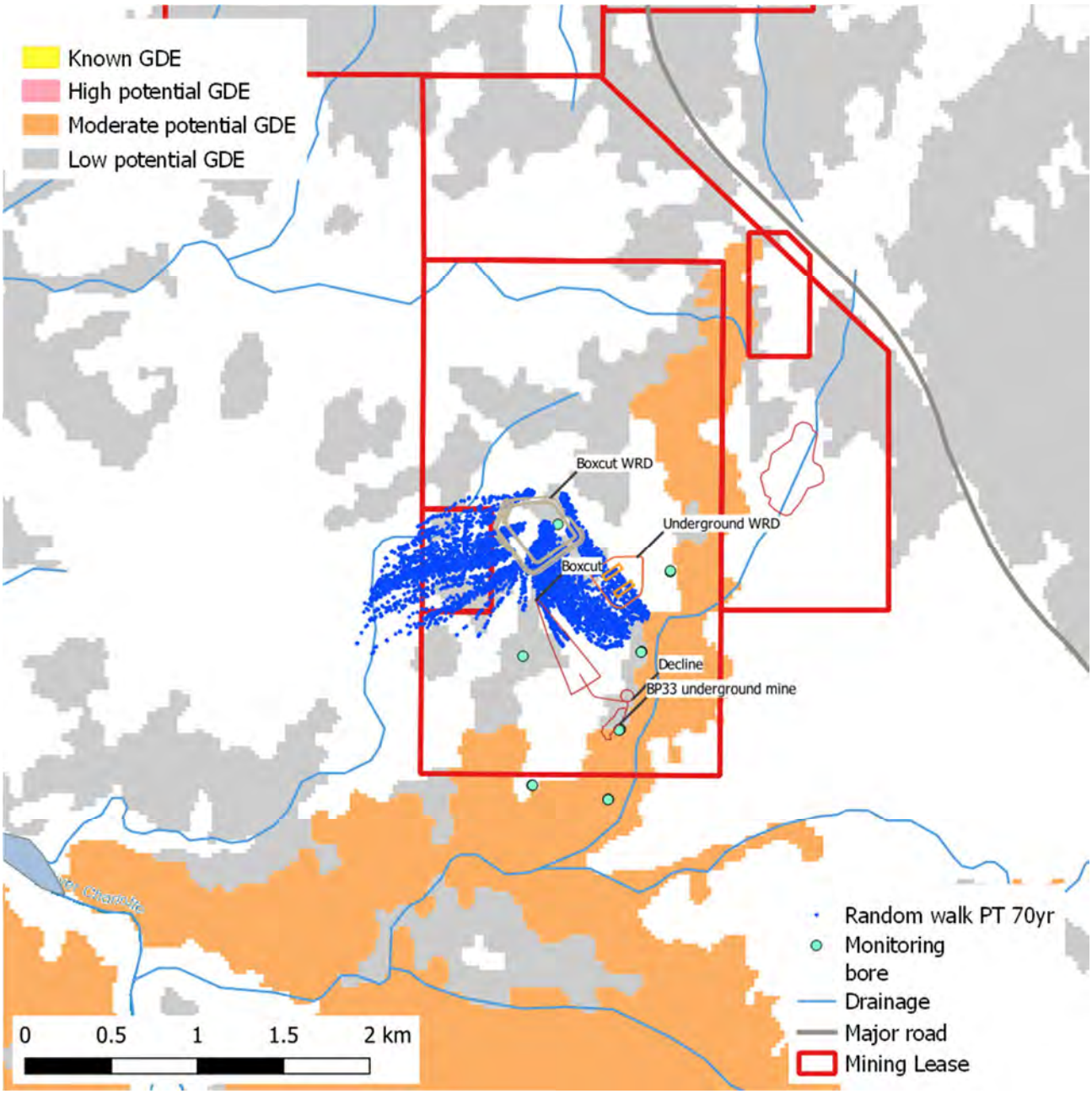



Figure 6-21 Post closure random walk particle tracking from the box-cut waste rock dump after 70 years recovery.

# 7 Conclusions

A numerical model was developed to assess the cumulative groundwater impacts resulting from the proposed development of an open cut lithium mine (Grants Lithium Project) and a nearby underground lithium mine (BP33) situated on MLA31726, MLA32074 and MLA32346, approximately 33 km west of Berry Springs. The mines are proposed to run for a total of 60 months. Proposed mine closure at BP33 will see the underground mine left as a mine void with the overlying box-cut filled with waste rock. At the GLP the pit void will be left to form a pit lake post closure.

A numerical groundwater model was developed using the FEFLOW modelling code and was underpinned by a conceptual groundwater model. Model parameter estimation was undertaken in accordance with best practice guidelines (Barnett et al, 2012). The model is deemed to meet the requirements of a Class 2 model and is suitable for providing estimates of dewatering requirements for mines and the associated impacts.

Predictive scenarios were run to determine mine inflows during the life of the mine (60 months), to estimate the cumulative impacts from GLP/BP33 on the watertable and to simulate the recovery of groundwater levels post closure (70 years).

## 7.1. Life of Mine Forecasts

Numerical model scenarios were run to assess groundwater impacts and pit inflows over the 60 month mining period. At the end of mining dewatering from the base of the GLP pit and dewatering of the box-cut, decline and underground mine at BP33 will result in the development of two separate drawdown cones in the surrounding aquifer. The predicted drawdown cone extends approximately 1 km from the GLP pit and around 2 km from the BP33 underground mine.

The drawdown cone in the vicinity of the GLP pit is not predicted to affect groundwater levels beneath ephemeral drainage lines or impact water levels outside the mining lease. The drawdown cone in the vicinity of the BP33 underground mine is predicted to affect groundwater levels beneath ephemeral drainage lines and also extend outside the mining lease.

The drawdown cone at the end of mining at BP33, shows the 0.1 m contour extending approximately 1 km beyond the western, southern and eastern boundary of the ML and intersecting ephemeral drainage lines to the west and east of the ML. The drawdown cone is predicted to extend beneath areas in the east and south of the ML that are mapped as having moderate GDE potential.

Groundwater inflow into the underground mine at BP33 is expected to peak at around 6000 – 7000 kL/day (69 – 80 L/s) for the life of the mine.

## 7.2. Post Closure Forecasts

Based on the groundwater modelling results, it is very unlikely that the drawdown impacts predicted at Grants and BP33 will interact.

The post closure model scenario predicts that groundwater levels at BP33 will recover to pre-mining levels within 3 years of the closure of the mine. This assumes that the underground mine and decline are left as mining voids and the box-cut is backfilled with material that has storage properties a magnitude higher than the in-situ host rock. The modelling suggests that

any impacts to GDEs are likely to be short-term and persist for a period of approximately 5 years.

Consistent with previous modelling (CloudGMS, 2018) the post closure model scenario predicts that the GLP pit lake will fill slowly over a period of roughly 50 years before the water level stabilises at 12 – 13 mASL or around 7 - 8 m below the existing land surface.

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# Appendix F Management Procedures

# Rehabilitation Management Plan
# BP33 Underground Lithium Mine NT

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# ACRONYMS

| | |
|---|---|
| *EP Act* | *Environmental Protection Act* Northern Territory |
| GDE | Groundwater Dependent Ecosystem |
| LDGNT | Lithium Developments (Grants NT) Pty Ltd |
| MCP | Mine closure plan |
| *MMA* | *Mining Management Act* Northern Territory |
| MMP | Mining management plan |
| NT EPA | Northern Territory Environmental Protection Authority |
| RMP | Rehabilitation Management Plan |
| SER | Supplementary Environmental Report |
| WRD | Waste rock dump |

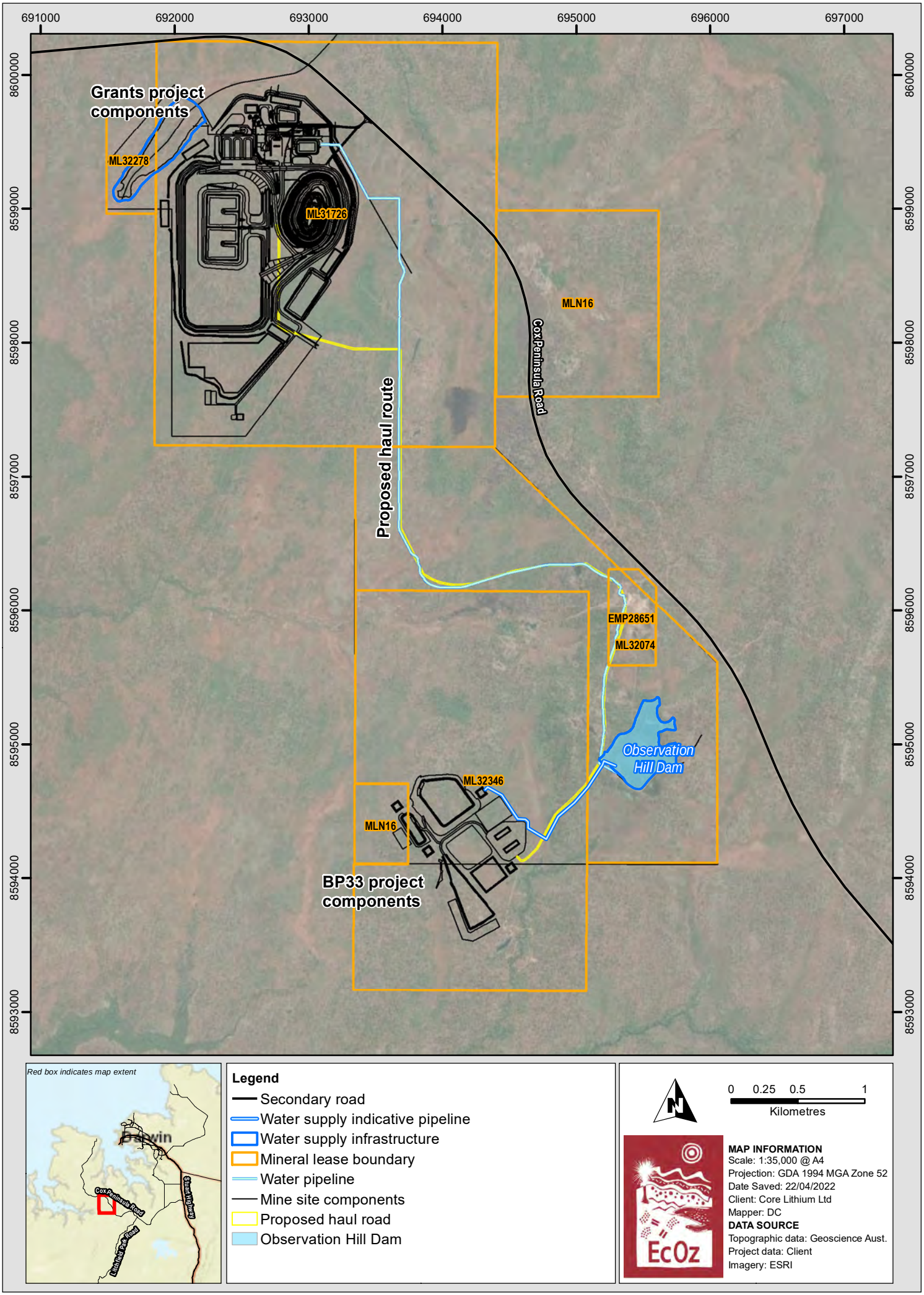
# 1 INTRODUCTION

Lithium Developments (Grants NT) Pty Ltd (here-in referred to as LDGNT) is a 100% owned subsidiary of Core Lithium Ltd. LDGNT propose to develop and operate the BP33 Underground Lithium Mine (her in referred to as 'the project area'). The project area has been subject to Environmental Assessment under the *Environmental Protection Act* (Northern Territory) (*EP Act*), by the Northern Territory Environmental Protection Authority (NT EPA) through a Supplementary Environmental Report (SER) assessment method. The project area is located 90 km by road from Darwin CBD, or 25 km south as the crow flies. The site is accessed off the Cox Peninsula Road, approximately 36 km west of Berry Springs and 15 km south-east of Belyuen community (Figure 1).

To commence mining activities a Mining Authorisation under the Northern Territory *Mining Management Act* (*MMA*) is required. A Mining Authorisation requires a Mining Closure Plan (MCP) to be submitted as part of the Mining Management Plan (MMP). This document, the Rehabilitation Management Plan (RMP) has been prepared as a stand-alone document to the MCP, to inform the rehabilitation management requirements during operations, and outline monitoring and maintenance requirements during pre-closure and post-closure. A high-level summary of the rehabilitation strategy remains in the MCP however additional information is detailed in this RMP.

EcOz Environmental Consultants (EcOz) were engaged by LDGNT to develop a RMP with specific rehabilitation strategies for each domain as rehabilitation techniques will continue to be adapted and refined to suit the specific needs across the site. This process involved:

- Overview of existing site information based on previous work and desktop studies and provide a representative flora species.
- Rehabilitation schedule based on information provided in the MCP.
- Ongoing engagement/discussions with local native seed and plant suppliers.




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

**Figure 1. Map showing location and regional setting of Finniss Lithium Project BP33 Underground Project**

## 1.1 Relevant projects and lessons learnt

Where necessary, lessons learnt from other mining rehabilitation projects have been incorporated into the RMP:

- Allen, C., & Verhoeven T. (1986). *Rum Jungle Rehabilitation Project, Final Project Report.* Prepared by Northern Territory Department of Mines and Energy for Commonwealth Department of Resources and Energy
- Top End Seeds (2020). *Rum Jungle Stage 3 Draft Revegetation Strategy Framework*. Report to the Department of Primary Industry and Resources, Northern Territory Department of Primary Industry and Resources - Rum Jungle Stage 3 Rehabilitation Project: Appendix 27

## 1.2 Best practises

The following best practice and standards for rehabilitation have been adopted and assisted in developing this RMP:

- Commonwealth of Australia (2016). *Mine Rehabilitation Leading Practice Sustainable Development Program for the Mining Industry*. Available at https://www.industry.gov.au/sites/default/files/2019-04/lpsdp-mine-rehabilitation-handbook-english.pdf
- International Erosion Control Association (IECA) (2008). *Best Practice Erosion and Sediment Control.* Picton, NSW. Available at: https://www.austieca.com.au/documents/item/57
- Kraatz, M., Jacklyn, P., & Clark, M (2009). *The Bush Book. A manual for managing native vegetation across northern Australia*, Greening Australia (NT).
- Society for Ecological Restoration (SER) (2018). *National Standards for the Practice of Ecological Restoration in Australia*. 2nd edition, Australia.
- Merritt, D., Cochrane, A., Commander, L., Sommerville, K., Breman, E., & Quarmby, A (2021) '*Florabank Guidelines – best practice guidelines for native seed collection and use* (2nd edn).' (Florabank Consortium: Australia).

## 1.3 Objectives of rehabilitation

The objective of rehabilitation (and by preparing this RMP) is to restore any disturbance areas during mining. The aim is to re-establish with native vegetation species local to the area, comprising a ground cover of native grasses and herbs, mid-storey shrubs, and a mixture of canopy trees. The intent is to simulate the natural features, including vegetation that exist in the local landscapes. The key objective for rehabilitation at the project area is stabilisation and ecological restoration i.e. providing diversity and structural complexity based on surrounding intact vegetation.

# 2 DOMAINS

The closure objective for the project area is to backfill all temporary waste rock dumps (WRDs) into the underground workings and box cut, and all supporting infrastructure will be removed. There will be no box cut void, WRD or other mining landforms remaining on site post closure.

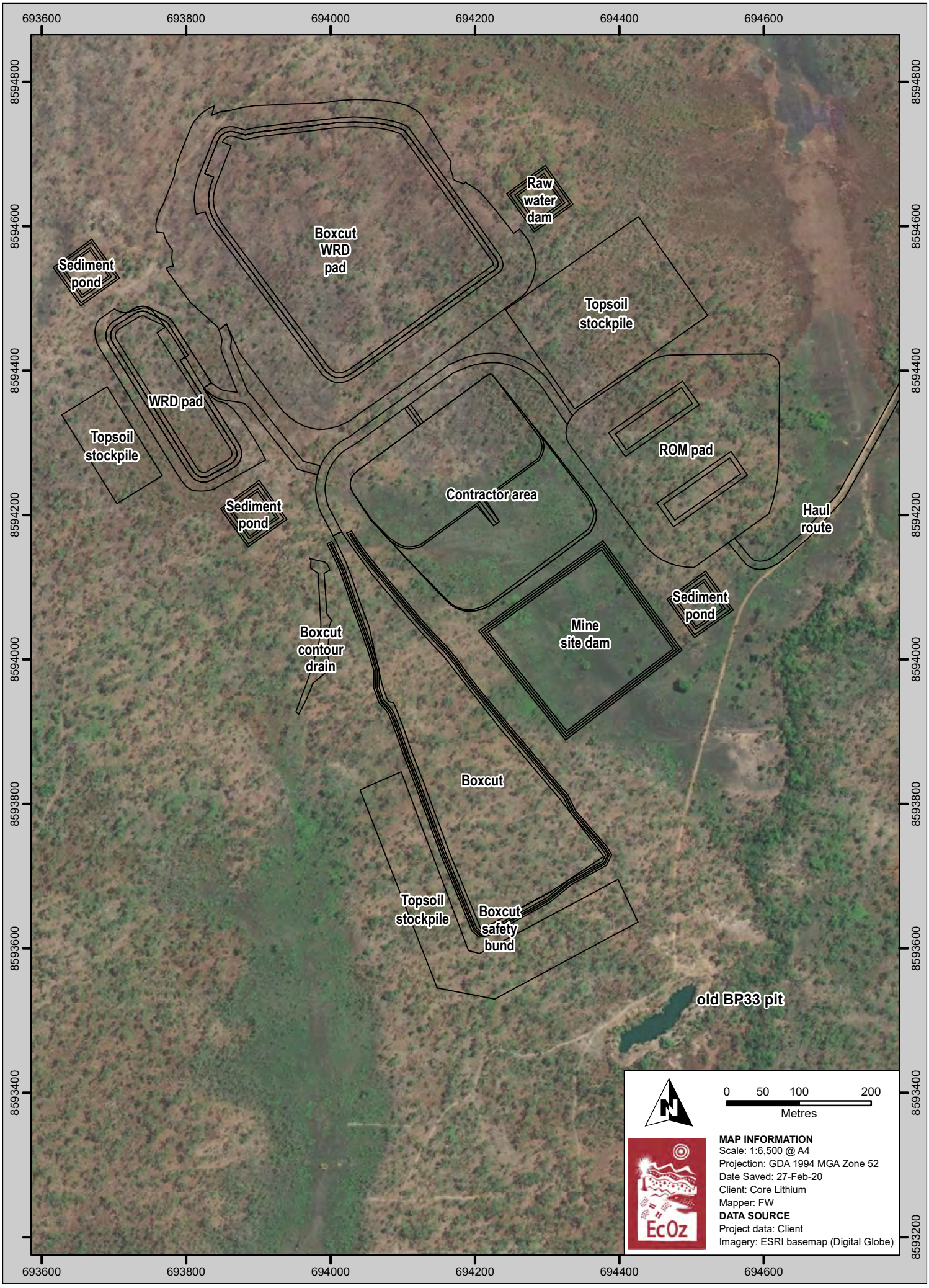
The domains aligning the MCP include:

- Boxcut and underground workings
  - At completion of mining activities at BP33, the UG and box cut will be backfilled with all surface waste material.
  - The surface will be reprofiled and revegetated.
  - Subsoil and topsoil re-spreading and contour ripping.
  - Revegetation and weed control will be key to rehabilitation success.
  - There will be a slightly elevated backfill profile on the box-cut to allow for settlement over time.
- BP33 pit void
  - Existing historical pit. No current rehabilitation required; will either be left as a pit lake or backfilled with waste material and rehabilitated.
- Mine waste facilities
  - WRD 1 will be completely removed (backfilled into the box-cut) and the area it occupied rehabilitated.
  - WRD 2 will be backfilled underground and the area it occupied rehabilitated.
  - ROM pad material will be backfilled and the area it occupied rehabilitated.
  - Topsoil dumps systematically removed as required for rehabilitation.
- Haul road
  - Internal haul road will be re-profiled to pre-mining landforms congruent with the surrounding areas.
- Water storages and drainage lines
  - The construction overburden and insitu material used to create dam walls will be used to reprofile the surface similar to pre-mining conditions.
  - The surface will be covered in a suitable growth medium, ripped and revegetated.
- Support infrastructure and pipeline corridor
  - Progressive rehabilitation will occur over the pipeline route.
  - Specific areas for rehabilitation trials along the pipeline corridor will be selected based on the differing terrain and soil types.
  - Once pipeline and pipeline route is no longer required, the pipeline will be decommissioned, remain buried and surface breather valves removed.
  - Successful outcomes of the rehabilitation trials will be implemented for the remainder of the pipeline route.
  - Internal access roads will be re-profiled to pre-mining landforms congruent with the surrounding areas.
- Other areas (ad hoc lay down yards, ROM, topsoil, contractor area etc.)
  - ROM pad will be scraped and scraped material backfilled, remaining material will be reprofiled and rehabilitated.
  - Topsoil dumps systematically removed as required for rehabilitation.

- Laydown and contractor areas will be ripped and rehabilitated.

See Figure 2 showing locations of each domain in relation to the project area.

Section 2 outlined below, provides a brief description of each of the areas that will be rehabilitated. The specific objectives and strategies for rehabilitating each of these areas are described in section 4.




Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ19171 - BP33 NOI\01 Project Files\Report maps\Figure 3-3. Map of mine site footprint and preliminary layout.mxd

**Figure 2. Map of project area domains to be rehabilitated**

## 2.1 Domain-based strategy

This section describes the domain-based strategy, unique/precautionary measures applicable to each domain. The strategy discusses the rehabilitation objective, areas to be rehabilitated, landform gradient, target vegetation community, sewing technique, specific rehabilitation requirements and domain rehabilitation risk.

The closure risks have been assessed as part of the MCP. Each domain to be rehabilitated has been provided with an inherent rehabilitation risk (prior to controls) and residual risk (after implementation of controls). Risks associated with rehabilitation failure maybe due to:

- Unsuitable rehabilitation works.
- Poor drainage design.
- Lack of suitable materials for rehabilitation.
- Unsuitable storage and management of topsoil.
- Unexpected climate, especially low rainfall wet seasons.
- Weed infestation.

Table 2-1 below outlines the rehabilitation objectives, the area size to be rehabilitated, slope of the landform post earthworks, and rehabilitation risk of each domain.

**Table 2-1. Specific approach to rehabilitation as per MCP**

| Domain | Rehabilitation objective | Area (ha) | Slope | Target vegetation community | Sewing technique | Specialised rehabilitation notes | Inherent risk | Residual risk |
|---|---|---|---|---|---|---|---|---|
| Box cut | Stabilisation - The landform is a stable, non-polluting and erosion resistant landform.<br>Ecological restoration - the landform supports self-sustaining native vegetation groundcover, comparable to that of the surrounding ecosystems | 6.1 | Slightly elevated from surface level | Rises, Mixed Eucalypt woodland | Direct seeding (primarily) once weeds have been removed, and supplementary tubestock planting | Area will be backfilled, topsoiled, ripped and revegetated | Low | Low |
| Existing BP33 Pit void | Stabilisation - Pit void is stable and safe. Pit abandonment bund is a stable, non-polluting and erosion resistant landform<br>OR<br>Bit is backfilled as per box-cut. | 0.4 | Slightly elevated from surface level (backfilled option) | Groundcover establishment only required for abandonment bund<br>OR<br>Entire backfilled void | Direct seed and tubestock planting on abandonment bund<br>OR<br>Entire backfilled void | Only required stabilisation, rehabilitation opportunities may arise over the next few months<br>No revegetation of mid-sotrey and canopy species<br>OR<br>Pit void backfill area backfilled, topsoiled, ripped and revegetated | Low (both options) | Low (both options) |
| Mine waste facilities | Waste rock dumps removed from surface. Stabilisation - returned to pre-mining and stable landform.<br>Ecological restoration - Domain supports self-sustaining native vegetation similar in form and function to what was on site prior to mining and that of surrounding areas. | 18.9 | Natural surface | Rises, Mixed Eucalypt woodland | Direct seed and supplementary tubestock planting (only if necessary) | Profiled, topsoiled, ripped and revegetated | Low | Low |

| Domain | Rehabilitation objective | Area (ha) | Slope | Target vegetation community | Sewing technique | Specialised rehabilitation notes | Inherent risk | Residual risk |
|---|---|---|---|---|---|---|---|---|
| Haul road | Stabilisation - returned to pre-mining and stable landform.<br>Ecological restoration - Domain supports self-sustaining native vegetation similar in form and function to what was on site prior to mining and that of surrounding areas. | 12.5 | Natural surface | Ranging from rises to low hills, Mixed Eucalypt woodland and some drainage areas | Direct seed and supplementary tubestock planting (only if necessary) | Ripped deeply, topsoiled, ripped shallow and revegetated | Low | Low |
| Water storages and drainage lines | Stabilisation - returned to pre-mining and stable landform.<br>Ecological restoration - Domain supports self-sustaining native vegetation similar in form and function to what was on site prior to mining and that of surrounding areas. | 3.46 | Natural surfaces | Low open/low lying woodland | Tubestock plantings for grasses | Scraped clean and backfilled scraped material, reprofiled, topsoiled and revegetated | Low | Low |
| Support infrastructure and pipelines | Stabilisation - Support infrastructure domain is returned to pre-mining and stable landform.<br>Ecological restoration - Support infrastructure domain supports self-sustaining native vegetation similar in form and function to what was on site prior to mining and that of surrounding areas. | 0.4 | Natural surface | Open woodland over Tussock Grassland | Direct seed and supplementary tubestock planting | Demolished and removed to 0.5 m below ground level all sources of contamination removed. Topsoiled, ripped and revegetated. | Low | Low |
| Other areas (ad hoc lay down yards, ROM, topsoil, contractor area etc.) | Stabilisation - returned to pre-mining and stable landform.<br>Ecological restoration - Domain supports self-sustaining native vegetation similar in form and function to what was on site prior to | Contractor area 6.4ha<br>ROM pad 6.5ha<br>Topsoil stockpiles 8.3ha | Natural surface | Open woodland over Tussock Grassland | Direct seed and supplementary tubestock planting | All sources of contamination removed to long-term non-polluting storage.<br>Topsoiled, ripped and revegetated | Low | Low |

| Domain | Rehabilitation objective | Area (ha) | Slope | Target vegetation community | Sewing technique | Specialised rehabilitation notes | Inherent risk | Residual risk |
|---|---|---|---|---|---|---|---|---|
| | mining and that of surrounding areas. | | | | | | | |

# 3 BASELINE STUDIES

## 3.1 Vegetation communities and general site description

Many desktop resources were accessed in the development of this RMP. Existing vegetation data in each area to be rehabilitated within the project area has been obtained based on previously surveys and mapping by EcOz Environmental Consultants (EcOz 2019) (Figure 3) at a scale of 1:10,000. The vegetation survey used existing land unit mapping dataset, Land Units of the Greater Darwin Region 1:25,000 as a guide, and the data collected followed NT guidelines and field methodology for vegetation survey and mapping (Brocklehurst et al. 2007).

The intent was to compare to areas to be rehabilitated and the associated surrounding vegetation communities for appropriate target vegetation types to be developed. Several vegetation communities may intersect an individual rehabilitation area, and, in this case, species were selected from across all communities intersected.

The majority of the areas to be rehabilitated comprise of low rises with gravelly well-drained soils, associated with vegetation comprised of *Eucalyptus miniata*, *Eucalyptus tetrodonta* mid high woodland over *Erythrophleum chlorostachys*, *Livistona humilis*, *Eucalyptus miniata* mid open shrubland over *Alloteropsis semialata*, *Eriachne sp* mid tussock grassland (land unit 2a1). Other areas to be rehabilitated (contractor area and sections of the RoM Pad, topsoil stockpiles and the box-cut) intersect drainage systems, associated with vegetation comprised of *Corymbia polycarpa*, *Erythrophleum chlorostachys*, *Corymbia confertiflora* mid open woodland over *Grevillea pteridifolia*, *Xanthostemon paradoxus*, *Livistona humilis* mid shrubland over *Alloteropsis semialata*, *Eriachne sp* mid tussock grassland (with land unit 6b) (See Table 3-1, Figure 3). Only a small section of the haul road and the contractors' area is located on narrow alluvial plains and upland terrain (land unit 5a) (See Table 3-1, Figure 3). Both land units 6b and 5a are classified as having 'severe level of seasonal water logging'. Observation Hill Dam (OHD) is located on narrow upland alluvial plains (land unit 5a), which are associated with ephemeral drainage lines. The pre-existing water pipeline corridor traverses mainly low rises with gravelly well-drained soils (land unit 2a1) and broad drainage floors (land unit 6b). Short sections of the route traverses steep ridges (land unit 1b) and narrow alluvial plains (land unit 5a). The land is generally flat, with a slope of 5%, except for part of the haul road (associated with land unit 1b).

See Table 3-1 for land unit descriptions and Figure 3 represents land units intersecting the domains.

## 3.2 Significant or sensitive vegetation

The only sensitive vegetation type relevant to the project is the narrow fringe of riparian vegetation along an ephemeral watercourse downstream of the OHD– land unit 5b2, as shown in Figure 3.

The well-developed riparian vegetation potentially indicates some level of groundwater dependenc

e supporting this vegetation community throughout the dry season; however, there is no evidence of spring-fed surface water flows.

The watercourse is a minor stream order one drainage line, but the closed structure of the riparian vegetation and observed persistence of surface pools of water in the dry season (EcOz, 2020), indicates the community is likely to be a facultative groundwater dependent ecosystem (GDE), with an infrequent or partial dependence on groundwater (CloudGMS, 2021 p.59). Monitoring data collected from monitoring bore BPG5i[1], close to the riparian area, indicate that depth to groundwater ranges from around one meter in the wet season, to six metres in the late dry season[2] and on this basis it is assumed that the riparian vegetation accesses the groundwater for some or part of the dry season when there are no surface flows.

[1] Hydrographs are based on monitoring data collected over the period October 2020 to April 2021
[2] Refer to the draft WMP

**Table 3-1. Vegetation communities and additional landform characteristic within areas**

| Vegetation communities and landform information | | | | |
|---|---|---|---|---|
| **Land unit No.** | **Landform** | **Vegetation description** | **Drainage** | **Soil** |
| 1b | Low hills | *Eucalyptus tetrodonta*, *Eucalyptus miniata*, *Eucalyptus tectifica* mid woodland over *Terminalia ferdinandiana*, *Eucalyptus tetrodonta*, *Erythrophleum chlorostachys* mid open shrubland over *Alloteropsis semialata*, *Eriachne sp* mid tussock grassland | Very rapid | Rudosols |
| 2a1 | Rises | *Eucalyptus miniata*, *Eucalyptus tetrodonta* mid high woodland over *Erythrophleum chlorostachys*, *Livistona humilis*, *Eucalyptus miniata* mid open shrubland over *Alloteropsis semialata*, *Eriachne sp* mid tussock grassland | Rapid | Rudosols |
| 2b2 | Rises | *Eucalyptus tetrodonta*, *Eucalyptus miniata*, *Eucalyptus tectifica* mid woodland over *Terminalia ferdinandiana*, *Eucalyptus tetrodonta*, *Erythrophleum chlorostachys* mid open shrubland over *Alloteropsis semialata*, *Eriachne sp* mid tussock grassland | Rapid | Kandosols |
| 5a | Alluvial plains | *Eucalyptus alba* mid open woodland over *Pandanus spiralis*, *Lophostemon lactifluus*, *Xanthostemon paradoxus* mid sparse shrubland over *Sorghum intrans*, *Imperata cylindrica* mid tussock grassland | Slow (subject to wet-season waterlogging and inundation | Hydrosols |
| | | *Grevillea pteridifolia*, *Pandanus spiralis*, *Lophostemon lactifluus* mid sparse shrubland over *Alloteropsis semialata*, *Sorghum intrans* mid tussock grassland | | |
| 7a | Alluvial plains | *Grevillea pteridifolia*, *Pandanus spiralis*, *Lophostemon lactifluus* mid sparse shrubland over *Alloteropsis semialata*, *Sorghum intrans* mid tussock grassland | Moderate (occasional wet-season inundation) | Kandosols |
| 5b2 | Drainage system | *Melaleuca leucadendra*, *Corymbia polycarpa*, *Xanthostemon eucalyptoides* mid open forest over *Pandanus aquaticus*, *Xanthostemon eucalyptoides*, *Leptospermum madidum* tall shrubland over sedge sp., *Alloteropsis semialata* high open tussock grassland | Poor (waterlogged in wet-season) | Hydrosols |
| 6a | Drainage system | *Corymbia polycarpa*, *Erythrophleum chlorostachys*, *Corymbia confertiflora* mid open woodland over *Grevillea pteridifolia*, *Xanthostemon paradoxus*, *Livistona humilis* mid shrubland over *Alloteropsis semialata*, *Eriachne sp* mid tussock grassland | Very poor (subject to wet-season inundation) | Hydrosols |
| 6b | Drainage system | *Corymbia polycarpa*, *Erythrophleum chlorostachys*, *Corymbia confertiflora* mid open woodland over *Grevillea pteridifolia*, *Xanthostemon paradoxus*, *Livistona humilis* mid shrubland over *Alloteropsis semialata*, *Eriachne sp* mid tussock grassland | Poor (waterlogged in wet-season) | Hydrosols |

## 3.3 Baseline soil sampling

Soils were classified within the project area by Geochemical characterisation report (EGi 2020). There are predominantly two soil groups in the BP33 proposed disturbance area - Rudosols and Hydrosols. Rudosols are very shallow soils or those with minimal development. Hydrosols are seasonally inundated and generally occur on coastal floodplains, swamps and drainage lines.

Soil characterisation was undertaken to determine the baseline growth medium attributes of each major soil type including nutrient status, and evaluates potential risks associated with salinity, wind erosion and water erosion. The results suggest that the soil at the site is an infertile, gravelly sandy loam. The Emerson test indicates that the soil should be non-dispersive but given the low organic matter level and sandy texture the soil likely has poor structure and limited water-holding capacity, and therefore could be susceptible to erosion under wet conditions. It is expected successful rehabilitation will require increasing the physical and chemical fertility of the soil to some extent, consistent with the proposed final end use (EGi, 2020). See Figure 3 for soil sampling sites.

## 3.4 Weed survey

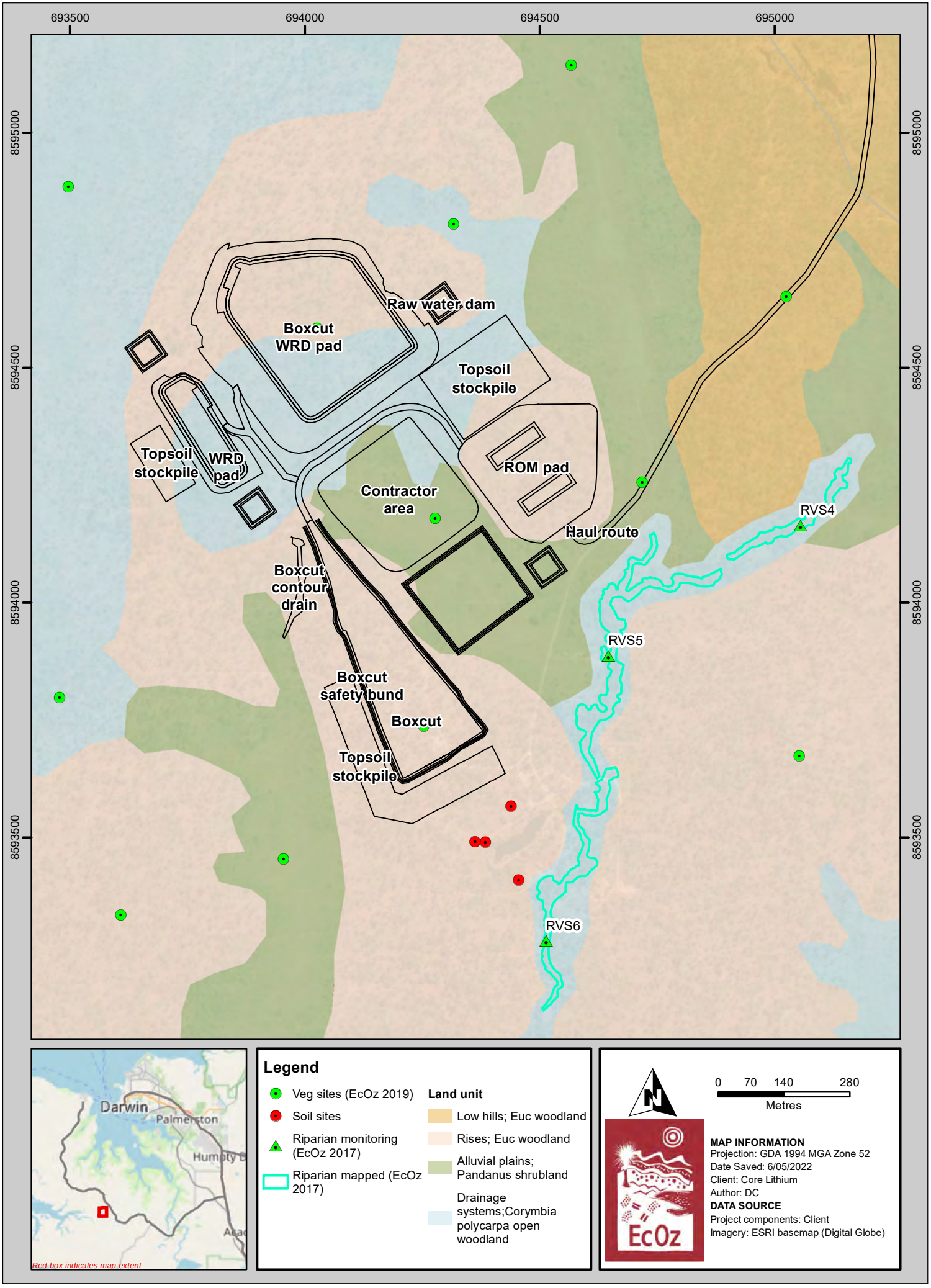
In the NT, introduced plants can be listed as weeds under the NT *Weed Management Act* as class A, class B and Class C weeds. The class of each weed confers different management responsibilities on the holder of the land on which the weed is found, these are:

- Class A: To be eradicated
- Class B: Growth and spread to be controlled
- Class C: Not to be introduced to the Northern Territory

In mine site rehabilitation in the NT, there are a few grassy weeds considered a significant threat to rehabilitation because of their high fuel load and risk of hotter and later fires; these are: Gamba Grass (*Andropogon gayanus*), Perennial Mission Grass (*Cenchrus polystachios)* and Annual Mission Grass (*Cenchrus pedicellatus)*.

An incidental weed survey was undertaken in conjunction with the BP33 ecological survey (EcOz 2019). A few Gamba Grass and Perennial Mission Grass plants were observed along the access track from the Cox Peninsula Rd. All these records are located in the disturbed area in the north-east corner of the project area. Though the project area has very low levels of existing weed infestation, these two grasses are key weeds of concern in the region and were the main weeds recorded during the survey (EcOz 2021) (see Figure 3).

A Finniss Lithium Project Weed Management Procedure was developed for LDGNT as a guide for identifying and treating targeted weeds across the site before, during mining operations and the rehabilitation process (Core Lithium 2021). This procedure will apply for the BP33 project.




Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ21269 - BP33 - Mining Management Plan\01 Project Files\Rehabilitation Plan BP33\Figure 3. Map of baseline studies undertaken v2.mxd

**Figure 3. Map of baseline studies undertaken (including vegetation monitoring and soil survey sties)**

# 4 REHABILITATION STRATEGY

## 4.1 Rehabilitation trials

An integral part of successful rehabilitation is to undertake a series of trials to help inform final rehabilitation strategy, design and methods for the final landforms in various site conditions. Three rehabilitation trial areas have previously been proposed within adjacent Grants Lithium Project open-cut mine site. The findings and raw data based on these trials will feed into this RMP and updated accordingly. This project area is similar to the Grants site in terms of vegetation, soil and landform. Refer to Core Lithium Grants Rehabilitation Management Plan (EcOz 2021).

The trial areas at LDGNT are located across diverse land units, ecosystems and topography to cover a broad study design. The trials will cover low drainage systems, alluvial plains, rises of variable slopes and aspects to capture the variations in the landscape.

### 4.1.1 Trial assessment

The trials assessments that will be undertaken are outlined in Table 4-1 below. These trials will be undertaken in designated trial areas at Grants and outcomes applied to the BP33 Project area.

**Table 4-1. Rehabilitation trial assessment aspects and trial aims as per Grants RMP**

| Aspect | Test/trial | Reason | Factors tested |
|---|---|---|---|
| Soil condition (nutrient status, dispersivity) | Bulk density and water holding capacity | Availability of soil to hold moisture for plant uptake | Species selection – hardy drought resistant species found in lower rainfall areas |
| | Nutrient concentrations | Availability of essential nutrients for plant uptake. Assessment to be undertaken immediately prior to rehabilitation. | Fertiliser requirement (type, method of application, rates) and species selection (hardy species and or species with nitrogen fixing capability) |
| | Stability and erosion of soil on final landform | Requirement for additional erosion prevention measures | Ripping depth, Jute matting, mulching. |
| | Gypsum dispersivity amelioration | Effect of soil amelioration on rehabilitation success | Requirement of gypsum from soil analysis, variability in rates |
| Soil type | Growth of plants using materials from topsoil (0-0.2m), subsoil (0.3-0.5m) and oxide weathered overburden at depth from within the pit. | To determine preferred soil growth medium for plant growth | Germination % of a selection of plants |
| Revegetation species | Various species composition to be based on analogue sites | Plant selection to maximise rehabilitation closure criteria are met in each specific domain soil type(s) | Variation of grasses, shrubs and trees – species and rates for each species.<br>Shallow rooted grasses and shrubs to be trialled on the pipeline route during operations to ensure the pipeline is not impacted from plant growth root systems. |

| Aspect | Test/trial | Reason | Factors tested |
|---|---|---|---|
| Site selection (Land unit and topography) | Various topography and land units (slope angles and aspect, alluvial plains and drainage systems) | Rehabilitated landform slopes may require revegetation methodology and species selection variances compared to with alluvial plains and drainage systems. | Constructed landforms are likely to be drier and soil structure more variable than other landforms on natural topography such as the pipeline corridor. |

Following the rehabilitation in these areas, rehabilitation monitoring will be undertaken annually (as per section 4.7). This monitoring will help determine the likely success of rehabilitation. This information will be used to review the MCP for the subsequent period, and the rehabilitation strategy will be updated if required. If the rehabilitation shows considerable failure, the rehabilitation strategy and permanent stabilisation actions specified in this plan will be adjusted and submitted to DITT for review and approval.

## 4.2 Site planning

Site planning will generally occur during the dry season months in preparation of the planting to occur in the wet season months when there is sufficient rainfall to sustain growth.

### 4.2.1 Physical characteristics

Physical characteristics need to be considered for rehabilitation planning. Such characteristics include:

***Climate seasonality***

Broadly the project area is exposed to a wet/dry monsoonal tropical climate with a distinct dry season (approximately April to October) and wet season (November to March). The annual average rainfall in the Project area is 1,800 mm, although this value is highly variable.

***Soil type***

Soil type, condition and health will largely impact revegetation success. A baseline soil assessment has been undertaken and detailed in section 3.3. Soil testing and preparation is discussed in section 4.3.6 and 4.4.2 respectively.

### 4.2.2 Species selection

The below Table 4-2 is a preliminary, recommended native flora species list composed of species from the provenance, based on:

- Existing land unit surveys *Land Units of the Greater Darwin Region 1:25,000,* as outlined in section 3.
- Additional field studies undertaken in the general region (i.e. full species obtained from BP33 vegetation survey undertaken by EcOz in 2019).
- NT Flora search, which includes a list of all native vegetation that has been recorded by NT Government or other Environmental Consultants in the region.

These baseline studies have helped to inform the species selection to ensure the revegetation if representative of the area.

The species list is comprised of a mix of corymbia/eucalypt, shurbs and grasses typical of savanna woodlands, and follows other species mixes in mine rehabilitation projects in the NT (Rum Jungle).

- Eucalypt and corymbia species in the upper strata – these are considered the long-lived/pioneer species that generally take longer time to establish but are critical to the long-term stability of rehabilitation areas.
- A number of acacias in the mid-strata, these are a fast-establishing group of species that have a good nitrogen fixing capability and assist in speeding up the nutrient cycling within the soil (TES 2020).
- Other tree and shrub species in the mid-strata – generally comprised of fruit-bearing shrubs and included to represent the diversity of the aera i.e. *Terminalia spp*, *Buchanania spp*, *Petalostigma spp,* Kurunjang (*Brachychiton spp*), Cocky apple and Calytrix.
- Mixture of grass species in the ground cover to provide maximum diversity and minimise erosion and will spontaneously colonise, but certain species have been known to dominate rehabilitation areas if seeding rate is too high.

Specific planting objectives for individual species i.e., ecological restoration and stabilisation (described in section 1.3) have also been included in Table 4-2 to assist with species selection.

Sowing techniques refers to preferred planting method for individual species i,e, direct seeding or nursery propagating.

The vegetation species types i.e., wet-indicator species and woodland species can be used as a guide when selecting suitable species for each domain depending on the nature/landscape of the area to be rehabilitated. For instance, wet indicator species more associated to floodplains/alluvial areas, therefore, will most likely survive in areas of that landscape type. Woodland species are considered hardy species, resilient to harsh conditions and more adapted to high ground/well drained area.

Other factors species selection should consider the following:

- Species availability during harvest may be affected by the seasonal growing conditions.
- Faster growing species to stabilise the soil and out compete weeds.
- Fast reproducing species to expedite revegetation success and out compete less desirable species.
- Species with low biomass and fire resilience to protect against the impacts of fire (species with a high biomass have a high fuel load and increases the temperature of fires).
- Species that will provide habitat and forage source for wildlife in the area.
- Species of nitrogen fixing capabilities such as acacias.

This list should only be used as a guide and should be re-evaluated post further field investigations at each domain, and at designated analogue sites as the rehabilitation progresses.

**Table 4-2. List of recommended suitable vegetation species, planting objective and applicable sowing techniques**

| Species | Strata* | Vegetation species types | | Planting objective | | Sowing techniques | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Wet-indicator sp. | Woodland sp. | Ecological Restoration | Stabilisation | Direct Seeding - Core Sp | Direct Seeding - Opportunistic Sp | Nursery Propagation - Core Sp | Nursery Species - Opportunistic Sp |
| *Alloteropsis semialata* | G | | * | * | * | * | | | |
| *Blumea integrifolia* | G | * | | | | | | | |
| *Cynodon radiatus* | G | * | * | | * | | | | |
| *Dapsilanthus spathaceus* | G | * | | | | * | | | |
| *Dianella odorata* | G | * | | * | | * | | | |
| *Digitaria longiflora* | G | * | | | * | * | | | |
| *Ectrosia leporina* | G | | * | * | * | * | | | |
| *Eragrostis sp.* | G | | * | * | * | * | | | |
| *Eriachne avenacea* | G | | * | * | * | * | | | |
| *Eriachne obtusa* | G | | * | * | * | * | | | |
| *Eriocaulon fistulosum* | G | * | | | | | | | |
| *Eriocaulon spectabile* | G | * | | | | | | | |
| *Eulalia mackinlayi* | G | | * | | | | | | |
| *Fimbristylis sp.* | G | * | | * | | | * | | |
| *Flagellaria indica* | G | | * | * | | | | | * |
| *Galactia megalophylla* | G | | * | | | | | | |
| *Germainia grandiflora* | G | * | | | | | | | |
| *Grevillea pluricaulis* | G | | * | | | | | | |
| *Haemodorum parviflorum* | G | * | | | | | | | |
| *Helicteres darwinensis* | G | | * | | | | | | |
| *Heteropogon triticeus* | G | | * | * | * | * | | | |
| *Hibbertia caudice* | G | | * | * | | | | | |
| *Hibbertia dilatata* | G | | * | * | | | | | |
| *Imperata cylindrica* | G | * | | | * | | | | |
| *Mnesithea rottboellioides* | G | | * | * | * | | | * | * |

| Species | Strata* | Vegetation species types | | Planting objective | | Sowing techniques | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Wet-indicator sp. | Woodland sp. | Ecological Restoration | Stabilisation | Direct Seeding - Core Sp | Direct Seeding - Opportunistic Sp | Nursery Propagation - Core Sp | Nursery Species - Opportunistic Sp |
| *Osbeckia australiana* | G | | * | | | | | | |
| *Pandanus spiralis* | G | * | | * | | * | | * | |
| *Petalostigma quadriloculare* | G | * | | * | | * | | * | |
| *Sauropus glaucus* | G | | | | | | | | |
| *Sehima nervosum* | G | | * | | * | * | | | |
| *Sorghum intrans* | G | | * | | | | | | |
| *Sorghum plumosum* | G | | * | | | | | | |
| *Sorghum stipoideum* | G | | * | | | | | | |
| *Themeda triandra* | G | | * | * | * | * | | | |
| *Xyris complanata* | G | * | | | | | | | |
| *Acacia latescens* | M | | * | | * | * | | | |
| *Banksia dentata* | M | * | | * | | * | | | |
| *Brachychiton paradoxus* | M | | * | * | | * | * | * | |
| *Buchanania obovata* | M | | * | * | | * | | * | |
| *Cycas maconochiei* | M | | * | * | | | | | |
| *Cyclophyllum schultzii* | M | | * | * | | * | | | |
| *Erythrophleum chlorostachys* | M | | * | * | | * | | * | |
| *Gardenia megasperma* | M | | * | * | | * | | * | |
| *Grevillea decurrens* | M | | * | * | | * | | * | |
| *Grevillea pteridifolia* | M | * | | * | | * | | * | |
| *Helicia australasica* | M | * | | * | | * | | | |
| *Hibbertia dilatata* | M | | * | * | | | | | |
| *Livistona humilis* | M | | * | * | | * | | * | |
| *Pandanus aquaticus* | M | * | | | | | | | |
| *Pandanus spiralis* | M | * | | * | | * | | * | |
| *Petalostigma pubescens* | M | | * | * | | * | | * | |

| Species | Strata* | Vegetation species types | | Planting objective | | Sowing techniques | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Wet-indicator sp. | Woodland sp. | Ecological Restoration | Stabilisation | Direct Seeding - Core Sp | Direct Seeding - Opportunistic Sp | Nursery Propagation - Core Sp | Nursery Species - Opportunistic Sp |
| *Persoonia falcata* | M | | * | * | | | | | * |
| *Planchonia careya* | M | | * | * | | * | | * | |
| *Terminalia pterocarya* | M | | * | * | | * | | | |
| *Verticordia cunninghamii* | M | | * | | | | | | |
| *Wrightia saligna* | M | | * | * | * | | * | | |
| *Acacia lamprocarpa* | U | | * | | * | * | | | |
| *Alphitonia excelsa* | U | * | | * | | * | | | |
| *Barringtonia acutangula* | U | * | | * | | | | * | |
| *Calophyllum sp.* | U | | * | * | | * | | | |
| *Clerodendrum floribundum* | U | | * | * | | * | | | * |
| *Corymbia bleeseri* | U | * | | * | | * | | | |
| *Corymbia confertiflora* | U | | * | * | | * | | | |
| *Corymbia dichromophloia* | U | | * | * | | * | | | |
| *Corymbia foelscheana* | U | | * | * | | * | | | |
| *Corymbia latifolia* | U | | * | * | | * | | | |
| *Corymbia polycarpa* | U | * | | * | | * | | | |
| *Corymbia polysciada* | U | | * | * | | * | | | |
| *Eucalyptus alba* | U | * | | * | | * | | | |
| *Eucalyptus miniata* | U | | * | * | | * | | | |
| *Eucalyptus tectifica* | U | | * | * | | * | | | |
| *Eucalyptus tetrodonta* | U | | * | * | | * | | | |
| *Leptospermum madidum* | U | * | | | | | | | |
| *Lophostemon lactifluus* | U | * | | * | | * | | * | |
| *Melaleuca argentea* | U | * | | | | | | | |
| *Melaleuca leucadendra* | U | * | | * | | * | | * | |
| *Melaleuca nervosa* | U | * | | * | | * | | * | |

| Species | Strata* | Vegetation species types | | Planting objective | | Sowing techniques | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Wet-indicator sp. | Woodland sp. | Ecological Restoration | Stabilisation | Direct Seeding - Core Sp | Direct Seeding - Opportunistic Sp | Nursery Propagation - Core Sp | Nursery Species - Opportunistic Sp |
| *Melaleuca viridiflora* | U | * | | * | | * | | * | |
| *Syzygium armstrongii* | U | * | | * | | | | * | |
| *Syzygium eucalyptoides subsp..bleeseri* | U | * | | | | | | | |
| *Syzygium suborbiculare* | U | * | | * | | | | * | |
| *Terminalia ferdinandiana* | U | | * | * | | * | | * | |
| *Xanthostemon eucalyptoides* | U | * | | | | | | | |
| *Xanthostemon paradoxus* | U | * | | * | | | * | * | |

*Strata: ground (G) storey, mid (M) canopy, upper (U) canopy.

### 4.2.3 Obtaining seed

Native grass seed local to the area will need to be purchased from a local native seed supplier such as Top End Seeds (TES); a company specialising in the native vegetation of the Top End. Seeds need to be ordered at least 12 months in advance based on the availability of stock.

Alternatively, it may be possible to collect grass seed from adjacent bushland. It is integral that seed collected is as local as possible to ensure that it is suitable for the site and to increase rehabilitation success, while maintaining genetic integrity of the seedbank. Native grasses are often abundant and easy to harvest for seed, especially in areas where they naturally occur in high density and easily accessible. The preliminary species selection outlined in Table 4-2 can be used as a guide when selecting potentially suitable species for ground-storey and upper/mid canopy cover species for the areas to be rehabilitated.

Seed availability may be a limiting factor that needs to be considered if collecting on-site. Collecting seed in a natural environment doesn't always meet the required amount due to environmental changes.

A seed harvesting strategy may be developed for long-term planning. Typical harvesting times for grass seeds is from December – May, but preferably in March/April (Kraatz et al. 2009). It is advised to collect from individual specimens 50m apart and only harvest up to 20% of the seed from each (Kraatz et al. 2009).

Seed collection for canopy and mid-storey vegetation is also an option, and the typical harvest time is between July – December.

### 4.2.4 Obtaining tubestock

Tubestock plants will need to be purchased from local native nursery suppliers. Native canopy, mid-storey vegetation and native grass seedlings can be purchased from local suppliers such as Territory Native Plants. Tubestock seedlings need to be ordered 3 to 6 months in advance depending on the species and availability at the local suppliers. The preliminary species selection outlined in Table 4-2 can be used as a guide when selecting potentially suitable species for ground-storey and upper/mid canopy cover species for the areas to be rehabilitated.

Another option is to construct a small-scale nursery to conduct propagation on-site. This could be achieved in collaboration with LDGNT environmental staff and local ranger groups (see section 4.2.8). The capacity will need to be determined based on tubestock requirements for the project area, which are yet to be confirmed. Generally, the intent of a nursery is to establish tubestock plants that can be difficult to establish through direct seeding.

### 4.2.5 Determining seed mix and rates

Preliminary seeding mix and rates were developed for areas to rehabilitated for LDGNT after additional on-ground assessments were undertaken. The survey focused on collecting vegetation data within areas will require different species composition i.e., areas to be rehabilitated that intersect drainage areas prior to re-profiled will require wet-indicator species that generally grow in lower lying areas in the landscape. The amount differs for each species per domain and alter accordingly depending on site conditions and the results from germination trials. The seed mix and rates developed for LDGNT can be used for this RMP, given the dominant areas to be rehabilitated for BP33 intersect similar land units compared to LDGNT (i.e. Land unit 2a1, 5a and 6b) (see Table 4-3, Table 4-4).

To provide some idea of the general process used, once the floristic composition has been emulated for each domain i.e., it could be a vegetation community of 70% *Eucalyptus tetrodonta*, and 30% *Eucalyptus miniata* in the overstorey. An overall density of 1000 stems/ha is often used as a general rule of thumb, therefore 700 *E. Tetrodonta* and 300 *E. Miniata* trees would be required. The next step following this is to work out how much seed is required – this needs to account for germination rates. For instance, if only 50% of *Eucalyptus tetrodonta* (on average) germinate, 1400 seeds would be required for that individual species. Keep in mind the

tests for seed viability are often done in controlled conditions, so out in the field there will be a lot more variability due to environmental conditions so the seeds required may increase accordingly.

Work out the amounts of seed required for the other species in the over storey, mid storey, and ground layer. Work out the % composition of each, seed germinability and again work out how many stems/plants required in each layer.

The seeding rates are based on a number of previous rehabilitation projects in the Top End (Kraatz et al. 2009) but may need to be refined over time. As a 'rule of thumb' sowing rates for native grasses/herbs is 3kg/ha, and trees and shrubs are 4kg/ha; this equates to 40 grams of seed for every 100m$^2$ (10x10m) (Kraatz *et al.* 2009).

Once you have determined how much seed required per ha for each seed species (based on germination % in controlled conditions and how many stems per ha) you can proportionally up the amount of each species to make up 3kg/ha for native grasses/herbs and 4kg/ha for trees and shrubs. For example, with *E. Tetrodonta*, the 1400 seed might end up 3 times that figure.

A portion of no more than 20% of Acacias should be established in any given area as they can dominate the site, a good diversity of acacias is recommended i.e., this may incorporate a combination of long lived and short lived species (TES 2020).

**Table 4-3. Tree and shrub seed volumes (Kg)/ha based on individual species for each vegetation type**

| Vegetation type | Species | Weight of seed (Kg) required per/ha (adjusted) |
|---|---|---|
| Alluvial plains (land unit 5a) | *Pandanus spiralis* | 1.48 |
| | *Livistona humilis* | 1.15 |
| | *Grevillea pteridifolia* | 0.24 |
| | *Banksia dentata* | 0 |
| | *Melaleuca nervosa* | 0.04 |
| | *Petalostigma pubescens* | 0 |
| | *Lophostemon lactifluus* | 0.6 |
| | *Planchonia careya* | 0.53 |
| | *Syzygium eucalyptoides subsp. bleeseri* | 0 |
| | **TOTAL** | **4.04** |
| Drainage systems (land unit 6b) | *Corymbia polycarpa* | 0.02 |
| | *Erythrophleum chlorostachys* | 0.34 |
| | *Grevillea pteridifolia* | 0.05 |
| | *Terminalia carpentariae* | 1.84 |
| | *Terminalia ferdinandiana* | 0.64 |
| | *Planchonia careya* | 0.17 |
| | *Grevillea pteridifolia* | 0.18 |
| | *Petalostigma pubescens* | 0.02 |
| | *Melaleuca nervosa* | 0 |
| | *Erythrophleum chlorostachys* | 0.34 |
| | *Lophostemon lactifluus* | 0 |
| | *Livistona humilis* | 0.49 |
| | **TOTAL** | **4.09** |
| Woodland Land unit | *Eucalyptus tetrodonta* | 0.07 |
| | *Corymbia polysciada* | 0.01 |

| Vegetation type | Species | Weight of seed (Kg) required per/ha (adjusted) |
|---|---|---|
| 2a1 | *Eucalyptus miniata* | 0.18 |
| | *Corymbia bleeseri* | 0.01 |
| | *Erythrophleum chlorostachys* | 1.09 |
| | *Persoonia falcata* | 0.54 |
| | *Xanthostemon paradoxus* | 0.13 |
| | *Terminalia ferdinandiana* | 0.69 |
| | *Livistona humilis* | 0.89 |
| | *Syzygium eucalyptoides subsp. bleeseri* | 0.32 |
| | *Buchanania obovata* | 0.14 |
| | **TOTAL** | **4.07** |

**Table 4-4. Grass seed volumes (Kg)/ha based on individual species for each vegetation type**

| Vegetation type | Species | Weight of seed (Kg) required per/ha (adjusted) |
|---|---|---|
| Alluvial plains (land unit 5a) | *Sorghum stipoideum* | 2.99 |
| | **TOTAL** | **2.99** |
| Drainage systems (land unit 6b) | *Chrysopogon latifolius* | 0.62 |
| | *Themeda triandra* | 0.08 |
| | *Eriachne sp.* | 0 |
| | *Sorghum plumosum* | 0.08 |
| | *Sorghum stipoideum* | 0.28 |
| | *Heteropogon triticeus* | 1.46 |
| | *Chrysopogon fallax* | 0.48 |
| | **TOTAL** | **3** |
| Woodland Land unit 2a1 | *Sorghum stipoideum* | 0.58 |
| | *Themeda avenacea* | 0.29 |
| | *Eriachne ciliata* | 0.04 |
| | *Heteropogon triticeus* | 1.01 |
| | *Sorghum plumosum* | 0.13 |
| | *Chrysopogon fallax* | 1 |
| | **TOTAL** | **3.05** |

### 4.2.6 Seed viability

There are multiple factors that can affect the quality of the seed and prevent germination (rainfall and other climatic conditions, fire history, insects/pests, mould, age of plants and general health). If obtaining seed from local suppliers, germination standards should be undertaken by carrying out seed tests ensure the seed is quality.

Fruit-bearing shrubs i.e *Terminalia spp, Buchanania spp, Petalostigma spp, Kurunjang (Brachychiton spp),* Cocky apple and Calytrix, often require special treatment in order to grow or undergoing trials i.e. heat or scarification). Conditions may need to be artificially replicated to enhance or encourage germination. Refer to Greening Australia's NT The Bush Book for more information on specific seed treatment.

For other mine rehabilitation in the NT (Rum Jungle), TES (2020) examined the germination rates of 1000 g of core direct seeding species derived from Rum Jungles species list. This information helps to improve the seed mix for the future to determine the viability of seed in the local region.

### 4.2.7 Seed storage

The main idea of seed storage is to maintain the seed quality and viability from the time of their collection until their use some time in the future. Good practices for storing seeds focuses on controlling the storage temperature and the seed moisture content. Follow the Florabank guidelines for further information (Merritt et al 2021).

### 4.2.8 Local rangers

The Northern Land Councils Kenbi Ranger's Group are a group of local rangers who focus on managing the land at Cox Peninsula. This ranger group have previously been involved in undertaking environmental work at the Grants Project which has involved Cycad translocations from vegetation clearing practises within Stage 1 clearing. The continual involvement in the rehabilitation of this project, including seed harvest is highly recommended.

### 4.2.9 Liaise with relevant stakeholders

Continual engagement with all relevant stakeholders is required during rehabilitation process. The key stakeholders are outline within the MCP (Core Lithium 2022).

## 4.3 Site preparation

Site preparation will occur during the dry season, being finalised closer to the wetter months in preparation of the planting to occur in the midst of wet season months when there is sufficient rainfall to sustain growth.

### 4.3.1 General clean-up

General site clean-up should be undertaken at-least 12 months prior to seeding and planning - this involves checking for waste or dumped material, and if present, remove from site.

### 4.3.2 Minimising human disturbance

Human activity into a rehabilitation area can cause disturbance and have negative impacts such as ground disturbance, erosion, weed spread, destruction of vegetation and increase likelihood of fire. The site will be secured and accessed controlled from the Cox Peninsula Highway to restrict access. 'No unauthorised entry' signage will be installed on access gates. Site access will be maintained for monitoring and maintenance during rehabilitation and closure.

### 4.3.3 Weed control

Weeds can quickly out-compete native vegetation if not appropriately managed. One of the upmost vital steps to undertake prior to earthworks, movement of material and seeding/planting, is weed control. It is

recommended to commence weed control at least 12 months prior to seeding to eradicate noxious weeds and reduced seed bank in soils. It is also vital to check for weeds in the surrounding area (not only in project area) to determine if there is a risk of these weeds entering the site and if so, but how weed spread will also be prevented. Specific focus will be on the weeds recorded as part of the BP33 Ecological Survey (EcOz 2019) including Gamba Grass and Mission Grass. All other NT class A/B/C weeds and Weeds of National Significance (WoNS) will also be controlled if new infestations arise prior to works commencing.

Good weed hygiene practices will be implemented site wide during operations to prevent weed spread and will include:

- no-access zones, such as avoiding driving off designated tracks
- wash bay facilities and protocols
- equipment weed seed inspections prior to and departing site
- minimise land clearing and disturbance where possible
- conduct weed management in accordance with the site-specific Weed Management Procedure (Core Lithium 2021), and Northern Territory *Weed Management Handbook*, 2018.

### 4.3.4 Pest animals

This includes feral and domestic animals. No incidental pest animal records have been made within the project area, although Buffalo, Donkeys and Pigs have been recorded within the project area that have the potential to cause considerable damage to soil and rehabilitation areas. Cane toads and feral cats were also observed within the project area during field investigations when undertaking baseline vegetation surveys (EcOz 2017). Additionally, signs of pigs were observed in the drainage depressions where there was likely to be water holding for the longest period.

A feral and pest animal control program will be implemented during the maintenance stage of the rehabilitation to keep populations low in the area. Fencing of rehabilitation areas will also help prevent the occurrence of feral animals in the rehabilitation areas.

### 4.3.5 Installation of fire breaks

Fire will need to be managed for the initial years for successful revegetation establishment. The rehabilitation areas will be protected with fire breaks. The NT *Bushfires Management Act, 2016*, provides a framework for installation of appropriate firebreaks. A fire management program will be developed to reduce the fuel loads immediately following the wet season month once the surrounding vegetation has cured. This will ensure a slow cool burn is conducted, preventing adverse impacts to the flora and fauna and reducing the likelihood of hot fast burns during late dry season. Keeping the rehabilitation areas fire free for the initial 5 years will allow the vegetation to establish and facilitate success. Cool burns will be managed within the revegetation areas after 5 years to stimulate nutrient cycling and growth until closure criteria are met.

### 4.3.6 Soil testing

No further soil testing required at this stage as part of the RMP. Refer to baseline soil sampling *Geochemical characterisation report* EGi 2020).

The soil testing results from during the rehabilitation trials for the Grants Project will also inform decision making regarding design consideration and soil preparation to promote healthy revegetation as part of this RMP.

### 4.3.7 Salvaging resources

Resource reuse and salvaging is critical to successful rehabilitation processes. Additional resource reuse and recycling measures include salvaging of any timber or vegetation that cannot be preserved during the

earthworks program and clean, rocky oversize that can be used in rock armouring. Suitable material will be stockpiled as it becomes available and placed once final landform shaping is completed.

### 4.3.8 Fauna habitat

Several physical elements including large woody debris (LWD), rocky mounds and hollows all provide potentially habitat to a range of native wildlife species as it increases structural complexity within rehabilitation sites.

It is noted the aim of some rehabilitated areas is to limit wildlife from entering, and so faunal habitat will not be introduced in these areas. This will be captured in the specific domain-based strategy.

## 4.4 Soil preparation

### 4.4.1 Topsoil management

Topsoil will be stripped from all cleared areas to a depth of 100 mm and subsoil will be stripped to a depth of 400 mm. LDGNT have estimated that 54,805 m3 of topsoil and 164,028 m3 of subsoil will be produced from all mining components and the haul road, for the duration of the mine life. These materials will be stockpiled separately for later use in rehabilitation.

Topsoil is a vital part of revegetation, as it contains the nutrients, microbes and seed bank. Topsoil is to be removed and stored in such a way that it is protected until such time that it can be re-spread. It is essential to minimise chemical or physical deterioration of the topsoil, and careful consideration is to be given to the location of topsoil storage areas and how is it handled. It should be reiterated that checking for weeds while top soil is stockpiled is a vital and highly recommended.

Stockpiles containing valuable plant seed content should not be piled higher than 1 to 1.5 m to protect from entering drainage areas (IECA 2008). The duration of stockpiling should be the minimum as practical, ideally less than six months, before the first wet season otherwise the seeds will start germinating (Catchments & Creeks Pty Ltd 2010). Any longer than this time may cause structural degradation and the death of seeds and micro-organisms (Commonwealth of Australia 2016). LDGNT have estimated that the stockpile area required based on a maximum topsoil height of 2 m with subsoil placed in a maximum of 3 m high stockpiles. The actual height and slope requirements will depend on the materials characteristics and final stockpile locations. Batter slopes will be minimised to maintain the structural integrity and soil seed bank. The design criteria and controls required for each stockpile will be detailed in an ESCP prepared in accordance with IECA (2008), which will be submitted with the MMP.

Topsoil stockpiling will assist in preservation of its biological and chemical properties. It is to be stockpiled separately from other cleared vegetation and protected and stabilised to minimise erosion and soil loss. Erosion and sediment control measures are to be implemented where stockpiles are located within 50 m of any watercourse or drainage flow path.

#### *Re-contouring*

Re-contouring is to ensure that water flowing over the surface behaves in a similar way to the surrounding area to minimise the risk of erosion. Where possible, planning is to minimise cut-and-fill to reduce the need for re-contouring. Re-contouring is to be completed before re-spreading of topsoil.

#### *Ripping and scarification*

Prior to re-spreading of topsoil, it may be necessary to rip the ground surface. Ripping aids in water infiltration and retention, facilitating seed germination, and reducing the velocity and volume of surface water runoff.

Ripping is to be done following the natural contours. Depth of ripping will depend on degree of soil compaction but should not exceed 400 mm to avoid disturbance of underground infrastructure (IECA 2008).

After re-spreading of topsoil, the surface can be lightly scarified to promote water infiltration and plant growth. Zig-zagging lines may assist in preventing rill erosion in flat and low gradient areas.

***Topsoil re-spreading***

The topsoil will be spread back over areas of earthworks once engineering works are completed. Re-spreading of topsoil should be carried out as follows:

- Topsoil is to be spread evenly but with a rough surface to avoid compaction and assist with water infiltration and plant growth.
- The box cut will be backfilled and covered with suitable growth medium on completion of operations. Surface is shaped to proposed x-sections, ripped and covered with a suitable growth medium to a minimum depth of 0.2 m. This meets the general rule of amount of topsoil required to be re-spread in rehabilitation i.e. 0.2m – this amount of topsoil assists in capturing rainfall prevents seedlings from drying (Greening Australia, n.d.).
- Topsoil is to cover all sub-surface material where it has been removed. If insufficient topsoil is available, it may be sourced from suitable subsoil growth medium or another similar location, provided the location has similar plant species and is weed-free. This should be done in consultation with an environmental specialist.
- Erosion and sediment control measures should be incorporated to limit run-off velocities - e.g., contour banks.
- Check for weeds prior to laying, weed-infested topsoil is not to be used.

### 4.4.2 Soil condition

Depending on results of soil testing (section 4.3.6), soil adjustment for problematic soils, design and revegetation considerations (Table 4-5) should be factored into the rehabilitation. Generally, for soils showing signs of waterlogging adding compost or gypsum to soil after ripping will improve aeration and drainage potential. If soils are compact, ripping and scarification methods should be undertaken to improve water infiltration and roots to penetrate the soil. If soils are dry and deficient of nutrients, applying topsoil or additional mulch layer may encourages more micro-organisms into the soil promoting a healthier soil bed.

**Table 4-5. Design considerations for various problematic soils (IECA 2008)**

| Soil type | Design consideration | Revegetation |
|---|---|---|
| Dispersive (sodic) soils | • Dispersive soils are highly susceptible to deep, narrow, rilling (fluting) on slopes and drains.<br>• High risk of tunnel erosion if water pathways are not managed properly.<br>• Wherever practicable, dispersive soils must be treated or completely buried under a layer of non-dispersive soil before placing any scour control measures, including vegetation. | • Avoid the direct revegetation of dispersive soil. Where this is unavoidable, treat (i.e., add gypsum) prior to vegetation.<br>• Do not rely solely on the root system of plants to control erosion within dispersive soils.<br>• Critical erosion areas are steep slopes and changes of grade within drainage channels. |
| Non-cohesive, sandy soils | • Design of constructed slopes should be based on geotechnical advice, or existing stable slopes.<br>• Batter slopes of 6:1 (H:V) or flatter are highly desirable in non-cohesive soils, with a maximum recommended slope of 4:1. | • Sandy soils are usually best stabilised with grasses and ground cover vegetation.<br>• High, steep slopes (>4:1) should also be well anchored with deep rooted plants (e.g., trees and shrubs) |
| Highly erodible | • Long-term scour protection is likely to rely on the establishment of a good vegetative cover. | • Grasslands or open woodlands often work best. |

| Soil type | Design consideration | Revegetation |
|---|---|---|
| clayey soils | | • Avoid establishing a high density of trees that will eventually shade out ground cover vegetation. |
| Low fertility soils | • These soils are usually more erodible than fertile soils.<br>• Consider rock protection if a suitable vegetative cover cannot be achieved. | • Revegetation may require a long maintenance period.<br>• Soil fertility should be tested and adjusted before revegetation (as is the case for all soils). |
| Potential acid sulfate soils | • Avoid exposure of potential acid sulfate soils. Especially avoid the formation of open drains that intersect these soils.<br>• Manage soils in accordance with the State policies/guidelines.<br>• Long-term erosion and scour holes should be prevented from occurring. | • Test soils located below 5m AHD before commencing excavations.<br>• Treat exposed soils with agricultural lime.<br>• Follow established guidelines for site rehabilitation and revegetation. |

### 4.4.3 Erosion and sediment control measures

A primary ESCP has been developed as part of the Mining Management Plan (MMP).

The following principles should be followed when limiting erosion risk in terms of rehabilitation:

- revegetation should be undertaken in a progressive manner to limit erosion risk
- contour banks should be placed at intervals along a flow path
- inspections of potential erosion should be undertaken in areas prone to concentration of surface water flows
- erosion and sediment control structures are to be installed prior to land disturbance, and maintained in place until after revegetation is complete
- all erosion and sediment control devices are to be constructed with consideration of the IECA *Best Practice Erosion and Sediment Control Guidelines 2008*
- regular inspections of drainage control measures should be scheduled, with improvement, augmentation and/or repair of controls as necessary
- as per topsoil management practises, topsoil piles are to be located away from drainage lines to reduce chance of erosion.

## 4.5 Seeding and planting

### 4.5.1 Sowing technique

It is assumed some natural regeneration of native vegetation in the disturbed areas will occur through weed control, erosion mitigation, controlling grazing and fire management, however it is unlikely to be sufficient to rapidly stabilise the disturbed areas. To augment natural regeneration, a combination of direct seeding supplementary tubestock planting is required (Kraatz et al. 2009).

Direct seeding of grasses is commonly used in the NT and a good choice for seeding onto areas where natural regeneration is gradual and timely (Greening Australia, n.d.). Direct seedings of woody/native trees and shrubs is widely practised in topical Australia and its use is strongly recommended (Kraatz et al. 2009). Direct seeds can be sown directly on the ground, however rocky areas or alluvial areas exposed to flooding may be unsuitable due to the risk of seeds washing away and unable to establish. There are multiple techniques for

how to direct seed; generally, for larger areas, aerial seeding is used for larger scale areas and direct seeding by hand or via broadcast seeding is more effective for smaller area sizes. Broad cast seeding is best suited for seeding areas on flat ground, as the broadcaster is mounted on the back of a vehicle/Ute. This option will require 10-20% more seed (Kraatz et al. 2009). The approach will depend on resources available and cost.

Tubestock planting often requires more maintenance than direct seeding, but should be undertaken in conjunction with direct seeding, to enhance species diversity. Planting seedlings provides greater control over the distribution of species according to the changes in topography i.e., can be easily determined if more planting of suitable species needs to take place for alluvial areas prone to waterlogging.

### 4.5.2 Timing

The optimum time for carrying out direct seeding is early December to take advantage of the most reliable rainfall and when the soil moisture levels are maintained. It is best to undertake plantings after the first significant rains to avoid seed from being away. This timing is also suitable for tubestock seedlings.

## 4.6 Maintenance

Maintenance of rehabilitation success is key to the long-term success and will occur immediately after seeding/planting and will be undertake ad-hoc during the rehabilitation process. This may involve personnel undertaking weekly inspections.

### 4.6.1 Birds and human disturbance

Seed eating birds may become an issue after sowing. Use of gas guns as a scare tactic to prevent birds eating seeds in recently rehabilitated areas may be necessary.

The use of bunds and/or fencing with locked gates to restrict access will minimising human disturbance of rehabilitated areas.

### 4.6.2 Weed control

On-going weed maintenance is important and can be controlled with hand pulling (particularly occurrences of isolated weeds) or spraying with herbicides. If using non-residual herbicides such as glyphosate, seedlings need to be a minimum height of 8 cm prior to use. Weeds need to be sprayed by a qualified and experienced person to reduce the risks of drift, overspray and spraying native species. Weed management should be conducted in accordance with the Finniss Lithium Project Weed Management Procedure (Core Lithium 2021) as specified, and Northern Territory Weed Management Handbook, 2018.

### 4.6.3 Pest animals

Adhere to the pest animal control program that is proposed to be implemented during the maintenance stage of the rehabilitation to keep populations of livestock low in the area.

### 4.6.4 Management of erosion

Checking that all ESCP control measures are inspected against the ESCP plans for each domain.

### 4.6.5 Fire

The Finniss Lithium Project Fire Management Plan should be developed and implement on site during rehabilitation and closure. Dependant on growth of vegetation, generally rehabilitation areas will need to be

protected from fire for the initial 5 years for establishment. Post 5 years of revegetation establishment, annual post wet season cool burns could be implemented.

## 4.7 Ecological monitoring

### 4.7.1 Vegetation

This section provides detail on the vegetation monitoring that will be used to assess the progress towards rehabilitation completion criteria in section 5. It is noted there will be two types of monitoring undertaken:

- Transitional i.e. a type of short term monitoring for young revegetation after initial establishment in the first two years – this will be undertaken to identify and manage revegetation risks and will continue until there are no revegetation risk areas identified in monitoring.
- Long-term vegetation monitoring – quantitative monitoring to compare data obtained from vegetation sites against analogue sites. Further field investigation and monitoring at analogue sites will need to be undertaken so rehabilitation vegetation monitoring can be compared to surrounding undisturbed vegetation. Assessment of vegetation will be conducted by a suitably qualified person.

***Survey timing***

Due to the highly seasonal nature of the environment in northern Australia – particularly rainfall, all rehabilitation surveys will be conducted in the early dry season (between March and June). This timing will allow accessibility of the site and while many plants (particularly grasses) have reproductive material to aid in identification (Neldner et al. 2004).

***Transitional revegetation monitoring***

Revegetation will occur quickly following reinstatement of topsoil. Transitional vegetation monitoring will be conducted by drone. Drones with attached cameras will be used to capture high resolution imagery of the entire project area as an aerial survey. Imagery will be captured annually in the early dry season and comparisons between years will be made to identify any rehabilitation risk areas: areas where revegetation has not established, areas of excessive erosion and any patches of listed weed species. Not all floristic species will be able to be identified through this method, but both gamba grass (*Andropogon gayanus*) and perennial mission grass (*Cenchrus polystachios*) should be identifiable when in large patches.

Where aerial surveys detect a rehabilitation risk area, early intervention management actions will be implemented. This will include follow-up assessment of risk through on-ground assessment. Early implementation measures will be determined on a case-by-case basis but may include:

- Installation of additional erosion management structures
- Sourcing and spreading of additional topsoil
- Reseeding and/or direct planting of impacted areas.

***Long term vegetation assessment***

Revegetation assessment will not start until the entire area is free of significant rehabilitation risk. Due to the relatively small site, rehabilitation risk area in one domain might affect rehabilitation success in other domains. Vegetation assessment will compare analogue sites to vegetation monitoring sites to determine progress towards closure criteria.

### *Site selection*

Three analogue sites will be established in each of the vegetation communities equivalent to those mapped in pre-mining project footprint. Location of the centre of the analogue sites will be recorded on GPS and marked with a star picket.

Vegetation monitoring sites will be selected within each domain of the project area. The minimum number of sites located within each domain is shown in Table 4-6 and is based upon both expected rehabilitation risk and rehabilitation area. Monitoring sites will also be established where remediation has occurred (if required) to ensure effectiveness of the corrective actions are monitored. Note the number of monitoring sites proposed is indicative only and may alter once monitoring commences.

**Table 4-6. Vegetation monitoring sites within each domain**

| Domain | No. of sites |
|---|---|
| Box cut | 3 |
| Existing BP33 pit void | 1 |
| Mine waste facilities | 4 |
| Haul road | 2 |
| Water storages and drainage lines | 2 |
| Support infrastructure and pipelines | 2 |
| Other areas (ad hoc lay down yards, ROM, contractor area, topsoil stockpiles etc.) | 4 |

A figure showing proposed monitoring locations and analogue sites will be prepared in the subsequent revision of the RMP following construction of the infrastructure and assessment of suitable analogue sites.

### *Data collection methods*

Broad scale monitoring using aerial footage from drones (as per transitional vegetation monitoring) will continue once vegetation assessment has begun to ensure the project area remains free of rehabilitation risk areas. This assessment will assess overall revegetation cover, presence of weed and erosion patches, and other erosion risks.

The transect method will be used to collect data at each of the reference and monitoring sites. Each site will consist of a 100m transect marked with a star picket at each end (each end also to be recorded on GPS). A digital photograph in portrait orientation will be taken from each star picket at 1.5m height looking along the transect. The photograph will be focused on a labelled (site code and date) marker board approximately 3 m towards along the transect from the star picket. The transect will be walked by ecologists who will use a point intersect method to determine ground cover (plant species, soil, rock, litter) at every 1 m interval along the transect. The results from this method will be used to determine percentage groundcover and groundcover species richness.

Along the transect, three 10m x 10m quadrats will be established and each corner marked with star pickets (corners also marked with GPS). The quadrats will be evenly spaced along the transect (17.5m between quadrats).

<u>Ecologically dominant layer/emergent layer species</u>

In each plot all seedlings (woody plants under 1m in height), saplings (woody plants between 1m and 3m high and < 2cm diameter at breast height, or DBH) and trees (woody plants with stems ≥ 2cm DBH and greater than 3m high) will be identified and counted. For each individual the height will be estimated and DBH measured.

<u>Weeds</u>

The percentage cover of weed species (declared as weeds under the *Northern Territory Weeds Management Act*) within each 10m x 10m quadrat will be visually estimated for each weed species as follows:

- < 3 isolated small plants = 0.01 %
- > 3 isolated small plants = 0.1 %
- or a visual estimate of the % cover of plot area

Fire

At each plot an estimate of the timing of the last fire (this year, last year, more than 3 years ago) and for recently burnt sites the severity was scored from 1 to 4. Categories for characterisation of fire are:

- No evidence of fire
- Evidence of groundcover fire only
- Evidence of burnt saplings
- Evidence of fire in canopy layer.

Ecosystem function indicators

Indicators of ecosystem function (Tongway et al. 1997) biota such as ants, termites and other nutrient cycling biota noted in the analogue sites, are included as other measures of ecosystem health. Species and abundance will be recorded as noted along the transect and within each quadrat.

The monitoring sites will be established as rehabilitation work is completed (for the WRD annulus this is anticipated to be whilst project operations are still in progress). The transects and photo monitoring locations will be permanent locations (marked with a star picked and GPS location) so that the monitoring is able to be replicated over time at the same locations. Monitoring will be undertaken yearly until rehabilitation criteria are met. Monitoring will cease when the completion criteria is met, and rehabilitation is determined as complete.

***Justification of monitoring methods***

The vegetation monitoring program specified within this plan meets leading industry practice by being practicable, repeatable, able to identify likely causes of any rehabilitation failure and demonstrate success of rehabilitation against the rehabilitation completion criteria (see section 5).

Established field guidelines for vegetation surveying and mapping (*Northern Territory Guidelines and field methodology for vegetation survey and mapping* (Brocklehurst et al 2007) and *Queensland Bio-condition assessment manual* (Eyre et al. 2015) have been referenced in creation of these monitoring methods. Similar monitoring methodologies have been utilised in the assessment of rehabilitation in the NT and Qld.

The monitoring methods specified collect more information that is required for the assessment of rehabilitation against the completion criteria. This additional data is collected so that relevant information is available is the site-specific closure objectives and/or completion criteria are adjusted in future iterations of this Mine Closure Plan.

***Data management***

Each vegetation transect, quadrat and photo monitoring record will be stored in a flora monitoring database and mapped with suitable GIS software. Rehabilitation mapping will be updated following each vegetation monitoring event with indicated levels of success across each domain. Details of any management response actions will also be added to both the database and the mapping.

### 4.7.2 Weeds (site based)

Other methods of control may be undertaken at various times of the year dependent on weeds identified, stage of growth, and optimum treatment time and methodology for successful control. Weed mapping will direct requirements and define effectiveness of the Finniss Lithium Project Weed Management Procedure (Core Lithium 2021). Weed surveys are also incorporated into the vegetation surveys (Section 4.7.1).

***Survey Timing***

Weed management will be conducted annually when sufficient weed growth has occurred and the weeds are more easily identifiable, when the plant is actively growing and prior to seeding. Weed mapping and treatment monitoring will be conducted site wide annually, during late wet season when the weeds are easily identifiable and prior to implementation of prescribed burning activities.

***Site selection***

Weed mapping will occur within the project area, particularly within areas of disturbance, along access tracks, fence lines, on and around landforms and rehabilitated areas.

***Data collection methods***

An all-terrain vehicle (ATV) will enable access to most areas during or immediately following the wet season. A GPS will be used to record locations of identified weed species, and will record the following information on a field record sheet:

- Project location and date
- GPS waypoint
- Weed name
- Distribution - size (20, 50 or 100m diameter)
- Density – categorised based on proportion of groundcover that if weeds on a scale of 1-5, 1 (absent) to 5 (>50%)
- Growth stage (seedling, juvenile, adult)
- Seeded (has the weed seeded?)
- Treatment (has the weed been treated and if so with what method of treatment)
- Comments, such as effectiveness of control, site observations, disturbed area.

Suitably qualified and experienced personnel will conduct the weed mapping.

***Justification of monitoring methods***

Weed presence and density is a key success indicator for mine rehabilitation against revegetation criteria. Weed mapping and data collection will be conducted in accordance with the Northern Territory Weed Management Branch (WMB 2015), *Northern Territory Weed Data Collection Manual*.

***Data management***

Field data will be recorded in a weed mapping field sheet and on a hand-held GPS. The data will be uploaded into a database and metadata created for ArcGis to map the data accordingly.

### 4.7.3 Fauna and pest animal monitoring

Abundance and diversity of fauna in rehabilitated areas is an indicator of ecosystem health. Abundance indicates that the rehabilitation is providing a suitable habitat for the wildlife.

***Transitional Fauna Monitoring***

Although it is anticipated that revegetation will occur quickly following the reinstatement of topsoil, it is not anticipated that rehabilitation completion criteria will be met in the first few years as revegetation, and thus habitat, become reinstated. Transitional fauna monitoring will be undertaken from year one to year three to allow vegetation establishment and will continue until there are no rehabilitation risk areas identified in monitoring.

<u>Opportunistic Observations</u>

Opportunistic observations will occur during site inspections, vegetation surveys and broadly across the project area. Evidence of scats, tracks, digs or burrows, pig wallows will be noted and any wildlife, livestock, feral and pest animal sightings will be documented.

### *Survey Timing*

Fauna surveys will be conducted following the transitional period of three years, commencing from year five and will be undertaken biannually; during the dry season to coincide with the vegetation assessments when the sites can be accessed and a second survey during the wet season is appropriate if the areas are accessible. Conducting surveys during both the wet and dry seasons will account for seasonal variation in species detection.

### *Fauna assessment*

### *Site selection*

The three reference sites utilised for the vegetation monitoring (see section 4.7.1) will also be used for the fauna monitoring, established in each of the vegetation communities equivalent to those mapped in pre-mining project footprint. Location of the centre of the reference sites will be recorded on GPS and marked with a star picket. A camera trap at the pit lake will be located on the access ramp towards the water to monitor if the pit lake is utilised as a water source and habitat for terrestrial and avian wildlife.

### *Data collection methods*

Camera Surveillance

Camera surveillance will be established at all rehabilitation locations and analogue sites. Cameras are equipped with motion detection and infra-red flash (for night). The cameras will be left *in situ* recording for two weeks each time. Survey design will involve a standard 50 m x 50m quadrat with 5 cameras placed in and around each of the quadrats. One camera will be placed in the centre of the quadrat and four cameras are placed in a diamond configuration surrounding the trapping quadrat. As a standard, the outer cameras are placed 50 m from the centre camera; this creates a total area of coverage of 0.5 Ha. To accommodate situations with more restricted access (e.g., rocky areas) or habitats that are narrow (e.g., riparian zones) the shape of the diamond can be flattened by deploying some cameras closer to the centre camera, to a minimum distance of 30 m (Gillespie *et al*. 2015). Specific locations will target areas with evidence of fauna activity where notable (scats, tracks, digs or burrows, tree hollows). The cameras will be attached to a picket or tree looking towards suitable habitat a few meters in front of the camera. Bait (peanut butter, rolled oats and honey or sardines) stations will be used in an enclosed canister (such as a perforated PVC pipe) to emit odour as an attractant only, positioned in the foreground of each camera. Cameras will record continually and will be set to high sensitivity and to take three photographs per trigger, with a 10 s interval between triggers to provide adequate shots for identification purposes.

The cameras will be collected at the end of the two weeks and species sightings recorded from each of the traps within each location. Not only will native wildlife be documented, the occurrence of feral animals and pests will also be noted. The findings will be compared to the analogue sites and findings that indicate success are outlined in section 5. GPS locations of each camera trap will be recorded.

Active Searching

Active searching will occur at each site. This involves systematic searches for amphibians, mammals, and reptiles spread throughout the morning, afternoon and night to capture species active at different periods of the day. Searches will be for 20 minutes and involved turning rocks and logs, raking through leaf litter and grass, looking under bark, trees hollows, in crevices, and nocturnal searches. The use of binoculars and camera for photographs will be used to confirm the identification of some species and for reporting purposes. Presence of ants will also be noted when demobilising the bait stations.

Permits and ethics requirements

Even though camera surveillance is a less intrusive method, animal ethics committee approval is still required for camera surveys in the NT and will be obtained accordingly.

***Justification of monitoring methods***

Where possible camera traps are preferred over the more intrusive trapping methods such as pit fall traps, funnel traps and cage traps. The aim is to determine fauna presence/absence over time in the rehabilitated areas and compare to the analogue sites. The methodology is based on Gillespie *et al*. (2015).

***Data management***

Each camera trap monitoring location will be recorded and be stored in a fauna monitoring database and mapped with suitable GIS software. Data record sheets will include location, site number, camera number and SD Card number, bait type, GPS coordinates, site description, and date deployed and collected. Fauna mapping will be updated following each camera surveillance event with indicated of species present across each domain/rehabilitation area. Details of fauna management actions will also be added to both the database and the mapping. Fauna and vegetation mapping will be assessed together to indicate rehabilitation success.

### 4.7.4 Sediment and erosion

This section provides detail of the sediment and erosion monitoring that will be used to assess the progress towards and successful obtainment (or otherwise) of completion criteria.

***Survey timing***

As highly seasonal rainfall is the greatest contributor to erosion in the NT tropical north, landform, sediment and erosion monitoring will be undertaken annually at the end of the wet season. During the first two years of monitoring, additional monitoring will be undertaken e.g., following significant rainfall events. Erosion monitoring will be undertaken until completion criteria relating to percent groundcover are met (i.e., ground stabilisation is achieved).

During monitoring, each erosion and sediment control structure will be visually inspected by a suitably qualified person who will note if the structure is operating to design or whether maintenance works need to be undertaken.

***Site selection***

During the first year's post closure, erosion monitoring will be undertaken as per transitional rehabilitation monitoring (i.e., using a drone to take aerial imagery of the site from which any erosion patches can be identified). Where erosion patches are identified, on-ground assessment will then be undertaken to determine the severity and intensity of erosion (Table 4-8).

***Data collection methods***

Visual inspections and surveys:

Inspections will occur annually as a minimum following each wet season (and more frequently following high intensity rainfall events) during rehabilitation, pre and post closure until completion criteria is achieved.

Erosion monitoring:

On-ground field monitoring will be undertaken at the identified erosion monitoring locations using the transect method outlined in the vegetation surveys (Section 4.7.1).

Classification criteria:

The criteria for assessment of accelerated erosion (Van Vreeswyk et al. 2004) will be adopted as outlined in Table 4-7. This research publication was based on a condition survey of the Pilbara region in Western Australia, thus, the criteria applicable to the NT tropics for estimating the intensity of erosion will be adopted.

**Table 4-7. Criteria for assessment of accelerated erosion (Van Vreeswyk et al. 2004)**

| Estimate of area affected by erosion | | Estimate of the intensity of the erosion |
|---|---|---|
| **Rating** | **Severity** | **Intensity** |
| 0 | No accelerated erosion present | n/a |
| 1 | Slight erosion<br>(<10% of site affected) | • Slight accumulation of wind-blown soil around plant bases and other obstacles and/or<br>• Removal of finer soil particles evident but soil crust is largely intact and/or<br>• Occasional rills (<300mm deep evident) and/or<br>• A few scalds present, usually |
| 2 | Minor erosion<br>(10-25% of site affected) | • Accumulation of soil around plant bases with plant mounds noticeably enlarged and/or<br>• Evidence of pedestalling but soil loss minor and plant bases not greatly elevated and/or<br>• Breaking of surface crust with small erosion faces and some redistribution of soil and/or<br>• Rilling evident but no gully development and/or<br>• Scalding evident but scalds relatively small and discontinuous |
| 3 | Moderate erosion<br>(25-50% of site affected) | • Wind piling around plant bases and other obstacles is common but no plants completely covered and/or<br>• Pedestalling apparent with plant bases distinctly raised and with obvious soil loss and/or<br>• Rilling common or gullying present on parts of site and/or<br>• Surface sheeting with erosion faces (and/or microterracing) and active redistribution of soil and/or<br>• Wind scalds common |
| 4 | Severe erosion<br>(50-75% of site affected) | • Extreme hummocking around plants and other obstacles; some plants completely covered and/or<br>• Severe pedestalling with plant bases greatly elevated and major soil loss and/or<br>• Widespread rilling or major gullying and/or<br>• Scalding extensive, smaller scalds have coalesced to form large, more or less continuous scalded areas and/or<br>• Surface sheeting with extensive exposure of subsoil or parent material; erosion faces (and/or microterracing) and active redistribution of soil and/or<br>• Much of surface generally unstable with ripple mark formation |
| 5 | Extreme erosion<br>(75-100% of site affected) | • General surface movement, total surface area bare with formation of shifting dunes and/or<br>• Surface sheeting and/or scalding complete with exposure of subsoil or parent material and/or<br>• Extensive gullying |

| Dominant type of erosion present | |
|---|---|
| **Rating** | **Erosion characteristics present** |
| 0 | No erosion |
| A | Microterracing/sheeting |
| B | Scalding/capping |
| C | Pedestalling |

| Dominant type of erosion present | |
|---|---|
| **Rating** | **Erosion characteristics present** |
| D | Rilling/guttering |
| E | Guttering/gullying |
| F | Accelerated accretion of soil material |

***Justification for monitoring methods***

Criteria for erosion monitoring has been sourced from Van Vreeswyk et al. (2004), *An inventory and condition survey of the Pilbara region*, Western Australia.

***Data management***

A rehabilitation monitoring database will document erosion monitoring and mapped on suitable GIS software. Erosion mapping will be updated following each erosion monitoring event. Details of erosion management actions will also be added to both the database and the mapping.

Geotechnical inspection reports will document details of the inspection including details of issues identified, associated risks, management and mitigation measures and follow-up inspections.

### 4.7.5 Summary of ecological monitoring

Table 4-8 summarises the monitoring to be undertaken to assess progression towards and success in meeting the completion criteria that define site-specific closure objectives.

**Table 4-8. Summary of ecological monitoring for areas to be rehabilitated**

| Monitoring type | Monitoring undertaken | Objectives | Frequency | Duration | Responsibility[3] |
|---|---|---|---|---|---|
| Transitional vegetation (i.e., young rehabilitation) | Drone, which may lead to follow-up assessment through on-ground inspections if early management issues are identified | Native vegetation establishment comparable to that of the surrounding ecosystems | Early dry season (or late wet season) annually | Continual until rehabilitation risk lowers/or becomes negligible i.e. no weeds (particularly Gamba Grass and both Perennial and Annual Mission Grass | Project manager |
| | | Domain is a safe, stable, non-polluting and erosion resistant landform. | As above additional monitoring will be undertaken e.g., following significant rainfall events for erosion | Continual until rehabilitation risk lowers/or becomes negligible i.e. no noxious weeds, no excessive erosion impacting native vegetation establishment | |
| | | Self-sustaining native vegetation comparable to that of the surrounding ecosystems | Early dry season (or late wet season) annually | Continual until rehabilitation risk lowers/or becomes negligible i.e. no weeds (particularly Gamba Grass and both Perennial and Annual Mission Grass) | |
| Long-term vegetation | Permanent vegetation transects and photo points of ground storey plants | Self-sustaining native vegetation comparable to that of the surrounding ecosystems:<br>(Ground-storey plant establishment) | Annually (undertaken post wet season) | On-going until completion criteria are met and relinquishment of security by DITT. | |
| Long-term vegetation | Permanent vegetation transects and photo points of canopy and mid-storey regeneration | Self-sustaining native vegetation comparable to that of the surrounding ecosystems:<br>(Canopy and mid storey establishment through the spread of topsoil and the planting of tree and shrub seedlings) | Annually (undertaken post wet season) | On-going until completion criteria are met and relinquishment of security by DITT. | |
| Long-term vegetation | Permanent vegetation transects and photo points of reseeded areas | Self-sustaining native vegetation comparable to that of the surrounding ecosystems:<br>(Determining if evidence of weeds and fire, and desirable biota such | Annually (undertaken post wet season) | On-going until completion criteria are met and relinquishment of security by DITT. | |

[3] Responsibility refers to the person with overall responsibility for ensuring for the monitoring – monitoring will be undertaken by other staff or consultants.

| Monitoring type | Monitoring undertaken | Objectives | Frequency | Duration | Responsibility[3] |
|---|---|---|---|---|---|
| | | as ants and termites and other nutrient cycling are comparable to analogue sites) | | | |
| Weeds | Weed mapping (site based) | Self-sustaining native vegetation comparable to that of the surrounding ecosystems:<br>(Map weeds within project footprint, but also in surrounding areas to inform Weed Management Procedure, and to gain an understanding of source occurrences). | Annually (during wet season months or when the site is accessible and weeds easily identifiable and prior to fire management. Weed spraying will occur during the active plant growth stage during the wet season (if possible) and immediately after the wet season prior to seeding). | On-going until completion criteria are met and relinquishment of security by DITT. | |
| Transitional fauna monitoring | Observations during on-ground inspections | Ecological restoration based on fauna recolonisation (presence, abundance and diversity). | From year one to year three (to allow vegetation establishment) | Continual until rehabilitation risk lowers/or becomes negligible | |
| Long term fauna monitoring and pest animal monitoring | Active searching and camera trap surveillance at vegetation transect | Ecological restoration based on fauna recolonisation: presence, abundance and diversity.<br>(To ensure the health of rehabilitated areas by detecting native fauna presence/absence over time and compare abundance/richness to the analogue sites.) | Following the transitional period of three years, commencing from year five and will be undertaken biannually; during the dry season | On-going (following the first three years post transitional monitoring) until completion criteria are met and relinquishment of security by DITT. | |
| Landform, erosion and sediment | Geotechnical inspections | Domain is a safe, stable, non-polluting and erosion resistant landform | Annually (undertaken post wet season) and additional monitoring undertaken following significant rainfall events during the first two years. | Continual until rehabilitation risk lowers/or becomes negligible i.e. no indications of instability or impact to landform integrity | |
| | Transect monitoring | Domain is a safe, stable, non-polluting and erosion resistant landform.<br>(No areas of excessive erosion impacting landform integrity and stability) | Annually (undertaken post wet season) and additional monitoring undertaken following significant rainfall events during the first two years. | Continual until rehabilitation risk lowers/or becomes negligible i.e. no erosion and signs of native vegetation establishment | |

## 4.8 Summary of rehabilitation strategy

The bulk of closure and rehabilitation activities are planned to occur over months 51-55 of the project schedule and maintenance and monitoring to occur shortly after in month 55 (Core Lithium 2022). Table 4-9 below outlines a schedule for stages and rehabilitation activities. All stages are detailed as above in section 4.

**Table 4-9. Rehabilitation schedule**

| Stage | | Activities | Timing |
|---|---|---|---|
| 1 | Site planning | • Develop RMP<br>• Baseline flora surveys to further develop species selection and validate existing baseline information<br>• Engage local seed suppliers in preparation for seed collection. Seed suppliers to advise seeding rates per hectare based on seed size, viability (germination), site conditions and availability of stock<br>• Engage interest with local ranger groups regarding seed collection methods during the rehabilitation process<br>• Engage with key stakeholders | Prior to commencement of operations (seed collection is species and season dependant) |
| 2 | Site preparation | General site clean-up, minimise human disturbance, weed and pest control, install firebreaks, soil testing, salvaging resources, providing fauna habitat | Within 12 months leading up to the planting stage<br>Soil testing to be undertaken for rehabilitation trails, prior to revegetation. |
| 3 | Soil preparation | Ripping the soil on the contour (ideally immediately prior seeding), applying topsoil, weed control (non-residual herbicide), soil adjustment (as required from soil testing results) and erosion protection (if required on slopes, such as jute mesh or hydro-mulching). | In months prior to wet season |
| 4 | Seeding and planting | Sowing technique - direct seeding will be the preferred method (aerial seeding in larger areas to be rehabilitated), however supplementary tubestock may be required in floodplain areas to prevent seeds washing away. | Direct seeding to occur during the wet season when there is sufficient soil moisture, typically late November through to January depending on the season) |
| 5 | Maintenance | Management of birds and human activity, weeds and pests, erosion and fire. | Ongoing until closure criteria achieved |
| 6 | Ecological monitoring | Ecological monitoring for rehabilitation success:<br>• Drone monitoring – capturing aerial imagery for young/transitional rehabilitation (the first few years) to ensure native veg establishment, presence/absence of large weed infestations, and erosion. This is undertaken until rehabilitation risk is lowered (non-existent)<br>• Permanent vegetation transects (species composition, evidence of weeds, pests and fire, and desirable biota such as ants and termites and other nutrient cycling or comparable to analogue sites)<br>• Permanent photo monitoring sites<br>• Fauna and pest monitoring – camera trapping<br>• Weeds monitoring (site-based mapping)<br>• Landform, erosion and sediment (geotechnical inspections, drone monitoring and transects) | Flora and fauna monitoring will be undertaken during both wet and dry season months.<br>Landform, erosion and sediment monitoring -annually (post wet season) and additional monitoring undertaken following significant rainfall events during the first two years. |

# 5 PERFORMANCE INDICATORS

This section provides detail on the quantitative measures used to assess the progress towards rehabilitation completion criteria based on the monitoring undertaken in Section 4.7. The criteria set will be re-evaluated once results from trials from the Grants Project have been finalised and analogue site data has been obtained.

Monitoring analogue sites will assist in refining the performance indicators leading to a better understanding of the overall completion criteria that will need to be established.

Table 5-1 provides performance criteria that can be used to measure the success of rehabilitation.

**Table 5-1. Performance indicators**

| Ecological Monitoring | Monitoring undertaken | Objectives | Performance criteria | Corrective action |
|---|---|---|---|---|
| Transitional vegetation (i.e. young rehabilitation) | Drone, which may lead to follow-up assessment through on-ground inspections if early management issues are identified | Native vegetation establishment comparable to that of the surrounding ecosystems | Native vegetation establishment i.e. % of survivorship of planted seedlings and diversity of seedlings/plants:<br>• Survival rate of planted tubestock is >50% in the first year.<br>• >30% key species present in second and third year | • Reseeding impacted areas<br>• Sourcing and spreading of additional topsoil<br>• Direct planting |
| | | | Weed composition:<br>• Density of weed species within rehabilitated domain is not more than reference sites for three consecutive years.<br>• No declared weed species not previously recorded in the mining lease is present within the rehabilitated domains for three consecutive years. | • Implement treatment and prevention controls in the Weed Management Handbook (2018)<br>• Adhere to Weed Management Procedure (Core Lithium 2021) |
| | | Domain is a safe, stable, non-polluting and erosion resistant landform. | Erosion:<br>• Erosion score to remain 2 or less (Minor erosion 10-25% of site affected) (Table 4-7)<br>• No increase in erosion presence of severity from previous monitoring event for at least two consecutive years. | • Adhere to relevant ESCP's<br>• Installation of additional erosion management structures i.e. this could be in the form of short-term stabilisation<br>• Erosion remediation |
| Long-term vegetation | Permanent vegetation transects and photo points of ground storey plants | Self-sustaining native vegetation comparable to that of the surrounding ecosystems | Ground-storey plant establishment:<br>• Groundcover % and groundcover species richness recorded at vegetation transects needs to be more than or equal to that of the representative analogue sites for two consecutive years post closure. | Intervention required if less than % ground cover and species richness recorded at vegetation transects:<br>• Collect ripe native grass seed from adjacent bushland<br>• Sow seeds/supplementary grass seedlings in the wet season<br>• Plant supplementary grass seedlings |
| | Permanent vegetation transects and photo points of canopy and mid-storey regeneration | | Canopy and mid storey establishment:<br>• The number of woody plants (stems ≥ 2cm DBH and greater than 3m high) recorded at vegetation transects needs to be more than or equal to that of the representative analogue sites. | • Supplement regeneration through tubestock plantings |

| Ecological Monitoring | Monitoring undertaken | Objectives | Performance criteria | Corrective action |
|---|---|---|---|---|
| | | | • Three dominant species (per strata) recorded at vegetation transects need to be present in the analogue sites. | |
| | Permanent vegetation transects and photo points of ground storey, mid-storey and canopy | | Weed composition<br>• Density of weed species within rehabilitated domain is not more than reference sites.<br>• No declared weed species not previously recorded in the mining lease is present within the rehabilitated domains. | • Implement treatment and prevention controls in the Weed Management Handbook (2018)<br>• Adhere to Weed Management Procedure (Core Lithium 2021) |
| | | | Fire scar severity 1-4, 1 (no fire) to 4 (evidence of scaring in upper canopy).<br>• No fire scars recorded at vegetation transects within first 5 years of rehabilitation. | Intervention if fire scar is more severe at veg transects<br>• Assess effect of fire at rehabilitation and analogue sites (negative or positive)<br>• Undertake reseeding if fire occurs after germination of vegetation from the seed bank<br>• Review and implementation of fire management plan |
| | | | Desirable biota such as ants and termites and nutrient cycling:<br>• Abundance of biota recorded at vegetation transects needs to be more than or equal to species abundance in analogue sites. | Intervention for decreasing Biota compared to analogue sites:<br>• Increase structural complexity i.e. logs, existing rocks, dead trees and leaf litter<br>• Plant additional fruit bearing shrubs and trees to attract insects |
| | | Domain is a safe, stable, non-polluting and erosion resistant landform. | Erosion:<br>• Erosion score to remain 2 or less (Minor erosion 10-25% of site affected) (Table 4-7)<br>• No increase in erosion from previous monitoring event for at least two consecutive years. | • Adhere to relevant ESCP's<br>• Installation of additional erosion management structures i.e. this could be in the form of short-term stabilisation<br>• Erosion remediation Sow higher density of native grasses or provide short-term stabilisation if necessary<br>• Vegetation transects require remediation work if erosion score >2. |
| Weeds | Weed mapping (site based) | Self-sustaining native vegetation comparable to that of the surrounding ecosystems | Presence of declared weeds:<br>• Abundance and species richness of weeds recorded across the site are less than compared to baseline surveys. Note* surveys should be undertaken pre and post wet | • Active control i.e. either hand pull or the use of chemical if weeds establish, or use the bagging up technique for fruit and seed for disposal to reduce seed input within soil. |

| Ecological Monitoring | Monitoring undertaken | Objectives | Performance criteria | Corrective action |
|---|---|---|---|---|
| | | | season to ensure data is comparable season dependent<br>• Weed mapping - density and distribution score criteria (See section 4.7.2) | • Implement treatment and prevention controls in the Weed Management Handbook (2018)<br>• Adhere to Weed Management Procedure (Core Lithium 2021) |
| Transitional fauna monitoring | Observations during on-ground inspections | Ecological restoration based on fauna recolonisation (presence, abundance and diversity). | Fauna recolonisation:<br>• Notable increase in native wildlife occurrence and species diversity within the vegetation transects over each year with eventual results equivalent to that of the analogue sites.<br>• Evidence of scats, tracks, digs or burrows.<br>• No fauna injury and/or death related to mine closure and rehabilitation | • Incorporate fauna habitat to for structural complexity i.e. logs, existing rocks, dead trees and leaf litter<br>• Plant additional fruit bearing shrubs and trees to attract wildlife<br>• Assess potential contamination sources e.g., mine waters that have a pathway to fauna |
| Long term fauna monitoring and pest animal monitoring | Active searching and camera trap surveillance at vegetation transect | | Pest animals<br>• No notable increase in the presence of feral animal and pests within the vegetation transects each year compared to analogue sites.<br>• No increased evidence from previous inspection of pig wallows, hoof compaction, scats and tracks of feral animals. | • Conduct pest and feral animal control programs within the rehabilitation and surrounding areas.<br>• Fence establishment for pest animals |
| Landform, erosion and sediment | Geotechnical inspections | Domain is a safe, stable, non-polluting and erosion resistant landform. | Landform integrity and stability:<br>• No signs of seepage, tunnelling, slumping, cracks, and other signs of erosion impacting landform integrity and stability.<br>• No increase in seepage, tunnelling, slumping, cracks, and other signs of erosion from previous monitoring event for at least two consecutive years. | • Earthworks and remediation<br>• Increase frequency of geotechnical inspections.<br>• Adhere to relevant ESCP's<br>• Installation of additional erosion management structures i.e. this could be in the form of short-term stabilisation |
| | Transect monitoring | | Erosion:<br>• Erosion score to remain 2 or less (minor erosion) (Table 4-7)<br>• No increase in erosion from previous monitoring event for at least two consecutive years. | |

## 5.1 Reporting requirements

Rehabilitation performance will be monitored through site inspections and ecological surveys. Regulators will be informed via a rehabilitation progress report that includes the rehabilitation methodology. The outcomes of the Grants Project rehabilitation trials will feed into future revisions of the BP33 RMP and will inform decision-making process toward a successful post mining rehabilitation plan. Specific reports relevant to rehabilitation performance and trials are:

- Rehabilitation Management Plan (prior to commencement of operations)
- Rehabilitation progress report – submitted annually following establishment, reporting on the progressing and trial rehabilitation areas
- Revised Mine Closure Plans – submitted annually to incorporate changes in mining operations, outcomes of rehabilitation trials and site investigations.

## 5.2 Review

Two years after the commencement of the post-closure monitoring (and then each five years following), progress towards achieving the closure criteria will be assessed. The review will be undertaken by a suitably qualified person and will include consideration of:

- Results of rehabilitation monitoring.
- The effectiveness of rehabilitation trigger actions.
- New advice literature and/or guidelines relating to the rehabilitation.

# 6 KNOWLEDGE GAPS

Rehabilitation is progressive and will be a degree of trial and error. Some of the gaps identified throughout the process and should be addressed:

- Site based progressive ESCP's to be developed.
- Identify suitable analogue sites and conduct field investigations at the analogue sites, though this may not need to be done until transitional monitoring is complete (first three years).
- Flora species list to be provided to suppliers in advance to determine plants availability.
- Completion criteria may be altered accordingly.

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GROUNDWATER ENTERPRISES

RDM HYDRO

# Groundwater Dependent Ecosystem Management Plan

## *BP33 Underground Mine*

May 2022

PREPARED FOR CORE LITHIUM

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# Glossary

**Aquifer** - a geologic formation(s) that is water bearing. The term is usually restricted to those water-bearing formations capable of yielding water in sufficient quantity to constitute a usable supply.

**Aquitard** - groundwater-filled body of poorly permeable formations, through which still significant volumes of groundwater may move, although at low flow rates.

**Confined aquifer** - an aquifer below the land surface that is saturated with water. Layers of impermeable material are both above and below the aquifer, causing it to be under pressure so that when the aquifer is penetrated by a well, the water will rise above the top of the aquifer.

**Drawdown** - Lowering of the groundwater level or piezometric surface caused by abstraction of groundwater (including not only pumping, but also outflow from an artesian well or discharge from a spring).

**Ecohydrogeology** - a unifying, synthetic field of study integrating the approaches from the ecological and hydrogeological sciences in the study of groundwater dependent ecosystems, habitats, and organisms.

**Evaporation** - the process of liquid water becoming water vapor, including vaporization from water surfaces, land surfaces, and snow fields, but not from leaf surfaces.

**Evapotranspiration (ET)** - the quantity of water transpired (given off), retained in plant tissues, and evaporated from plant tissues and surrounding soil surfaces.

**Groundwater** - water that occurs beneath the land surface and fills the pore spaces of the alluvium, soil, or rock formation in which it is situated. It excludes soil moisture, which refers to water held by capillary action in the upper unsaturated zones of soil or rock.

**Groundwater Dependent Ecosystem (GDE)** – Natural 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

**Groundwater discharge** - Movement of groundwater from the subsurface to the surface. Natural discharge occurs into lakes, streams and springs as well as discharge induced by human activities (e.g. pumping).

**Hydraulic conductivity** - capacity of a porous medium to transmit water. Units m/day.

**Hydraulic gradient** - change in water level (piezometric level) per unit of distance.

**Obligate GDE** - Ecosystems with a continuous or entire dependence on groundwater

**Potentiometric surface** - surface defined by the piezometric levels corresponding to a predefined layer or topographic level inside an aquifer.

**Recharge** - water added to an aquifer or the process of adding water to an aquifer. Ground water recharge occurs either naturally as the net gain from precipitation, or artificially as the result of human influence.

**Specific yield** - the ratio indicating the volumetric fraction of the bulk aquifer volume that a given aquifer will yield when all the water is allowed to drain out of it under the forces of gravity.

**Storativity** (also storage coefficient) - the volume of water released from storage per unit decline in hydraulic head in the aquifer, per unit area of the aquifer. Storativity is a dimensionless quantity.

**Terrestrial GDE** - Ecosystems that rely on the subsurface presence of groundwater–this includes all vegetation ecosystems.

**Transmissivity** -the ability of the aquifer to transmit groundwater throughout its entire saturated thickness. Transmissivity is measured as the rate at which groundwater can flow through an aquifer section of unit width under a unit hydraulic gradient. Unit $m^2$/day.

**Unconfined aquifer** - a groundwater aquifer is said to be unconfined when its upper surface (water table) is open to the atmosphere through permeable material.

# 1 Introduction

Core Lithium Limited (Core) is developing the Finniss Lithium Project on the Cox Peninsula, Northern Territory, approximately 20 km west of Berry Springs. The Finniss Lithium Project comprises the Grants Lithium Project (Grants) located on Mineral Lease ML31726 and the BP33 Lithium Underground project on ML32346 and MNL16, approximately 4.5 km southeast of Grants.

A groundwater model developed to meet the environmental approval process predicted groundwater levels beneath potential Groundwater Dependent Ecosystems (GDEs) are likely to decline as a result of mine dewatering at the BP33 deposit (CloudGMS, 2021). GDEs are defined as *Natural 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).

The BP33 Lithium Underground Project was granted draft environmental approval by the Northern Territory Environmental Protection Authority (NTEPA). The assessment report (EP2020/001-001) contains a number of approval conditions including specific conditions concerning GDEs. Table 1 documents the approval conditions that relate to managing potential impacts on GDEs around the BP33 mine.

This document constitutes the GDE Management Plan (GDEMP) as required by condition 6-2(1).

**Table 1 GDE management conditions proscribed by EP2020/001-001**

| Condition Number | | Condition |
|---|---|---|
| 6-1 | | The approval holder must implement the action to meet the following environmental outcomes: |
| | (1) | identify the presence and extent of, and monitor the impacts of the action on, GDE vegetation within the predicted cone of groundwater drawdown; and |
| | (2) | avoid the loss of no more than 3.6 ha of identified GDE vegetation in 6-1(1). |
| 6-2 | | A GDE Management Plan must: |
| | (1) | be developed by a qualified person and submitted to the CEO for review and approval at least three months before substantial disturbance, and within every 12 months thereafter for the life of the action unless otherwise directed by the CEO in writing, to ensure it is consistent with achievement of the environmental outcomes in conditions 6-1(1) and 6-1(2); and |
| | (2) | provide for the collection of baseline data to assess the baseline condition of GDEs that could be affected by the action; and |
| | (3) | provide for monitoring and management of the impacts of the action on water availability for GDE vegetation within the area of drawdown; and |
| | (4) | define how the presence and extent of GDEs, and impacts of the action on GDEs, would be identified, monitored and measured including; |
| | | (a) determine the locations and methods for monitoring, measurement, analysis and evaluation to ensure valid results; and |
| | | (b) define when monitoring must be performed, when the results from monitoring must be analysed and evaluated, how monitoring results will be communicated and reported and to whom; and |
| | (5) | include quantitative triggers and limits which would be used to initiate investigative and/or adaptive management actions when: |

| Condition Number | | Condition |
|---|---|---|
| | | (a) groundwater levels deviate significantly from the predictions outlined in the Finniss Lithium Project BP33 Groundwater Modelling Report, Final Version 3.0, October 2021, prepared by CloudGMS (Appendix B to the SER); and/or |
| | | (b) GDE vegetation monitoring identifies that the extent of impacts to GDE health exceeds 3.6 ha, which is the extent of potential GDE that occurs within the modelled extent of the groundwater drawdown cone as a result of the action; |
| | (6) | detail how monitoring exceedances and the outcomes of investigative and/or adaptive management actions would be notified to the CEO. |
| | (7) | be implemented for the life of the action. |
| 6-3 | | The approval holder must continue to implement the last approved version of the GDE Management Plan required by condition 6-2 until the CEO provides written confirmation that a revised version is approved. |
| 6-4 | | The approval holder must provide notice in writing to the CEO if GDE monitoring identifies that the total area of GDE loss attributable to the action exceeds 3.6 ha, within seven days of the identification of the exceedance. |

# 2 Conceptual Ecohydrogeological Model

This section summarises relevant parts of EcOz (2019) and CloudGMS (2021). The conceptualisation has been updated where monitoring data collected subsequent to EIS submission has improved hydrogeological understanding. Figure 1 provides a schematic diagram of the conceptual ecohydrogeological model.

The BP33 underground mine will target spodumene, the lithium-bearing mineral, hosted within pegmatite intrusions in the Burrell Creek Formation (BCF). The BCF comprises heavily weathered shale, siltstone and strongly foliated phyllite with lenses of quartz pebble conglomerate. Groundwater flow around the BP33 site occurs in a fractured and weathered aquifer within the BCF. Thin (2 – 4.5 m thick) and discontinuous Quaternary-aged alluvial sediments overlie the weathered BCF. These are associated with drainage lines and comprise silty sands with minor laterite horizons. The Quaternary sediments typically become unsaturated during the late dry season.

Groundwater flow in the BCF aquifer is away from slightly elevated areas in the north-west and toward lower lying areas along the drainage line in the east and south of the site. The regional groundwater gradient is toward the south and the groundwater flow direction generally mimics the topography. A groundwater flow divide is inferred along the topographic divide located in the north of the BP33 site. Measured groundwater levels are less than 10 m below ground during the dry season, and may become artesian during the wet season, thus show a high degree of seasonality.

Topographic highs and surface water ponds, including the existing BP33 pit-lake and proposed dams/water storages, act as primary recharge areas. The lower electrical conductivity of the shallow groundwater (Core, 2021) suggests that distributed diffuse recharge also occurs across the site. Recharge may also be concentrated around the watercourses at the start of the wet season when water levels are deeper. Groundwater recharging in the vicinity of the BP33 mine and its infrastructure is expected to migrate offsite, either as discharge to surface water features or through evapotranspiration. The groundwater model predictions are relatively sensitive to numerical parameterisation of evapotranspiration (CloudGMS, 2018).

The operational life of the BP33 mine is projected to run for 55 months (approximately 5 years) commencing with the excavation of the box cut and running to the end of underground mining. Groundwater levels will decline progressively as the mine is dewatered. The modelling indicates that for the life of the BP33 mine to approximately three years post-closure, there will be some impact to groundwater levels and availability within a 2 km zone of influence around the mine site. Once mining ceases, the water table surface is predicted to recover to pre-mining levels within three years. At the peak of mine dewatering the drawdown cone is projected to extend beyond the mine lease (ML32346) below ephemeral drainage lines to the east and south (Figure 3), and could potentially impact riparian vegetation in these areas.

EcOz (2019) identified that, based on the community structure, the riparian vegetation associated with the ephemeral drainage line to the east of the BP33 underground mine and downstream of the Observation Hill Dam (OHD) is likely to constitute a terrestrial GDE. The vegetation included:

- Mid woodland - *Xanthostemon eucalyptoides, Syzygium armstrongii* and *Erythrophleum chlorostachys*
- Mid shrubland - *Pandanus spiralis, Helicia australasica* and *Carallia brachiata*
- Mid tussock grassland - *Eriachne triseta*

While the groundwater dependence of this community has not been verified through field studies, it is assumed that, based on the shallow groundwater depths, the vegetation uses groundwater at least on *intermittent basis to meet all or some of their water requirements* and therefore meets the definition of a GDE. This riparian vegetation occupied an area of 3.62 hectares (ha) (EcOZ, 2019). Canadell et al. (1996) in Eamus et al. (2006) identify that vegetation in tropical evergreen forest and tropical savannah have maximum root depths of 8 m and 15 m respectively.

The potential impact of groundwater level drawdown from mine dewatering on the GDE community is outlined in Figure 2 (Eamus, 2009). This figure identifies that the changes will first occur on an individual plant basis, but over time will manifest on a community level, resulting in the conversion of a diverse habitat into simplified system of less ecological value (Doody et al, 2009), and ultimately the transition to a new ecosystem where

plant species establish that are more suited to the lower water availability. It is noted that this simplified model best fits an obligate GDE community and does not consider the seasonal increase in water availability due to wet season rainfall that communities around BP33 are likely to receive.

In summary, the ecohydrogeological model of the GDE community at BP33 is as follows:

- Riparian vegetation associated with an ephemeral drainage line is likely to be a GDE based on its community of species;
- Groundwater levels are highly seasonal, and in the wet season may be close to or at ground level;
- The GDE community utilises shallow groundwater to meet some or all of its water needs;
- Mine dewatering will lower the water levels, potentially reducing the availability of groundwater to the GDEs
- Seasonal diffuse recharge and surface water flows are likely a source of water to the GDE communities during the wet season.

**Figure 1 Conceptual ecohydrogeological model**

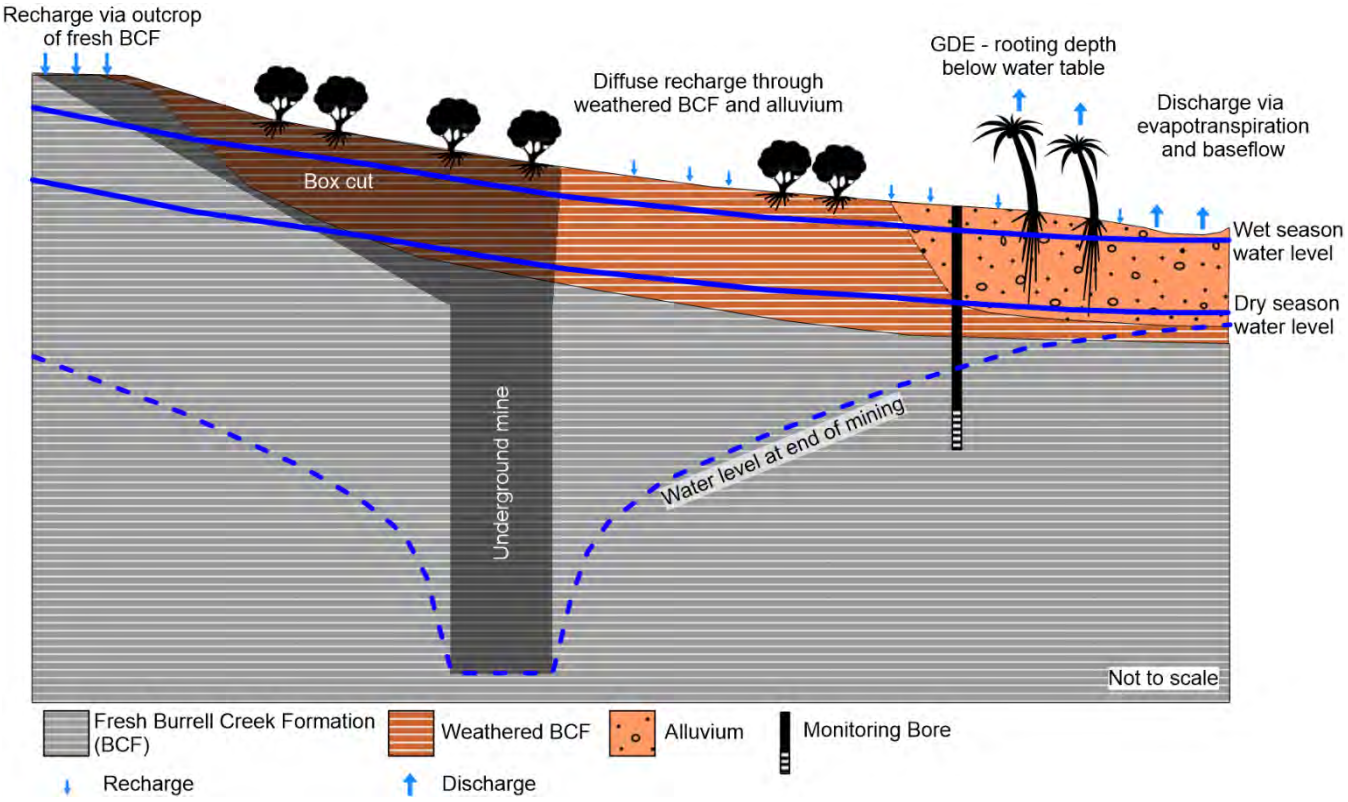


**Figure 2 Response of plants and communities of plants to reduced groundwater availability (Eamus, 2009)**

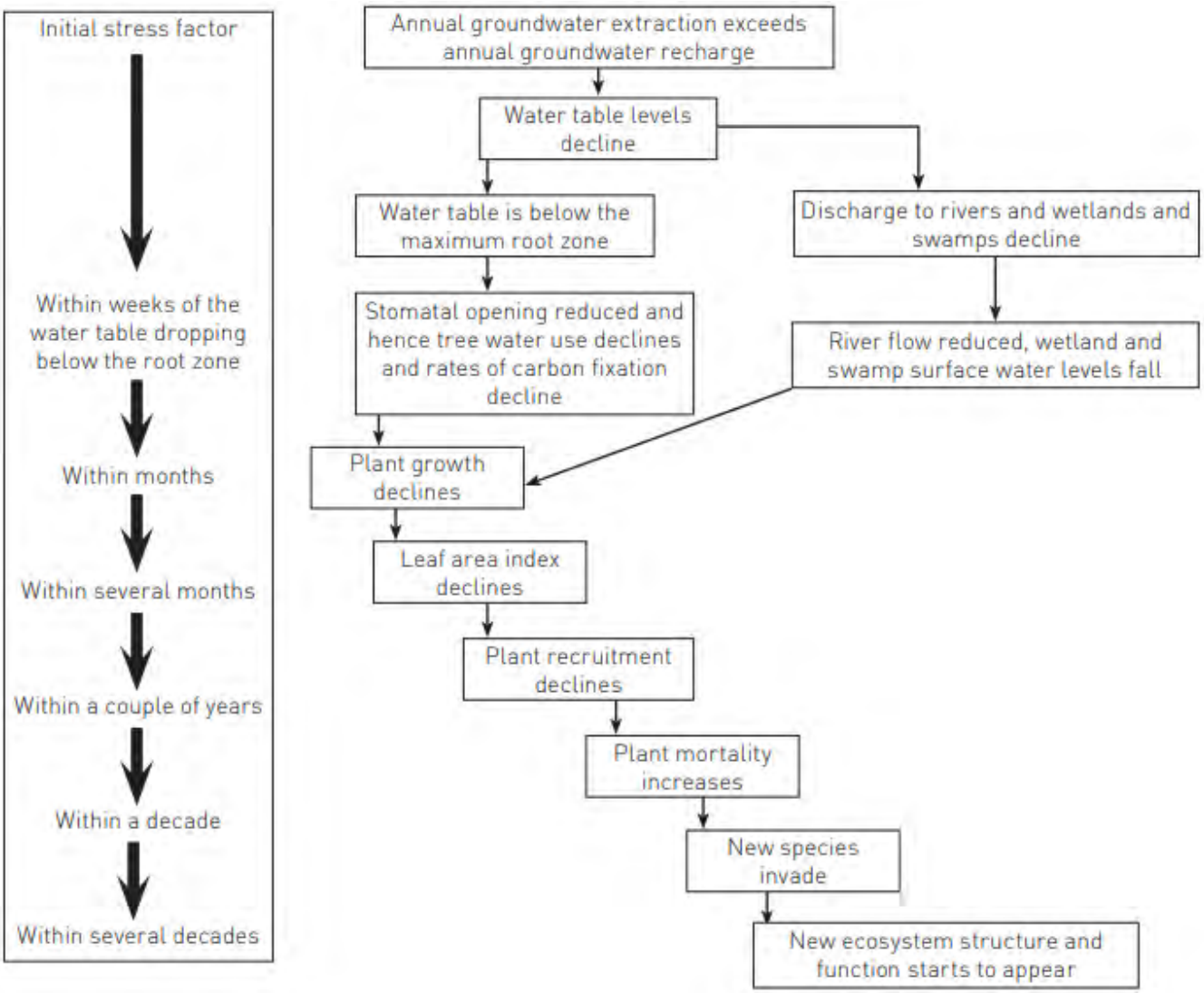
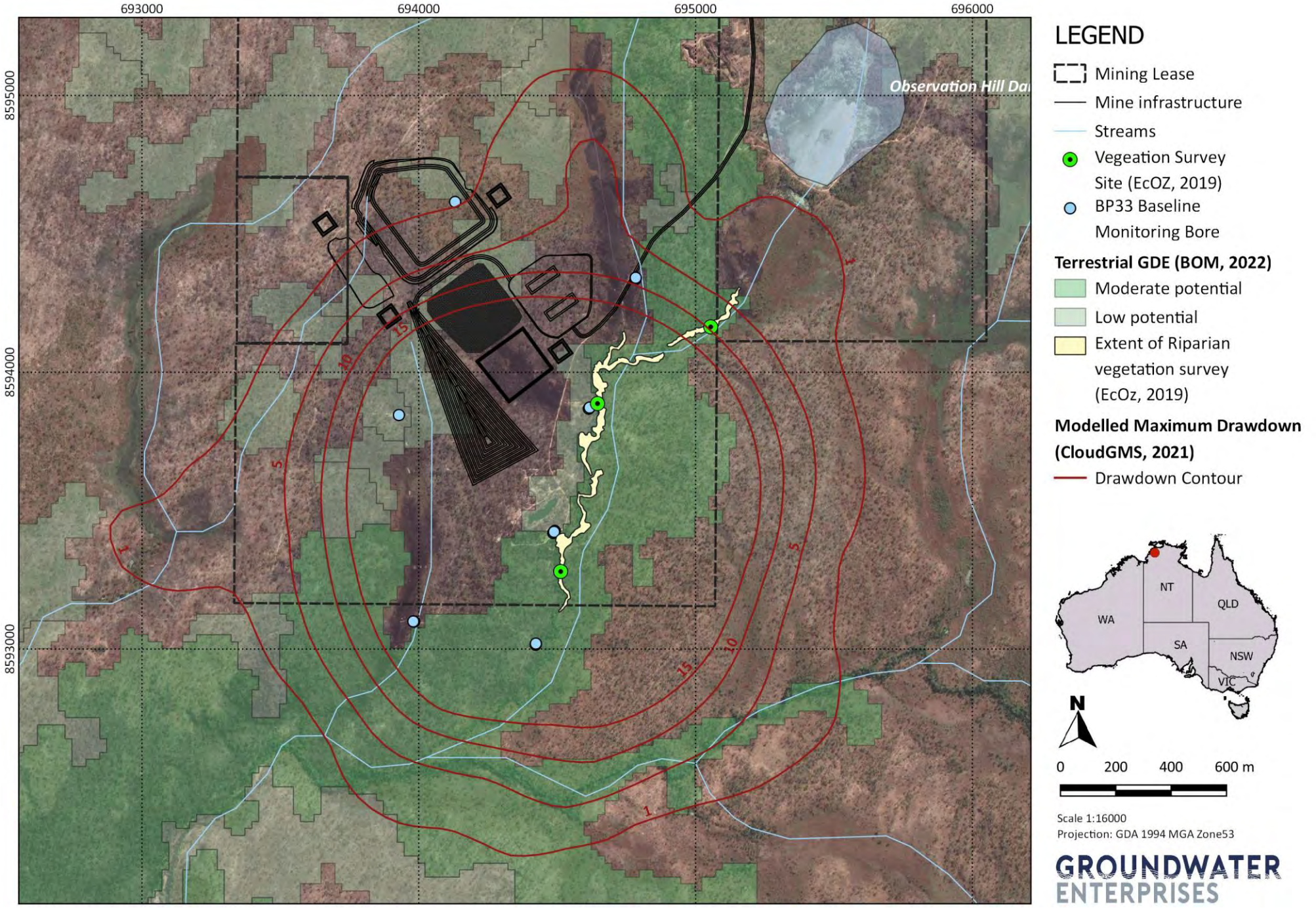


**Figure 3 Mapped drawdown contours, potential GDEs and surveyed riparian vegetation**



# 3 Monitoring activities

The GDE monitoring program comprises groundwater monitoring, surface water monitoring and vegetation monitoring. Much of the monitoring information is contextual, in that it will provide data on the baseline conditions and the effects of the imparted stress (water level drawdown due to mine dewatering) on the hydrogeological and ecological environments. This information will allow improved understanding of the ecosystem function of the GDEs. Using the process of adaptive management, this will enable targeted management measures - should they be required – to mitigate potential impacts to GDEs.

The location of mine infrastructure, potential GDEs and mapped riparian vegetation, monitoring locations and the predicted water level drawdown are shown on Figure 4.

## 3.1 Groundwater Monitoring

All established groundwater bores at the BP33 mine will be monitored (Table 2). Those monitoring bores in the immediate proximity of the mapped GDEs will be used for compliance with Condition 6-2(5) (Table 1), with the remainder used for contextual purposes.

Groundwater bores will be monitored in accordance with the BP33 Water Management Plan (Core, 2021), and will include:

- Continuous (daily) water level monitoring with a water level sensor and data logger. Continuous monitoring of all bores will commence in the calendar year 2022 dry season. The data loggers will be downloaded quarterly;
- Quarterly manual water level measurement with an electronic water level meter for quality assurance purposes; and
- Quarterly water quality sampling of the bores. This data will be used for contextual purposes only in connection with GDE monitoring and management.

Groundwater monitoring will continue until the water levels in the compliance bores (Table 2) have recovered to the pre-mining water level condition, allowing a buffer for uncertainty and seasonal variability (max-min of the baseline range).

**Table 2 Groundwater Monitoring Bores**

| Purpose | Bore ID | Screen Depth (mbgl) | Screened Lithology |
|---|---|---|---|
| Compliance | BPG2i | 22.3–- 28.3 | Weathered BCF (Fractured) |
| | BPG2s | 2.5–- 3.5 | Alluvial sediments |
| | BPG3i | 41.75–- 47.75 | Fresh BCF |
| | BPG3s | 3.5–- 4.5 | Alluvial sediments |
| | BPG4i | 28.4–- 34.4 | Weathered BCF |
| | BPG4s | 5–- 8 | Weathered BCF |
| | BPG5i | 49.3–- 56.3 | Fresh BCF (fractured) |
| | BPG5s | 5–- 8 | Weathered BCF |
| Context | BPG1 | 29–- 35 | Fractured/weathered BCF with pegmatite |
| | BPG4d | 47–- 109 | Fresh BCF (fractured) |
| | BPG6 | 66–- 72 | Fresh BCF (fractured) |
| | BPG7i | 46.2–- 52.2 | Fresh BCF (fractured) |
| | BPG7s | 4–- 7 | Weathered BCF |

### 3.1.1 Baseline data

Groundwater monitoring at the BP33 mine site commenced in November 2020. Currently available water level monitoring data is included in Appendix A.

Baseline data will comprise all groundwater monitoring data collected prior to the commencement of mining at BP33, which will include excavation of the box cut.

### 3.1.2 Data assessment

Water level monitoring data will be compared with model hydrographs generated from the groundwater model predictions (CloudGMS, 2021) in accordance with Condition 6-2(5)(a). Comparisons will be made within seven business days of the quarterly data download.

Predicted water levels from the CloudGMS (2021) model are provided in Appendix B. Some monitoring bores, particularly the shallow bores, are predicted to dewater in response to mining activities. Continued monitoring of these bores will provide valuable insight into the contribution of seasonal recharge to water availability.

As the drawdown cone will propagate from below, the intermediate bores will provide the key monitoring points for assessing modelled versus actual drawdown. Where water levels at a compliance monitoring site are deeper than *both* the intermediate and shallow bores by more than the seasonal water level range (max-min of the baseline range) for more than six months (to account for natural variability and model uncertainty), the follow up response will be triggered (Section 4).

## 3.2 Vegetation Monitoring

Vegetation monitoring, specifically the spatial extent of the riparian vegetation, is the primary metric used to measure compliance with the GDE conditions under the draft environmental approval. Vegetation health monitoring will indicate whether the GDE is water stressed and therefore at risk of community decline.

Vegetation monitoring will be undertaken in accordance with the Riparian Vegetation Monitoring Plan, Finniss Lithium Project (EcOz, 2022). Relevant components of that plan are summarised in the following sections.

### 3.2.1 GDE Extent

The extent of the riparian vegetation (GDE) will be assessed using drone-based remote sensing techniques.

Due to the rapidity of the predicted water level drawdown, the relatively short duration of the operations, and the potential for plant mortality to increase "*within a couple of years*" (Figure 2), the drone-surveys will be undertaken annually, commencing in the calendar year 2022 end of dry season.

The methodology for the drone surveys include:

- Surveys to be flown during the similar weather conditions to previous surveys and during the middle of the day to minimise the potential for atmospheric influences on the results;
- Using the Visible Atmospherically Resistant Index (VARI) to measure the reflectance of vegetation versus bare soil and to assign a numerical value for each acquired pixel;
- The VARI values will be categorised and the boundary of the riparian vegetation will be delineated; and
- GIS software will be used to calculate the current extent of the riparian vegetation and relative changes from previous monitoring surveys.

### 3.2.2 GDE Health

Vegetation health monitoring will be undertaken at:

- Two established vegetation monitoring sites (RVS4 and RVS5) within the area of predicted drawdown;
- Three new sites (RV1, RVS2, RVS3) located to the south and south-west of the existing vegetation monitoring sites within the area of predicted drawdown;

- One new vegetation monitoring site (BP33 Control) outside the area of predicted drawdown along Charlotte Creek. This site will be used as control monitoring site to assess whether potential changes to the GDE extent are related to groundwater level drawdown or other stressors.

At each site a 20 m x 20 m plot will be permanently marked (with star pickets or similar) to ensure repeat assessments of the same area. On each monitoring occasion and within each plot the following will be recorded:

- The number of seedlings, saplings and trees (dominant layer) and their species. This will include both native plants and invasive species. For each individual, the height and vital status (alive or dead) will be recorded.
- The percentage of groundcover comprising:
  - Herbs/vines/grasses/ferns and sedges
  - Soil
  - Rock
  - Litter
- The derived vegetation description for characterisation will be recorded to a standard that is equivalent to Level 5 in the National Vegetation Information System (NVIS), and in line with the NT guidelines and field methodology for vegetation survey and mapping (Brocklehurst et al. 2007).

The continuity of the riparian vegetation community will be monitored via a 100 m transect traverse from where the canopy cover is estimated. The transect will be marked to ensure repeat assessments.

### 3.2.3 Baseline Data

Baseline data will comprise all vegetation survey data collected prior to the commencement of mining at BP33, including the commencement of excavation of the box cut.

The new site on Charlotte River (BP33 Control) will be the control site used to assess non-drawdown related changes to GDE health.

An additional baseline vegetation survey should be undertaken to confirm that there are no additional stands of similar riparian or other groundwater dependent vegetation downstream of the baseline survey (EcOz, 2019) within the predicted drawdown zone of influence (1 m contour). This survey should be:

- Undertaken within the spatial extent of the modelled 1 m drawdown contour (CloudGMS, 2021) along the drainage line downstream of Observation Hill Dam; and
- Comprise a combination of desktop and field assessments;
- Undertaken during the 2022 dry season.

### 3.2.4 Data assessment

The drone surveys will be used to determine the baseline extent of riparian vegetation. Any changes in vegetation biomass will be identified in subsequent drone surveys using VARI analysis. This will be directly compared with the authorised area that can be impacted (3.6 hectares – Condition 6-1(-2), Table 1).

Vegetation health will be assessed against the baseline data collected at the vegetation health monitoring sites and will include a comparison of:

- Vegetation structure and composition.
- Groundcover area and type.
- Tree mortality.
- General vegetation description using NVIS level 5 aligns with the representative reference site descriptions.
- Tree canopy continuity.

Vegetation health data will be compared using the Before After/Control Impact (BACI) approach. BACI will be applied by performing statistical analysis to test whether there is a significant difference between:

- the baseline vegetation health and the current vegetation health at the five GDE health monitoring sites; and
- the current vegetation health at the five GDE health monitoring sites and the control site.

## 3.3 Surface Water Monitoring

Monitoring of surface water will provide important contextual information regarding the availability of water during and after the wet season. Surface water monitoring will comprise:

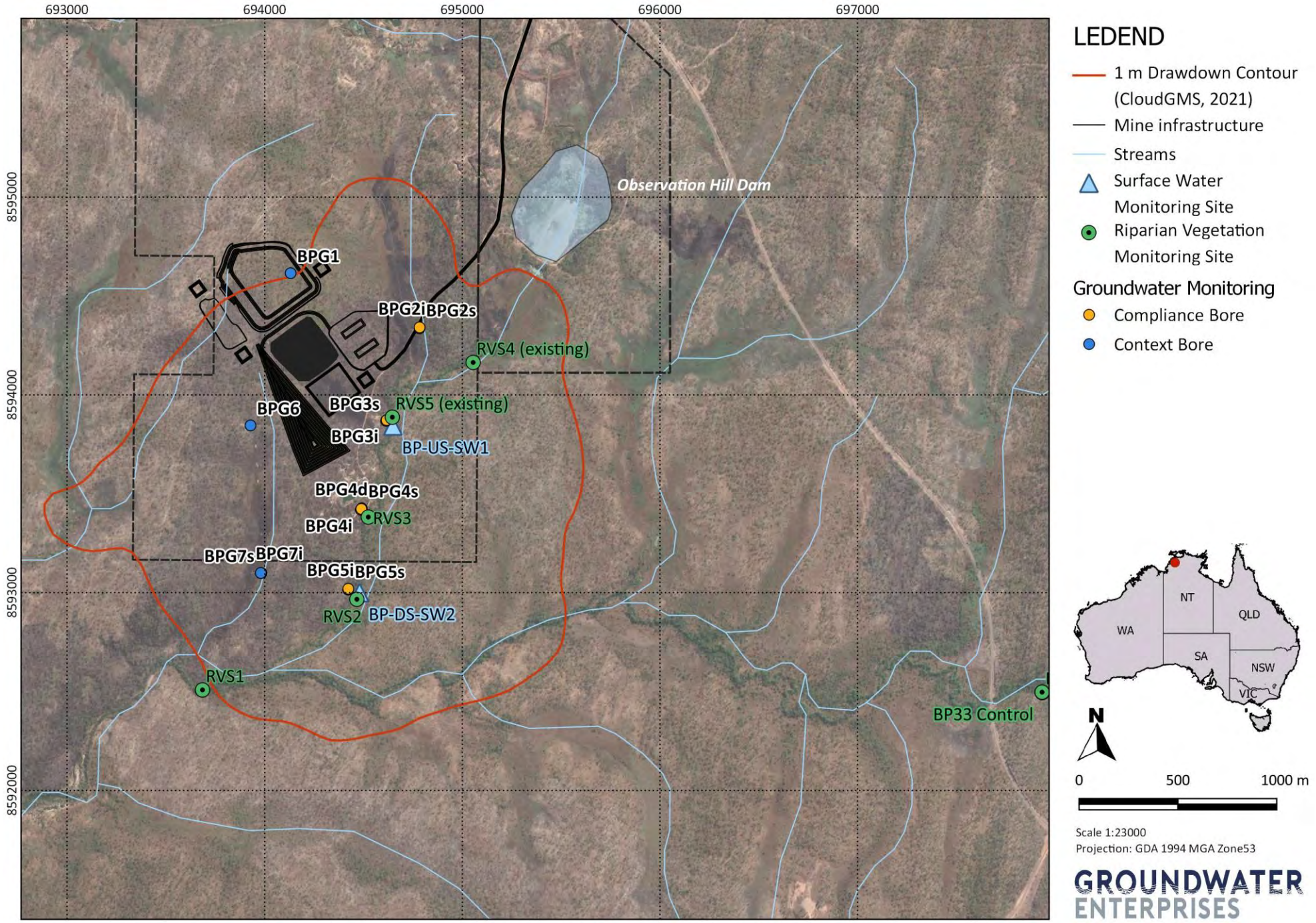
- Water quality sampling in accordance with the Water Management Plan (Core, 2021), specifically sampling at BP-US-SW1 and BP-DS-SW2;
- The installation of water level sensor/dataloggers in the thalweg of the drainage line at BP-DS-SW2 to assess the variability and continuity of surface water availability to the GDEs. The datalogger will record at a minimum daily frequency and will be downloaded quarterly. Contextual data on surface water flows will also be collected immediately downstream of Observation Hill Dam in accordance with WRM (2022).

### 3.3.1 Baseline Data

Baseline data will comprise all stream flow data collected prior to the commencement of:

- Altered surface water flow regimes through the use of water from the Observation Hill Dam; and
- Observed water level drawdown in the compliance monitoring bores identified in Table 2.

**Figure 4 GDE monitoring locations**



# 4 Triggers and Response Actions

A trigger action response plan (TARP) is outlined in Figure 5 with the aim of ensuring any loss of GDE vegetation from mine activities is less than 3.6 ha (Condition 6-1(-2), Table 1).

Key components of the TARP include:

- Groundwater level monitoring to validate the numerical groundwater flow model. If current water level drawdown predictions are exceeded by more than the seasonal water level range (for more than six months continuously), the administering authority CEO will be notified and the model will be transiently calibrated/recalibrated. The transiently calibrated model will be used to inform the duration and effectiveness of proposed management actions (where necessary). Once water levels fall below 15 m (maximum expected rooting depth of vegetation across the site) deviations between measured/predicted water levels will no longer activate this trigger action.
- Vegetation health will be used as a leading indicator of potential impacts to the GDEs and will provide early warning of loss potential loss of habitat. A BACI approach (Section 3.2.4) will be used to determine whether changes to vegetation health is likely to be associated with groundwater level drawdown;
- Loss of 10% of the GDE area[1] triggers response actions under the RVMP (EcOz, 2022) Level 2.
- Loss of 25% of the GDE area triggers response actions under RVMP level 3a in addition to further investigations and the development of a detailed management plan. Potential management actions are outlined in Section 4.1. The detailed management plan will include a schedule for its implementation;
- Loss of 50% of the GDE area triggers response actions under RVPM level 3b and the implementation of the selected management actions.
- Trigger points for notifying the administering authority CEO are identified in red within TARP.
- While this plan may be revised (with approval by the administering authority CEO), prescribed monitoring activities will continue throughout any revision process.

## 4.1 Management Actions

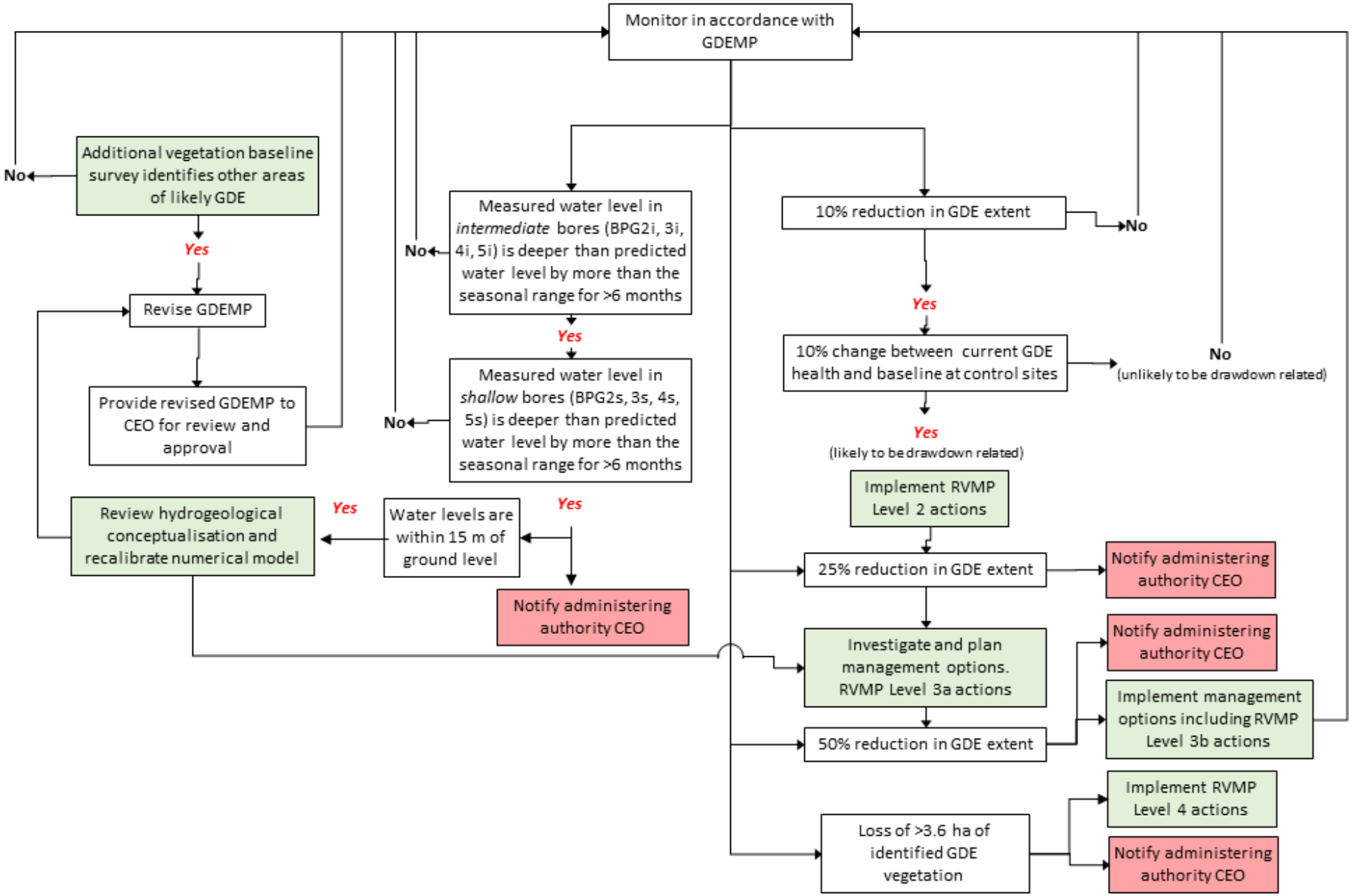
Measures to manage potential impacts to terrestrial GDEs are not well documented in literature. The primary means of minimising impacts to vegetation health, and hence maintain the spatial extent of the GDE community, is to ensure that sufficient water is available to the meet the vegetations' functional needs.

Under natural conditions, the watercourse with which the GDE is associated, is conceptualised to be a discharge feature. Water level drawdown associated with mining will reverse vertical hydraulic gradients and will therefore provide potential for enhanced recharge along the drainage lines. The salinity of the shallow groundwater, relative the groundwater deeper in the profile, suggests that this may already occur (under natural conditions). Wet season flow down the creek may be sufficient to sustain vegetation health and distribution despite groundwater level drawdown, however if flow decreases below natural variability, it may be necessary to augment water availability to the vegetation through:

- Discharge of water of suitable quality from mine water storages to the drainage lines;
- Enhancement of infiltration of surface water through the installation of:
  - Temporary or semi-permanent bunding or weirs to slow surface water flow and increase pooling and hence driving head; or
  - Infiltration galleries of trenches, shallow boreholes or a combination of the thereof, or
- Direct injection of water to the root zone of key tree specimens. There are few examples of this being undertaken, however Behrens et al (2009) did investigate the direct injection of fresh water into the root zone to improve the condition of river red gum.

[1] The GDE area is defined as the 3.6 ha identified as riparian vegetation in EcOz (2019)

**Figure 5 Trigger Action Response Plan (TARP)**



# 5 Reporting and Reviews

Results of the GDE monitoring program will be compiled in an annual report, which will be provided to the regulatory authorities upon request.

Following the completion of the annual report, and in accordance with Condition 6-2(1), the appropriateness of this plan to meet the approval conditions in EP2020/001-0001 will be reviewed and where necessary revised.

In accordance with Condition 6-4 (Table 1), the NT EPA CEO will be notified in writing if GDE monitoring identifies that the total area of GDE loss attributable to the action exceeds 3.6 ha, within seven days of identification of the exceedance.

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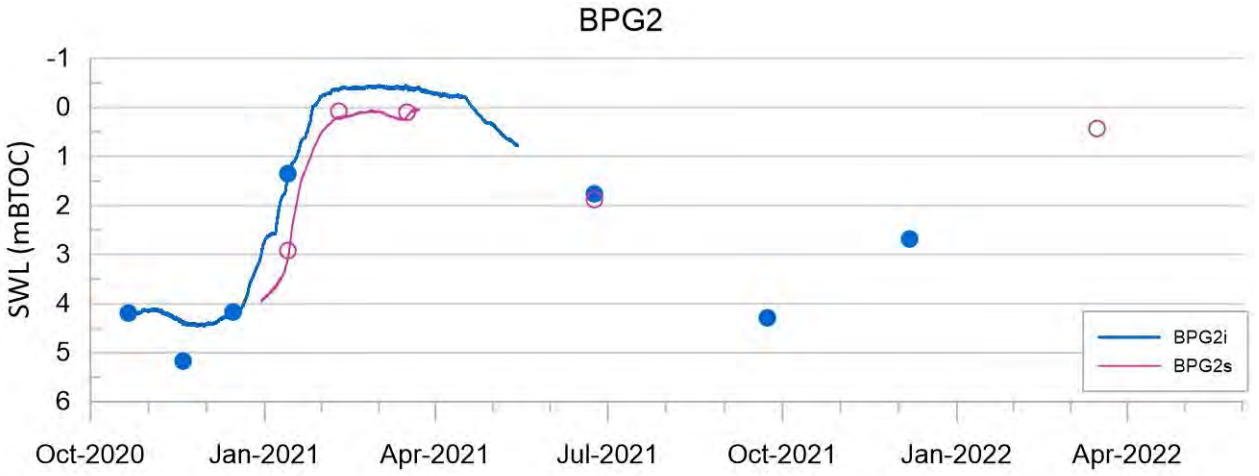
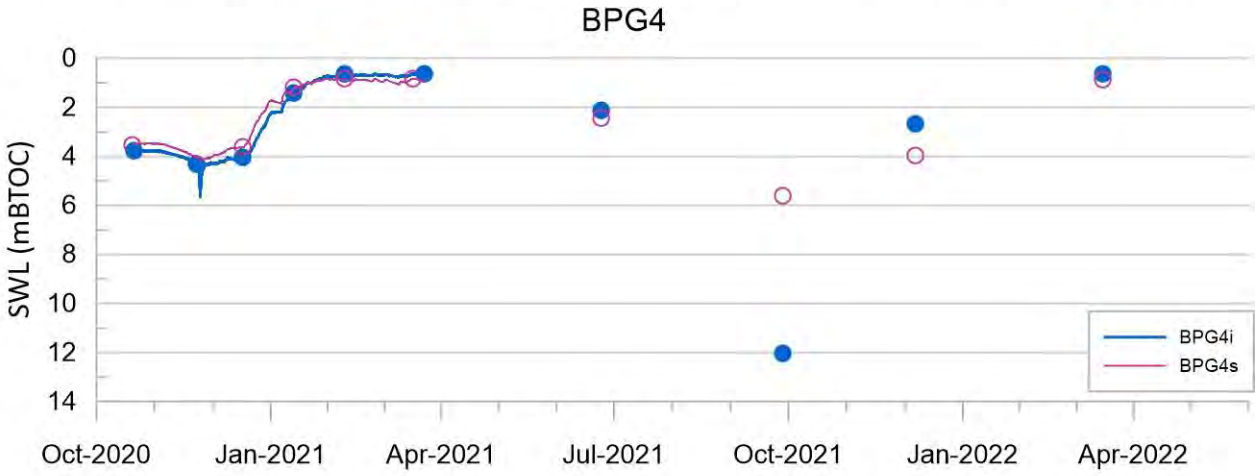
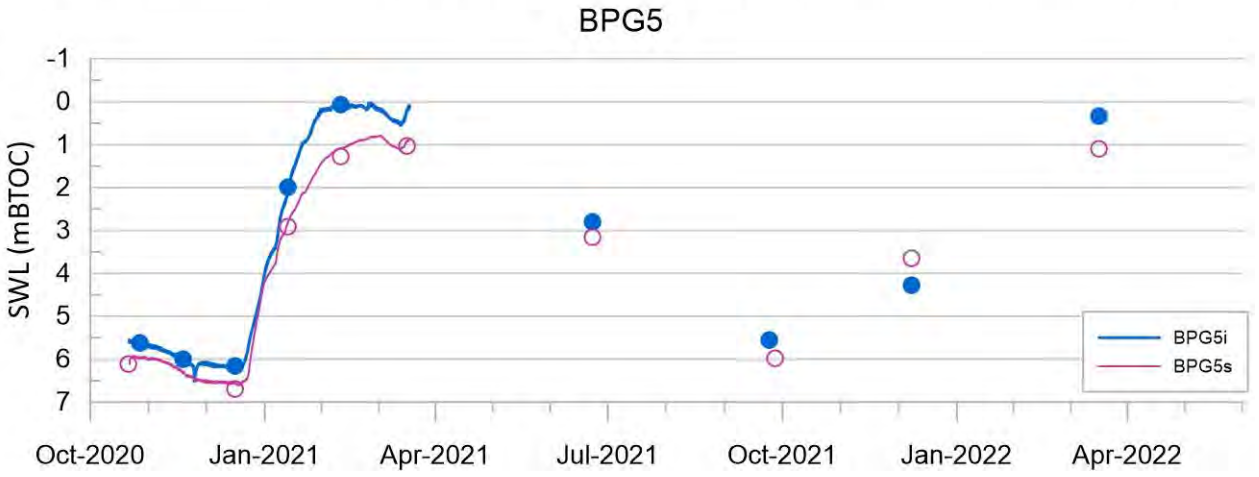
WRM (2022). Finniss Lithium Project, Observation Hill Dam Surface Water Monitoring Program. Prepared for Core Lithium by WRN Water & Environment Pty Ltd.

# Appendix A – Groundwater level hydrographs (April 2022)


BPG2
SWL (mBTOC)
-1
0
1
2
3
4
5
6
Oct-2020
Jan-2021
Apr-2021
Jul-2021
Oct-2021
Jan-2022
Apr-2022
BPG2i
BPG2s

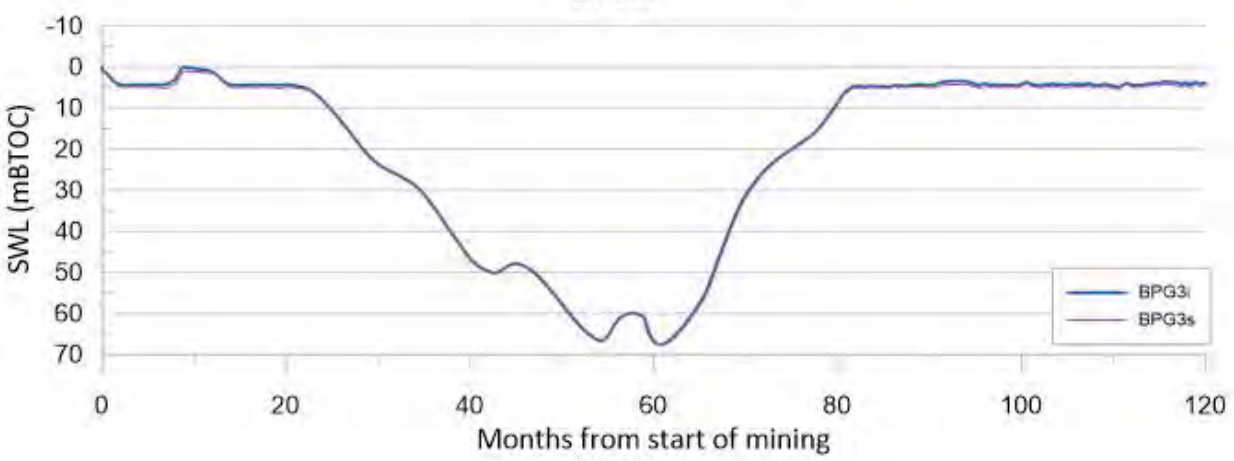
BPG3
SWL (mBTOC)
0
2
4
6
8
10
12
14
16
Oct-2020
Jan-2021
Apr-2021
Jul-2021
Oct-2021
Jan-2022
Apr-2022
BPG3i
BPG3s

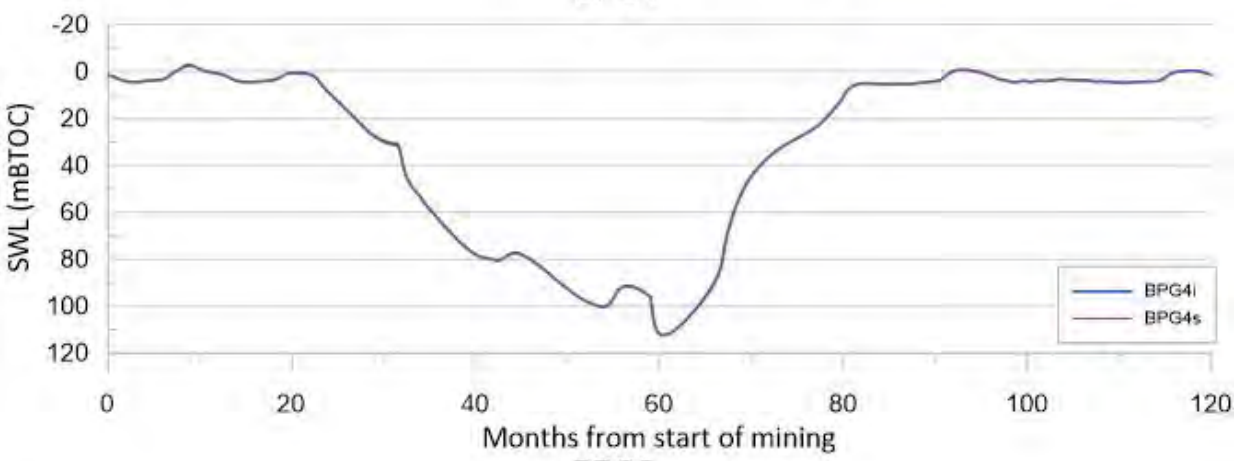

BPG4
SWL (mBTOC)
0
2
4
6
8
10
12
14
Oct-2020
Jan-2021
Apr-2021
Jul-2021
Oct-2021
Jan-2022
Apr-2022
BPG4i
BPG4s

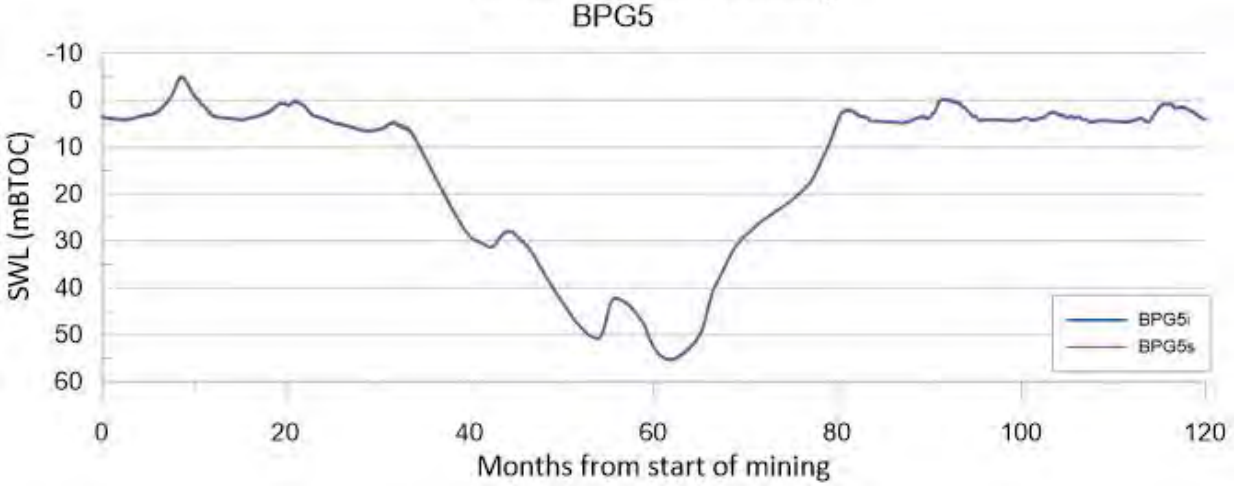

BPG5
SWL (mBTOC)
-1
0
1
2
3
4
5
6
7
Oct-2020
Jan-2021
Apr-2021
Jul-2021
Oct-2021
Jan-2022
Apr-2022
BPG5i
BPG5s

# Appendix B – Predicted groundwater levels (CloudGMS, 2021)

BPG2
SWL (mBTOC)
-8
-4
0
4
8
12
16
20
0
20
40
60
80
100
120
Months from start of mining
BPG2i
BPG2s


BPG3
SWL (mBTOC)
-10
0
10
20
30
40
50
60
70
0
20
40
60
80
100
120
Months from start of mining
BPG3i
BPG3s


BPG4
SWL (mBTOC)
-20
0
20
40
60
80
100
120
0
20
40
60
80
100
120
Months from start of mining
BPG4i
BPG4s


BPG5
SWL (mBTOC)
-10
0
10
20
30
40
50
60
0
20
40
60
80
100
120
Months from start of mining
BPG5i
BPG5s

CORE LITHIUM

ASX | CXO

# BP33 Waste Rock and AMD Management Plan

October 2023

## Document Control Record

| Version | Written | Reviewed | Approved By | Date |
|---|---|---|---|---|
| 1 | Tim Gunns | Paul McHugh | Paul McHugh | October 2023 |
| | | | | |

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## Attachments

**Attachment A:** EGi Geochemical Assessment Reports

**Attachment B:** WRD Design Drawings.

## Acronyms

| Acronym | Meaning |
|---|---|
| **AMD** | Acid and Metalliferous Drainage |
| **ANC** | Acid Neutralising Capacity |
| **CBD** | Central Business District |
| **EIS** | Environmental Impact Statement |
| **EL** | Exploration Licence / Lease |
| **EP Act** | *Environmental Protection Act (formerly Environment Assessment Act)* |
| **HSE** | Health, Safety, Environment |
| **ML** | Mineral Lease (granted) |
| **MMA** | *Mining Management Act* |
| **MMP** | Mining Management Plan |
| **mRL** | Meters Relative Level |
| **NATA** | National Association of Testing Authorities |
| **NMD** | Neutral Mine Drainage |
| **NT** | Northern Territory |
| **NT EPA** | Northern Territory Environmental Protection Authority |
| **PAF** | Potentially Acid Forming |
| **PAF-LC** | Potentially Acid Forming – Low Capacity |
| **QA/QC** | Quality Assurance and Quality Control |
| **UG** | Underground |
| **WRD** | Waste Rock Dump |

# 1 Introduction

Core Lithium are currently undertaking early works to facilitate construction and operation of an underground lithium mine (referred to as BP33) on Mineral Leases (ML) ML32346 and MLN16. Underground works are scheduled to commence in Q1 of 2024.

BP33 is part of the broader Finniss Lithium Project, comprising the approved Grants open cut lithium mine and processing facility, and several other areas prospective for lithium. The project will comprise three stages:

- Early works including excavation and backfilling of the box cut and construction surface infrastructure;
- Development of the mining decline; and
- Commencement of underground mining operations.

Acid and Metalliferous Drainage (AMD) risk has been assessed as part of comprehensive static and kinetic leach testing undertaken on representative waste materials from the BP33 project. Results of testing (EGi, 2020, 2021 and 2022) indicated waste rock stockpiled on the surface or used to backfill mine voids is likely to produce pH neutral leachate but there is potential for water in contact with these materials to contain elevated concentrations of arsenic, copper, lead and zinc, and possibly aluminium relative to local surface and groundwaters.

It is noted that this management plan considers waste volumes and waste rock dump designs developed for a proposed future expansion of underground operations at BP33. This proposal is yet to be formally assessed and approved under the Mining Management Act (MMA) and Environmental Protection Act (EP Act). The contents of this plan are subject to approval of future works under the above legislation.

## 1.1 Objective and Scope

The objective of this management plan is to:

- Detail the design and construction sequence of WRD 1 and WRD 2 to allow for the appropriate encapsulation and management of potential acid forming material (PAF) should it be identified;
- Define the waste rock sampling program to assess for potentially problematic material; and
- Provided appropriate triggers and management actions to mitigate key operational and environmental risks from potential or actual AMD.

## 1.2 Guidance Materials

This plan refers to the following guidelines:

- Australian Government Preventing acid and metalliferous drainage. Leading Practice Sustainability Development Program for the Mining Industry (DIIS 2016)

- AMIRA International Acid Rock Drainage Test Handbook. Project P387A Prediction and Kinetic Control of Acid Mine Drainage. Environmental Geochemistry International Pty Ltd (AMIRA 2002).
- International Network for Acid Prevention (INAP), 2009. Global Acid Rock Drainage Guide (GARD Guide).
- Northern Territory Environmental Assessment Guidelines, Acid and Metalliferous Drainage (EPA 2013)
- Western Australian Draft Guidance Materials Characterisation Baseline Data Requirements for Mining Proposals (DMP 2016)

# 2 Material Characterisation

Extensive waste material characterisation has been completed by specialist consultants Environmental Geochemistry International (EGI) between 2020 and 2022. Testing included both static and kinetic leach column testing that targeted oxide, fresh and transition waste rock. EGi reports are provided in Attachment A.

The approach and methods used to characterise waste rock are consistent with the GARD Guide. The guide describes the materials characterisation program as a chronology of data collection activities executed across each mine phase to progressively increase and refine knowledge of waste characteristics and management requirements.

## 2.1 Summary of Characterisation Undertaken

**EGI (2020) Geochemical Characterisation – Waste Rock and Ore**

Initial geochemical testing was undertaken to support referral under the EP Act for the development of the BP33 underground mine. 47 drill core samples were collected from a representative selection of waste rock and ore. Results suggested that most waste rock, including oxide and transitional rock excavated during installation of a box cut, transitional and fresh rock excavated during construction of the mine decline and ore that will be mined during the project, will present little risk of acid or saline drainage.

Investigations identified the potential for some potentially acid forming (PAF) waste, particularly in fresh phyllite rock as well as that both oxide and fresh rock may contain labile aluminium, arsenic and zinc which could be leached during surface storage. Consequently, EGI recommended:

- Complete ANC and NAG testing on selected samples, focusing on samples with sulphur content >0.2 %S.
- Kinetic testing (leach columns) of oxidised and fresh rock samples to confirm initial results of aluminium, arsenic and zinc leachability. Testing should be conducted under oxidising conditions to simulate conditions during storage in the WRD.

**EGI (2021) Static Geochemical Testing – Waste Rock and Ore**

EGI were engaged to complete the recommended testing noted above which included the original 47 samples as well as 29 additional samples collected during subsequent

drilling programs. These 29 samples included three oxide samples, four transition samples and five fresh samples which composited to produce oxide, transition and fresh rock samples for testing.

Results showed that:

- Oxide rock excavated from the box cut and which will be placed in the Box Cut WRD is expected to be NAF.

Preliminary water and hydrogen peroxide extraction testing showed:

- Oxide waste rock stored in the Box Cut WRD, or transition and fresh waste rock stored in the UG WRD would be unlikely to produce low pH saline seepage during short-term surface storage.
- The mobility of Al in all waste rock and As in fresh waste rock on contact with water, could potentially result in elevated concentrations of these elements in seepage during short-term surface storage.
- Should substantial oxidation of fresh waste rock occur during surface storage, the concentrations of Al, As, Co, Cr, Cu and Zn may by elevated in comparison to baseline environmental conditions.

**EGI (2022) Kinetic Geochemical Testing – Waste Rock**

From the findings of the above investigations, EGI established three kinetic leach column tests which included:

- Oxide waste rock that will be stored in the Box Cut WRD,
- Fresh waste rock that will be stored in the UG WRD, and
- Transition waste rock that will be stored in the UG WRD.

Results from leach column testing suggest that while acidic drainage from wastes stored in WRD at the BP33 project or following backfilling of mine voids is unlikely, there is potential for water in contact with these materials to contain elevated concentrations arsenic, copper, lead and zinc, and possibly aluminium relative to local surface and groundwaters.

## 2.2 Summary Underground Waste Characteristics

EGI note that acidic drainage from wastes stored at BP33 is unlikely with kinetic leach testing indicating neutral mine drainage. There is potential for elevated concentrations of As, Cu, Pb, Zn and possibly Al in water that contacts stored wastes.

It is proposed to utilise waste rock for the backfilling of voids as mining progresses. It is anticipated almost all waste materials will be backfilled at the completion of the mine. Waste materials are unlikely to be stored on the surface for a period greater than 10 years, reducing potential for leaching and mobilisation of metals.

## 2.3 Information Gaps

The BP33 geological block model does not include sulphur, however assessment of exploration drill core identified potential sulfidic materials are likely to be confined to the

contact between the pegmatite orebody and the host phyllites of the Burrill Creek formation and not constitute part of the typical mineralogy of these rock types.

Ongoing characterisation of waste rock proposed in the management plan will assist in developing a greater understanding of the distribution and confirm the nature of potentially problematic material as mine depth increases.

# 3 Sampling and Analysis Program

The sampling and analysis program provided below has been developed by EGi in consideration extensive static and kinetic assessment BP33 waste rock and ore. The program incorporates practical considerations including:

- External laboratory turnaround times;
- Operational constraints directing and managing material movements in underground mining; and
- The risk profile of waste materials at BP33 as identified through geochemical assessment.

## 3.1 Objective

The objective of the sampling and analysis program is to:

- Assess waste materials as they are mined:
- Validate existing geochemical testing undertaken; and
- Ensure appropriate management strategies are implemented should problematic material be identified.

## 3.2 Sampling Program

The following sampling program will be implemented to characterise waste rock generated during mining operations:

- Up to twelve (12) grab samples are to be collected per week from freshly dumped material across the active WRD.
    - This number may be reviewed and reduced should initial results be consistently low (as indicated by static and kinetic leach testing).
- A representative 5 – 10 kg sample from each location is to be collected in green plastic mining bag labelled with the date, RL of the dump surface and approximate location within the dump footprint.
- These details, as well a description of the sample and coordinates of the sample location should be recorded and entered into a sample register.
- Samples should be dispatched to a NATA accredited laboratory under chain-of-custody (COC) documentation.
- QA/QC should include a duplicate and inter lab triplicate with each sample batch.

## 3.3 Analysis

- Samples should be analyses for Total Sulphur (%) at a NATA accredited laboratory. The laboratory method should crush and split a 500 – 1000 g sample which is then pulverised and assayed.
- Where the Total S% of the test initial sample exceeds 0.2%, a second split should be taken, pulverised and analysed for Total S% to confirm the result.
- Where Total S exceeds 0.2%, this should trigger further investigations including further sampling from the WRD and testing to assist in identifying higher S rock.

Selected representative samples will also be assessed for basic physical properties using the Emerson Aggregate Test. Should results indicate potential for material instability, further testing may be required upon advice from the consulting geotechnical engineer.

## 3.4 Assessment and Classification Criteria

The following criteria can be used to classify the waste rock by ARD type (EGi, 2023).

**Table 6. Geochemical classification of waste rock (EGi, 2023)**

| Primary Geochemical Waste Type Class | Material | Total Sulphur Content |
|---|---|---|
| **NAF** | Ore / Oxide waste rock / Transition and fresh waste rock | S <0.2% |
| **PAF-LC** | Transition and fresh waste rock | S ≥0.2% and <0.4% |
| **PAF** | Transition and fresh waste rock | Total S ≥0.4% |

Should test results demonstrate significantly higher volumes of PAF-LC or PAF waste than the minimal amount previous geochemical testing indicated, then the testing regime may require modification to allow segregation of higher risk materials for placement in accordance with Section 4.2.3.

### 3.4.1 Acid Neutralisation Calculation

Geochemical testing indicates mined waste materials have limited to no acid neutralising capacity and as such PAF and PAF-LC may addition of lime to neutralise potential acid generation. Should problematic materials require treatment, the following equation should be used to calculate the rate of application of neutralising material i.e lime or limestone.

*Lime (kg / tonne waste) = (%S x 30.59) x 1.02 x Safety Factor) / ENV (%)*

Where:

- Total Sulphur expressed as %S.
- Conversion factor of 30.59 to convert from %S to units of $H_2SO_4$.
- Conversion factor of 1.02 is used to convert units of sulphuric acid (H2SO4) to units of calcium carbonate (CaCO3).
- A minimum safety factor of 1.5 is recommended.
- The actual rate of application of neutralising materials required must be corrected for the Effective Neutralising Value (ENV).
    - ENV is the *Calcium Carbonate Equivalent (CCE %) x fineness* of the material proposed to be used.

# 4 Landform Design and Construction

All waste material from underground will be placed in both WRD 1 and WRD2 prior to backfilling underground. WRD2 is proposed to be initially used for placement of waste materials before WRD1 is required.

Geochemical assessment of representative waste materials from BP33 indicates a small proportion of waste may be classified as PAF-LC and PAF at 5.1% and 0.6% of total volume respectively (EGi, 2021). WRD designs and waste placement strategies have been developed to accommodate for potential management of problematic material and metalliferous mine drainage which are detailed below.

## 4.1 Basis of Design

WRD designs consist of progressive 5-meter lifts, including a base lift of up to 5 meters. This base lift will be constructed atop a low-permeability layer to manage seepage. Each 5 m lift has been designed with a 37-degree slope angle, and 10-meter berms included on top of the base lift then every 10 m thereafter.

A vertical cross-section of the WRD is presented in Figure 1, the overall slope angle ranges from 20 to 23 degrees. Haul ramps have been designed at 10% and 20 m wide.

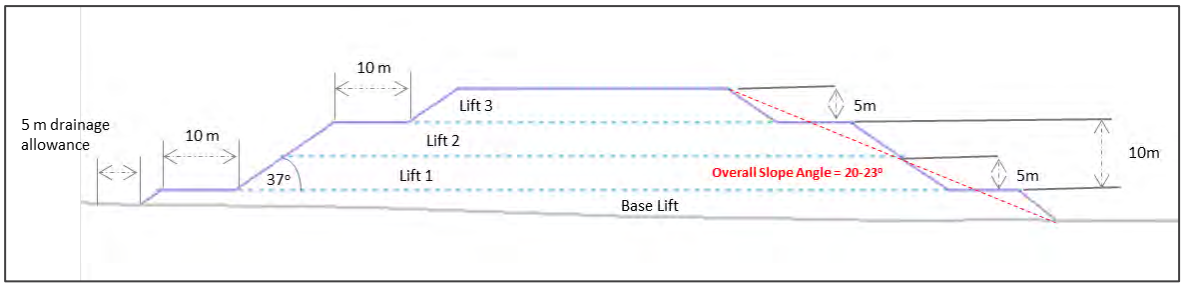


**Figure 1 Vertical cross section of WRD1/WRD2.**

Design details are provided in Table 2 below. Typical designs for WRD1 and WRD2 are provided as Attachment B.

**Table 2 WRD1 / WRD2 Basis of Design**

| Parameter | WRD1 | WRD2 |
|---|---|---|
| **Objective** | • Temporary storage of transitional and fresh waste will not pollute the receiving environment.<br>• All transitional and fresh waste rock will be backfilled in underground stopes. | |
| **Criteria** | Storage:<br>• Surrounding water quality meets site specific trigger values detailed in the BP33 WMP (WRM, 2023).<br>Construction:<br>• Stable: To required geotechnical specifications as per design requirements.<br>Backfill:<br>• Backfilling to present low risk to groundwater and GDEs<br>• PAF/PAF-LC material to be backfilled in stopes that will remain constantly below the water table level once the water table returns to pre-mining groundwater levels/conditions. | |
| **Geochemical Characterisation** | • EGi (2021, 2022) characterised transitional and fresh waste as comprising: | |
| | • 94.3 % NAF | • 5.1 % PAF-LC<br>• 0.6% PAF |
| **Dump Capacity** | • 508,934 m3 | • 144,500 m3 |
| **Dimensions** | • Length: 424 m<br>• Width: 125 m<br>• Maximum elevation: 37 mRL<br>• Footprint: 2.5 ha | • Length: 263 m<br>• Width: 105 m<br>• Maximum elevation: 37 mRL<br>• Footprint: 5.7 ha |
| **Batter Angle** | • 1:2.5 | • 1:2.5 |
| **Foundation** | • Subject to geotechnical testing, oxide waste from excavation of the Box Cut is proposed to be used to construct a flat, compacted, low-permeability foundation approximately 2 m high. | |
| **Duration / Material Fate** | • Modelled waste volumes stored within WRDs will vary over the proposed mine life. Ranging from < 50,000 m3 in 2024 and peaking at 580,000 m3 in 2029/2030.<br>• Waste rock will be progressively consumed as backfill in underground stopes at the completion of mining operations in 2038. | |

## 4.2 Construction Methods

Construction of the WRD will primarily involve end-dumping waste materials as they are transported from the underground over 5m lifts. Construction details are provided below.

### 4.2.1 WRD Foundation

Approval conditions require WRDs to have a low permeability foundation to mitigate seepage of AMD to groundwater. Subject to geotechnical assessment, low permeability foundations are proposed to be constructed of local materials i.e oxide box cut waste. If suitable compaction and infiltration rates cannot be achieved with local material, alternatives may be required such as imported clay or engineered liner such as HDPE.

Final construction specifications of the WRD low permeability foundation will be issued prior to construction once ongoing geotechnical investigations are complete. This management plan will be updated to include revised details.

### 4.2.1 Leachate Collection

A passive leachate collection system has been considered to allow assessment and management of leachate should it be generated from both WRDs. The proposed leachate collection system will comprise a network of slotted pipe within the foundation layer backfilled with rock. The leachate network would be directed to a collection sump to allow for sampling and pump out to the Mine Water Dam (MWD) should it be required.

Typical details of the proposed leachate system are provided in Attachment B.

### 4.2.2 WRD Structure

WRDs will be constructed by end dumping waste materials as they are excavated from underground. Both WRDs will be constructed in progressive 5-meter lifts, including a base lift which will be constructed atop a low-permeability layer to manage seepage.

### 4.2.3 PAF / PAF-LC Management

If PAF or PAF-LC material is identified, it will be directed to be dumped at least 20 meters away from the outer edges of the dump and 'paddocked' dump below the current tip head to allow it to be progressively contained by non-PAF materials once it has been surveyed. Should it be required, treatment of PAF / PAF-LC may be undertaken in accordance with Section 3.4.1 using an appropriate neutralising material i.e., limestone.

As material is backfilled into stopes, PAF / PAF-LC material is proposed to preferentially be used as backfill to reduce storage times on the surface.

## 4.3 Waste Schedule and Placement

Commencement of underground construction / operation is scheduled by Q1 2024. Initially waste rock will be brought to the surface and placed in WRD2, before transitioning to WRD1 once full. WRD capacity requirements by year are provided below.

The peak storage requirement is approximately 570,000 m3 in 2029/2030 before declining as waste material is reclaimed for backfill underground.

**Table 3 WRD capacity requirements by year (AMC, 2023)**

| Year | Peak WRD Volume ($m^3$) WRD1 and WRD2 |
|---|---|
| **2024/2025** | 33,325 |
| **2025/2026** | 139,146 |
| **2026/2027** | 281,547 |
| **2027/2028** | 405,855 |
| **2028/2029** | 535,456 |
| **2029/2030** | 569,290 |

### 4.3.1 Waste Placement

Schematics detailing waste rock volume and placement by year is provided in Figures 2a to 2f below (AMC, 2023). As noted above, WRD2 is given priority as the initial dump, followed by WRD1. Each dump is constructed in progressive 5-meter lifts. Material placed within the current year is shown in red, and material from previous years shown in purple.

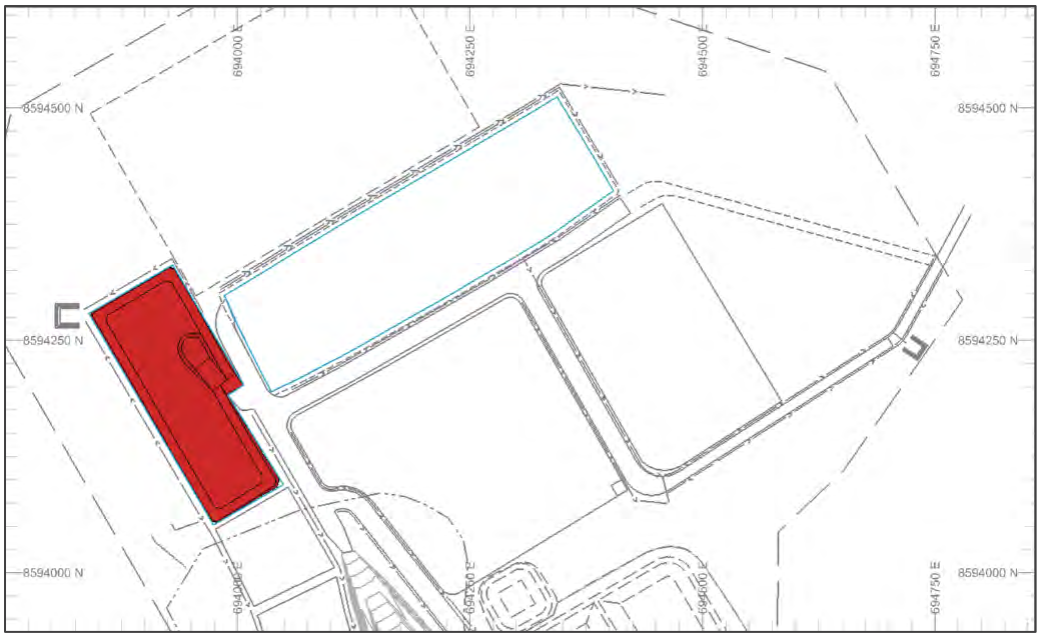


**Figure 2a WRD1 in 2024**

**Figure 2b WRD1 in 2025**

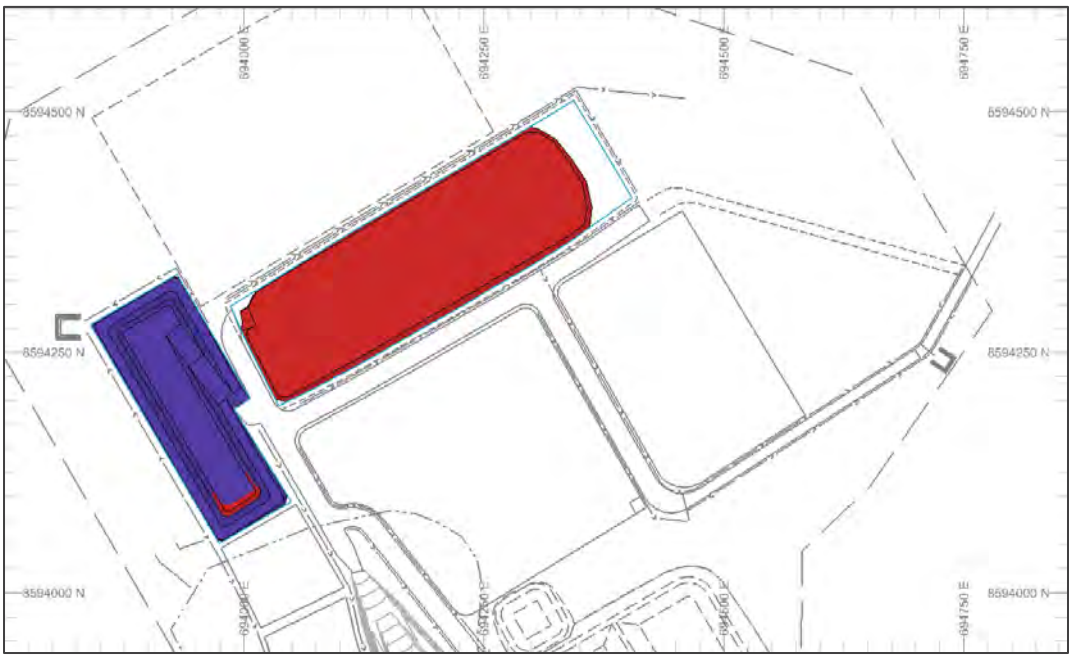


**Figure 2c WRD1 and WRD2 in 2026**

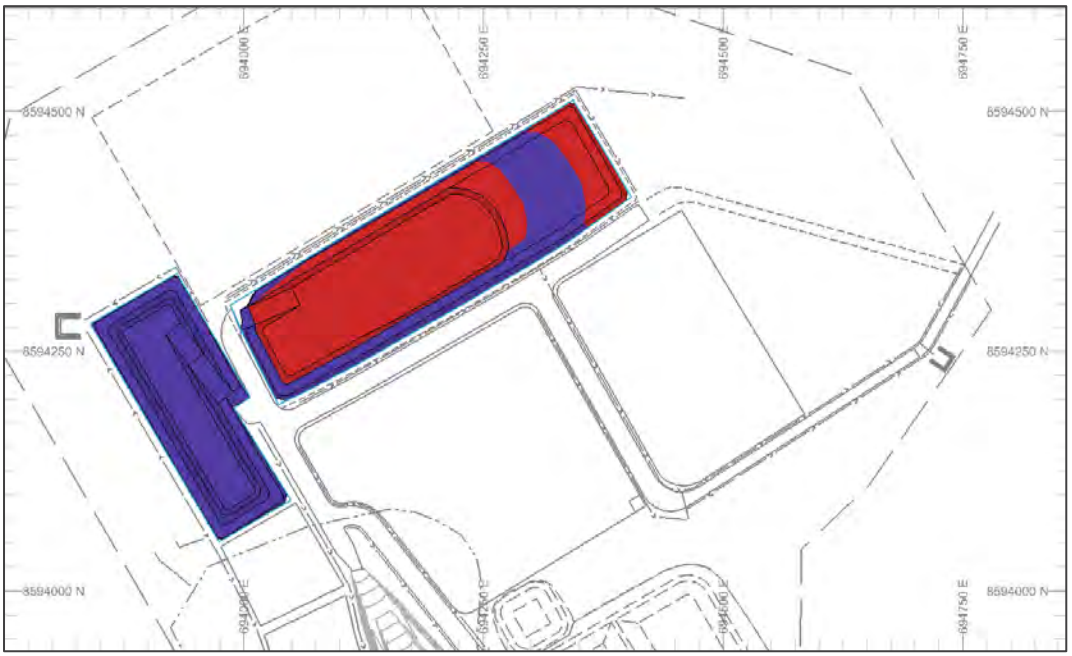


**Figure 2d WRD1 and WRD2 in 2027**

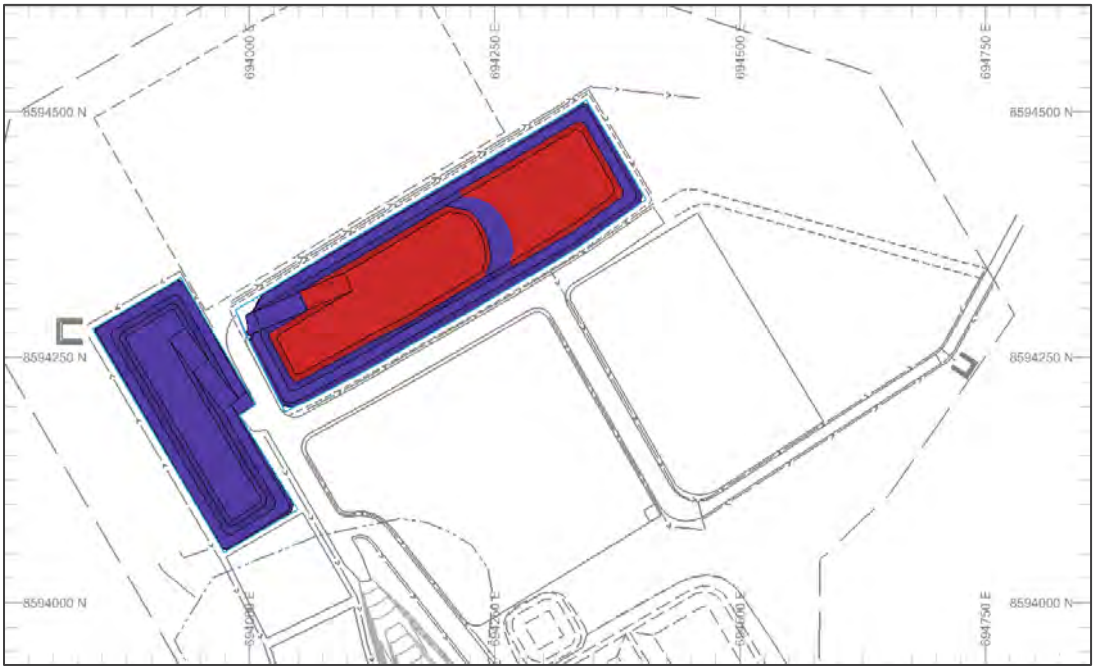


**Figure 2e WRD1 and WRD2 in 2028**

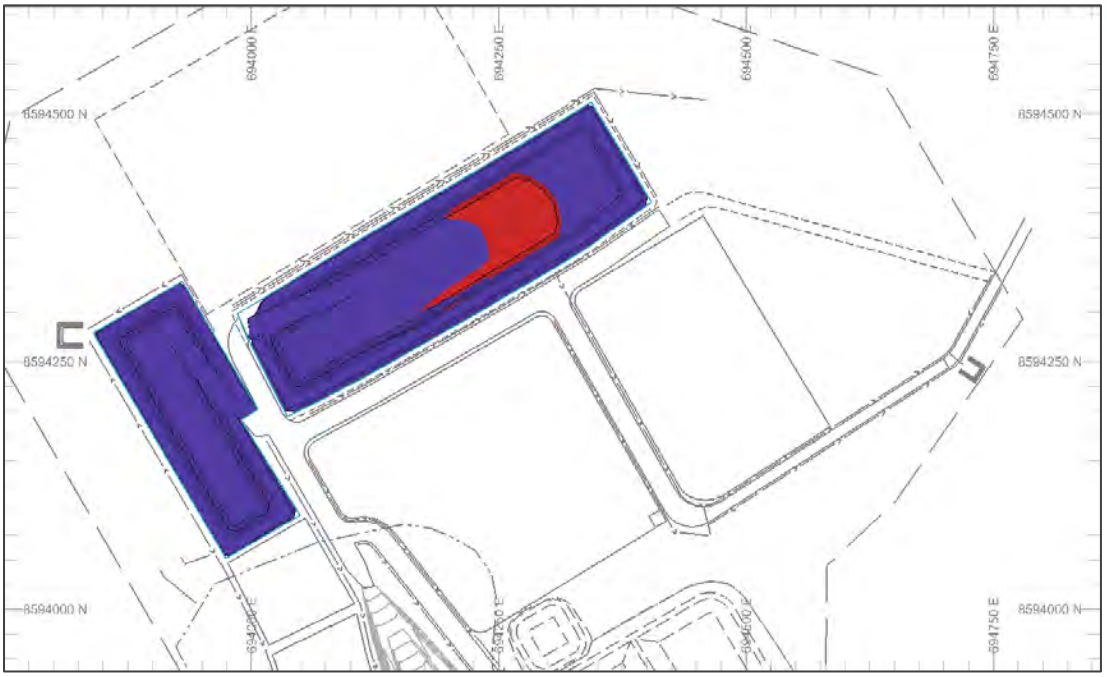


**Figure 2f WRD1 and WRD2 in 2029**

# 5 Monitoring and Evaluation

## 5.1 Leachate Monitoring

Leachate sumps are proposed to be installed downgradient of the WRDs to collect, sample and potentially pump out leachate if required. Details of the leachate sumps are provided in Attachment B. Leachate water will be assessed in accordance with the surface water sampling and analysis plan detailed in the approved WMP.

## 5.2 Surface and Groundwater Water Quality

The Water Management Plan (WMP) (WRM, 2023) outlines the on-site and off-site surface and groundwater water monitoring programs applicable at BP33. The WMP defines monitoring locations, key analytes for the detection of AMD, sampling frequency and site-specific trigger values.

Implementation of these programs will assist in the early detection and subsequent management of AMD should it be encountered.

## 5.1 Visual Inspection - AMD

Routine inspections of the WRD will be undertaken to assess for signs of AMD (if any). Suitably qualified and experienced persons from the Environment Team will assess the WRDs, leachate and surface waters to identify potential visual indicators of AMD which

can be used to trigger further actions as provided in the AMD TARP (Section 6.1). Key visual indicators include:

- Seepage that may be very clear or have red colouration and/or iron oxide (orange/brown) precipitate;
- Green algae filaments in clear water indicating high nutrient loads;
- Salt expressions forming on stream banks, WRD batters and toes, more noticeable in dry season;
- Fish kills; and
- Vegetation dieback

## 5.2 Visual Inspection – Landform Stability

Routine inspections of the WRD will be undertaken to assess for indicators of instability. Suitable qualified and experienced persons from the Geology Team will undertake landform monitoring to assess for stability indicators including:

- Slumping, subsidence or deformation;
- Erosional features such as gulling or tunnelling;
- Water ponding; and
- Excessive sedimentation against WRD containment bunds.

Early detection of landform monitoring will trigger remediation as identified in the AMD TARP provided in Section 6.1.

## 5.1 Rehabilitation

All material within WRD1 and WRD2 is proposed to be backfilled underground at the completion of mining. WRD foundations will be rehabilitated and monitored in accordance with the approved Mine Closure Plan (MCP) and associated with management plans.

## 5.2 Review

The performance of the AMD Management Plan will be evaluated annually, and the plan modified as required based on the outcomes of the monitoring programs and any unforeseen changes to predicted geochemical characterisation of waste material.

Internal audits will be conducted annually and documented to ensure compliance with the AMD Management Plan. The audit will review:

- Waste rock characterisation procedures
- Waste characterisation databases including analysis and interpretation.
- The waste block model (if required)
- Records of PAF waste placement locations; and
- Surface water and leachate monitoring results.

Following decommissioning and rehabilitation of the mine, on-going monitoring will occur to evaluate and validate the performance of the final landform designs, cover, structural integrity and rehabilitation success and ensure the post closure objective are met.

Annual MMPs will be submitted to DITT and will include an analysis of the monitoring programs. Results of all investigations will be reported to the relevant regulator for assessment as required.

# 6 Management Actions

## 6.1 General Management

The following management measures have been adopted or will be implemented over the course WRD operation:

- Robust WRD design, construction and monitoring using advice from suitably qualified experts.
- Regular mine water, surface water and groundwater monitoring undertaken in accordance with the approved WMP.
- Regular visual inspections of underground stopes and WRD, assessing lithological changes, looking for visible sulphide material, mineralisation etc. and identify any potential contaminant issues. Drainage assessment audits will be conducted on a frequent basis to promptly detect any new seepages, degradation of landforms such as erosion, water contamination and any associated AMD (if any) early to ensure a fast and efficient remediation strategy to be implemented.
- Appropriate risk-based assessment and management conducted as per Section 7.1.6 of the BP33 MMP.

## 6.2 Environmental Management

Key environmental risks for WRDs include:

- PAF / PAF-LC detected at greater volumes than anticipated;
- Potential seepage of AMD during short term storage;
- Release of sediment laden water if WRD during the wet season.
- Dust generation from stockpile material;

Environmental management of key risks are summarised below and detailed in the in the TARP provided in Section 6.3.

**Table 3 Environmental Management Actions**

| Key Risk | Triggers | Management Actions |
|---|---|---|
| **PAF or PAF-LC identified in waste rock sampling** | • PAF or PAF-LC identified in WRD at greater volumes than originally identified by EG (2021). | • Review waste management and placement within WRD1 and WRD2<br>• Assess potential to treat with a neutralising material i.e limestone |
| **Potential seepage of AMD during short term material storage** | • Leachate monitoring results indicate presence of AMD from WRD<br>• Surface water and groundwater quality demonstrate a declining trend with chemistry indicating possible WRD influence. | • Direct leachate to MWD for treatment / release under WDL.<br>• Review treatment options i.e., application of neutralising material.<br>• Investigate potential water treatment options.<br>• Review monitoring program to identify possible contributing sources. |
| **Release of sediment water offsite** | • Turbidity is detected above release criteria at sediment basin spillway.<br>• Turbidity is detected above SSTVs downstream of mine. | • Minimise disturbance / movement of material during the wet season.<br>• Ensure current ESCP has been implemented and controls functioning as designed. Review and update as required. |
| **Dust generation** | • Excessive dust generation from WRD during construction. | • Ensure implementation of the BP33 Dust Management Plan. |

## 6.3 Trigger Actions Response Plan

A TARP has been developed as outlined in Table 10 below. The TARP outlines the trigger levels, mitigation measures / management actions for adaptive management of risks.

**Table 4 TARP WRD 1 and WRD2**

| Aspect | | Normal State | Trigger 1 | Trigger 2 |
|---|---|---|---|---|
| **Material Classification** | Trigger | • Material tested and classified in accordance with the Sampling and Analysis Plan (Section 3) | • Waste material not tested or classified in accordance with the Plan.<br>• Waste material classified as potentially problematic according to site-specific criteria. | • No sampling or characterisation undertaken; or<br>• Characterisation highlights surplus problematic material (PAF and PAF-LC) greater than assess by EGi (2021). |
| | Response | • n/a | • Review material placement in WRDs and sample material to determine correct classification and management.<br>• Review sampling procedures and staff training | • Repeat Trigger 1 responses.<br>• Review WRD designs and placement strategy to determine suitable capacity to manage additional PAF/PAF-LC volume.<br>• Assess option to import a neutralising material for treatment i.e., limestone. |
| **WRD Waste Placement** | Trigger | • Material placement correctly as per geochemical classification | • PAF material incorrectly placed within WRD. | • Evidence of sulphide material on outer WRD.<br>• Evidence of venting, salt efflorescence or other indicators of AMD. |
| | Response | • n/a | • Review material placement in WRDs and sample material to confirm classification / risk of AMD.<br>• Relocate material to the correct location within the WRD for encapsulation.<br>• Audit daily activity logs dump / mining plans to assess requirements for corrective actions. | • Assess option to import a neutralising material for treatment i.e., limestone.<br>• Relocate material within WRD for encapsulation.<br>• Increase surveillance of WRDs for indictors of AMD |

| Aspect | | Normal State | Trigger 1 | Trigger 2 |
|---|---|---|---|---|
| **Landform Design and Stability** | Trigger | • WRDs constructed to design.<br>• Stable landform. | • Landform not constructed to engineered design.<br>• Evidence of erosion / instability as per Section 5.1. | • Structural instability or failure |
| | Response | • n/a | • Investigate root cause of incorrect placement.<br>• Review material placement in WRDs and sample material to confirm classification / risk of AMD.<br>• Relocate material to the correct location within the WRD for encapsulation.<br>• Audit daily activity logs dump / mining plans to assess requirements for corrective actions.<br>• Review SOP's, staff training and update as required. | • Assess option to import a neutralising material for treatment i.e., limestone.<br>• Relocate material within WRD for encapsulation.<br>• Increase surveillance of WRDs for indictors of AMD<br>• Seek expert advice as required. |
| **Surface and Groundwater Quality** | Trigger | • No identified impact to surface or groundwater | • Trend assessment indicates a trending decline in surface and/or groundwater quality but above SSTVs.<br>• Leachate trend analysis suggests early indication of AMD generation:<br>  o Decline in alkalinity and bicarbonate; and<br>  o Increase in sulphate.<br>• Surface and groundwater concentrations above SSTVs but within the range of natural background variation. | • Trend assessment indicates a trending decline in surface and groundwater below SSTVs.<br>• Leachate analysis confirms presence of acid and or/metalliferous mine drainage.<br>• Surface and groundwater concentrations above SSTVs and outside of natural background variation. |

| Aspect | | Normal State | Trigger 1 | Trigger 2 |
|---|---|---|---|---|
| **Surface and Groundwater Quality** | Response | • n/a | • Review analytical results and retest as required.<br>• Inspect WRDs for signs of AMD.<br>• Review leachate drainage system functionality<br>• Investigate potential sources of AMD and associated management.<br>• Review sampling program and modify / increase as required. | • Review analytical results and retest as required.<br>• Direct all leachate to MWD for treatment / discharge under WDL conditions.<br>• Investigate and implement remedial options as required i.e., neutralising agent.<br>• Increase surface and groundwater sampling frequency / locations to assist source identification and management.<br>• Review leachate drainage system functionality and performance.<br>• Investigate potential treatment options.<br>• Investigate potential sources of AMD and associated management |

## 6.4 Contingency Plans

### 6.4.1 Mine Closure

Core Lithium has developed a Mine Closure Plan (MCP) that will be revised and updated during the LOM in accordance with approval conditions. The MCP and closure objectives are appropriate and commensurate to the AMD risk profile given the temporary nature of WRD storage (<10 years) and limited volume of PAF and PAF-LC identified through extensive stative and column leach testing (EGi 2021, 2022).

If ongoing operational characterisation indicates a change in risk-profile, the MCP will be reviewed to re- assess feasibility and long-term viability of proposed closure strategies. Should PAF material encountered be unable to returned as backfill for any reason, alternative treatment/disposal options will be developed in consultation with DITT and NT EPA.

### 6.4.1 Water Quality

Any notable trend in deterioration of surface and / or groundwater quality, will trigger a source contamination investigation, with further monitoring to confirm source of contamination and management measures to remediate the impacts and prevent further contamination.

Collection and treatment of AMD will be undertaken in the event it is detected to prevent off-site contamination. Such measure pump-back systems via trenches, sumps and bores if detected in groundwater. The contaminated water will be treated appropriately following appropriate investigation of water treatment options.

# 7 Review

The performance of the AMD Management Plan will be evaluated annually, and the plan modified as required based on the outcomes of the monitoring programs and any unforeseen changes to predicted geochemical characterisation of waste material.

Internal audits will be conducted annually and documented to ensure compliance with the AMD Management Plan. The audit will review:

- Waste rock characterisation procedures
- Waste characterisation databases including analysis and interpretation.
- The waste block model (if required)
- Records of PAF waste placement locations; and
- Surface water and leachate monitoring results.

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# ATTACHMENT A

GEOCHEMICAL ASSESSMENT REPORTS (EGi 2021 and 2022)

Reference 3203/1327

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**EcOz Environmental Consultants**

**Core Lithium BP33 Project**

# Geochemical characterisation of waste rock and ore

March 2020

Environmental Geochemistry International

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| **REFERENCE:** | 1312/1346 |
| **SUBJECT:** | Core Lithium BP33Project - Geochemical characterisation of waste rock and ore |

| REV: | DESCRIPTION: | PREPARED: | REVIEW: | APPROVED | DATE: |
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| B | Issued for internal review | R Schumann<br>J Jeffery | W.Stewart | W.Stewart | 26/03/2020 |
| C | Issued for internal review | | | | |
| 0 | Issued for use | | | | |
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Table 3: Average soluble metals concentrations from waste and ore samples 12

# Executive Summary

Environmental Geochemistry International Pty Ltd (EGi) have been commissioned by EcOz Environmental Consultants to undertake data analysis, interpretation and reporting on physical and geochemical analysis results for drill core samples collected from the Core Lithium BP33 project. The BP33 proposal involves excavation of a box cut portal to a depth of 60 m and construction of a 400 m long decline from the base of the box cut to access the spodumene deposit located beneath the historically worked open pit. The total volume of material mined over the four-year life of mine will be 2,095 kt (comprising 99 kt ore and 1,996 kt of waste rock). Waste rock from BP33 will be stored in onsite waste rock dumps (WRD), including a box cut WRD and underground WRD. At the end of the mine life waste rock will be used to backfill the box cut and underground workings. Ore mined at BP33 will be transported to the Grants processing facility approximately 7 km to the north-west. Tailings will be deposited in the Tailings Storage Facility constructed as part of the Grants Project.

Sampling and analysis of waste rock was undertaken during the exploration drilling program. Fifty-four samples were selected by EcOz from holes drilled in July 2018 (FRC166 – FRC171) and submitted for a limited suite of analyses comprising Total S, paste pH and EC (1:5) and exchangeable cations. A further 48 samples were selected from holes drilled during September 2019 (NRC129 and FRC212 – FRC214). Four of these were surface (soil) samples submitted for paste pH and EC (1:5), KCl extractable S, bulk density, moisture, colour/texture/Emerson Class No, PSD, exchangeable cations, total metals, N & P and TOC analysis. The remaining 44 samples were submitted for a more comprehensive suite of analyses comprising Total S, acid neutralising capacity (ANC), net acid generation (NAG), paste pH and EC (1:2), exchangeable cations, soluble metals, leachable metals, and naturally occurring radioactive materials (NORM) measuring radiation dose.

The results for the four soil samples suggest that soil at the site is an infertile, gravelly sandy loam. The Emerson test indicates that the soil should be non-dispersive, but given the low organic matter level and sandy texture, the soil likely has poor structure and limited water-holding capacity, and therefore could be susceptible to erosion under wet conditions. It is expected successful rehabilitation will require increasing the physical and chemical fertility of the soil to some extent, consistent with the proposed final end use.

Excluding the four soil samples, the materials tested included 9 ore samples and 89 waste rock samples. Waste rock samples included highly weathered, transitional and fresh rock. All 9 ore samples, together with 35 of the 89 waste rock samples, underwent the full suite of testing, with the remaining waste rock samples submitted for limited testing.

Based on the results of tests conducted on the samples described above, the following conclusions can be made:

- The rock type and oxidation profiles for samples used for geochemical analysis indicate that these samples reasonably represent the lithology and oxidation profile of waste rock and ore from all drill holes and therefore the waste rock and ore in the BP33 deposit overall.
- The samples used for this initial geochemical study would appear to adequately cover variations in rock types and alterations that will be encountered during the mining operation.
- Oxidised waste rock samples are largely devoid of sulphur and are classified as non-acid forming (NAF). Water extracts have very low salinity. This indicates that oxidised waste rock, which will form the majority of rock excavated during development of the box cut and the majority of waste rock generated during the project as a whole, will present a very low risk of acid rock drainage (ARD) or saline drainage (SD). However, drainage from oxidised rock stored in the Box cut WRD may contain low concentrations of aluminium and zinc.
- Transitional waste rock, which will comprise a small portion of the rock removed during development of the box cut and the mine decline, is generally low in sulphur content and can, in the main, be classified as NAF. Transitional samples also gave water extracts with low salinity. These results show that transitional rock will present a low risk of ARD or SD.
- Fresh waste rock will comprise the major portion of rock removed during development of the underground mine and therefore of waste rock stored in the underground WRD. However, the volume of fresh waste rock mined will be relatively small (<10% of the total volume). Fresh waste rock is generally low in sulphur content, but with some areas of higher sulphur. Higher sulphur content appears to be associated with fresh phyllite. Most fresh waste rock can be classified as NAF, but there is evidence that fresh phyllite may include PAF material. This material appears to have limited readily

available ANC. Fresh waste rock samples also produced water extracts with low salinity, although salinity was higher than for other rock types. Fresh rock may also contain water leachable arsenic and zinc. These results show that fresh waste rock may present some risk of ARD and/or arsenic and zinc in drainage from the UG WRD, but further testing is required to confirm these findings and to quantify the likely volume of PAF material in fresh waste rock.

- Testing of ore samples showed that this material is devoid of sulphur and can be classified as NAF, indicating very low risk of ARD from tailings produced from processing of the ore. Water extracts from the ore also had relatively low salinity, but higher than any of the waste rock samples tested, indicating low risk of SD from tailings.
- The potential radiation dose from all of the samples tested was well below guidelines for occupational radiation exposure, indicating that these materials are unlikely to pose a risk from radiation exposure.

Based on these test results, there remains some uncertainty around the acid generating properties of fresh waste rock samples with higher sulphur content (>0.2% S). The current set of samples from holes drilled in 2018 and 2019 includes 8 samples with a total S >0.2%. However, only one of these samples was sourced from the 2019 drill hole samples which were used for ABA and NAG testing. Thus, the current geochemical test results are under-represented in samples with higher sulphur content, preventing better definition of the amount of PAF material present in fresh phyllite and development of potential segregation criteria, should this type of material require specific management to prevent ARD. Results also indicate that drainage from oxidised rock stored in the Box cut WRD may contain low concentrations of aluminium and zinc and some of the fresh rock stored on the UG WRD may contain water leachable arsenic and zinc. These waste storages will be temporary, with waste rock returned underground or into the box cut. However, the results to date provide no information on the kinetics of aluminium, arsenic and zinc leaching and whether this could be an issue during short-term surface storage.

Consequently, it is recommended that the following tests be undertaken to clarify these issues:

- Complete ANC and NAG testing on selected samples from drill holes FRC166 – FRC171, focusing on, but not exclusively, samples with sulphur content >0.2 %S. Ideally all fresh and transitional waste rock from the 2018 drill holes should be included in the test program.
- Kinetic testing (leach columns) of oxidised and fresh rock samples to confirm initial results of aluminium, arsenic and zinc leachability and to define the kinetics of this process. Kinetic leach column (KLC) testing should be conducted under oxic conditions to simulate conditions during storage in WRD and in the unsaturated zones within the backfilled UG mine and boxcut. Following a period of leaching under oxic conditions, KLC tests should be conducted under saturated conditions to simulate the leaching properties of backfilled waste which will be placed below the water table upon rebound.

Current test results suggest that the risk of ARD from surface storage of waste rock from the underground mine will be low, due to the likely low volume of PAF material present in fresh waste rock. However, currently there is insufficient evidence to say conclusively that there will be no PAF material removed from the underground mine which may require management to mitigate ARD. Depending on outcomes from the recommended follow-up tests, it may be necessary to undertake more detailed static testing to refine ARD classification of some waste rock, in addition to kinetic testing to provide better definition of the ARD properties of any PAF material identified. These more detailed tests, if required, would inform ARD management plans should the need arise.

# 1. Introduction

Environmental Geochemistry International Pty Ltd (EGi) have been commissioned by EcOz Environmental Consultants to undertake data analysis, interpretation and reporting on physical and geochemical analysis results for drill core samples collected from the Core Lithium BP33 project. Core are seeking to progress approvals for underground mining at their BP33 deposit. The first step in the approvals process is to submit a Notice of Intent (NOI) to the NT Environmental Protection Authority (NT EPA). EcOz have been engaged by Core Lithium to assist with environmental approvals for proposed spodumene (lithium) mining activities and this work is intended to inform environmental approvals for the current NOI.

The BP33 deposit is a part of Core's Finniss Lithium Project, located in the Northern Territory on the Cox Peninsula, approximately 23 km southwest of Darwin or 90 km by road (Figure 1). The BP33 proposal involves excavation of a box cut portal to a depth of 60 m and construction of a 400 m long decline from the base of the box cut to access the spodumene deposit located beneath the historically worked open pit. The total volume of material mined over the four-year life of mine will be 2,095 kt (comprising 99 kt ore and 1,996 kt of waste rock). Waste rock from BP33 will be stored in onsite waste rock dumps (Figure 2) and at the end of the mine life will be used to backfill the box cut and the underground mine. Ore mined at BP33 will be transported to the Grants processing facility approximately 7 km to the north-west. Tailings will be deposited in the Tailings Storage Facility constructed as part of the Grants Project.

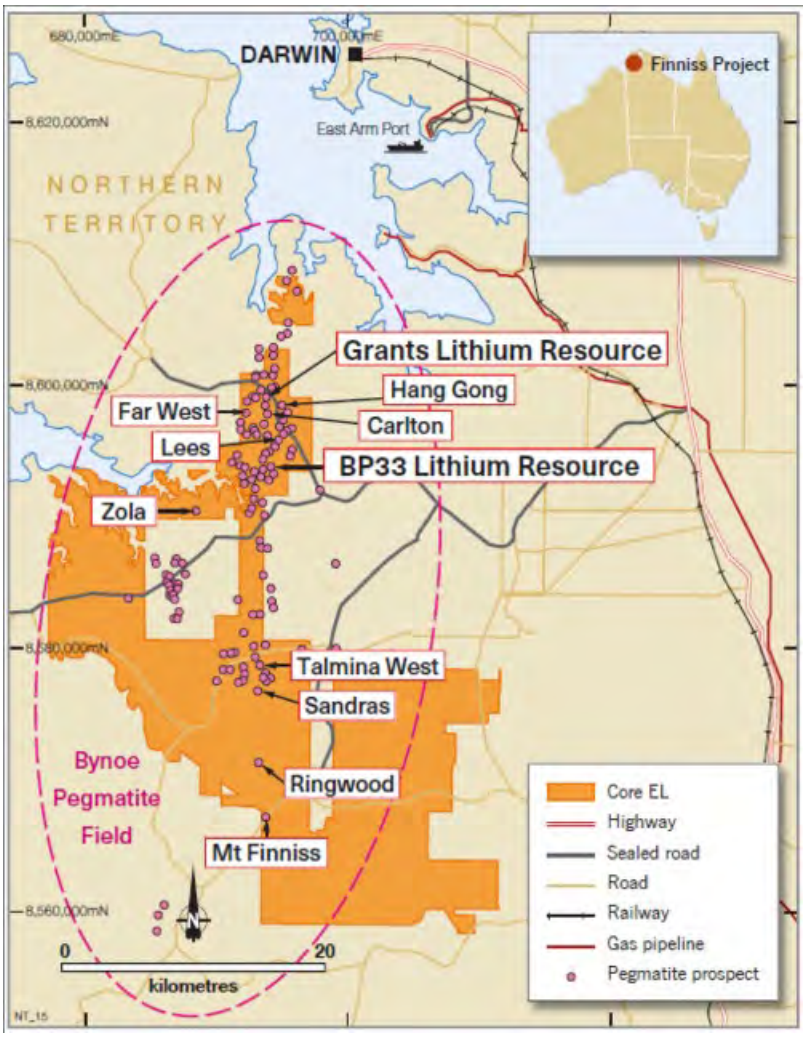
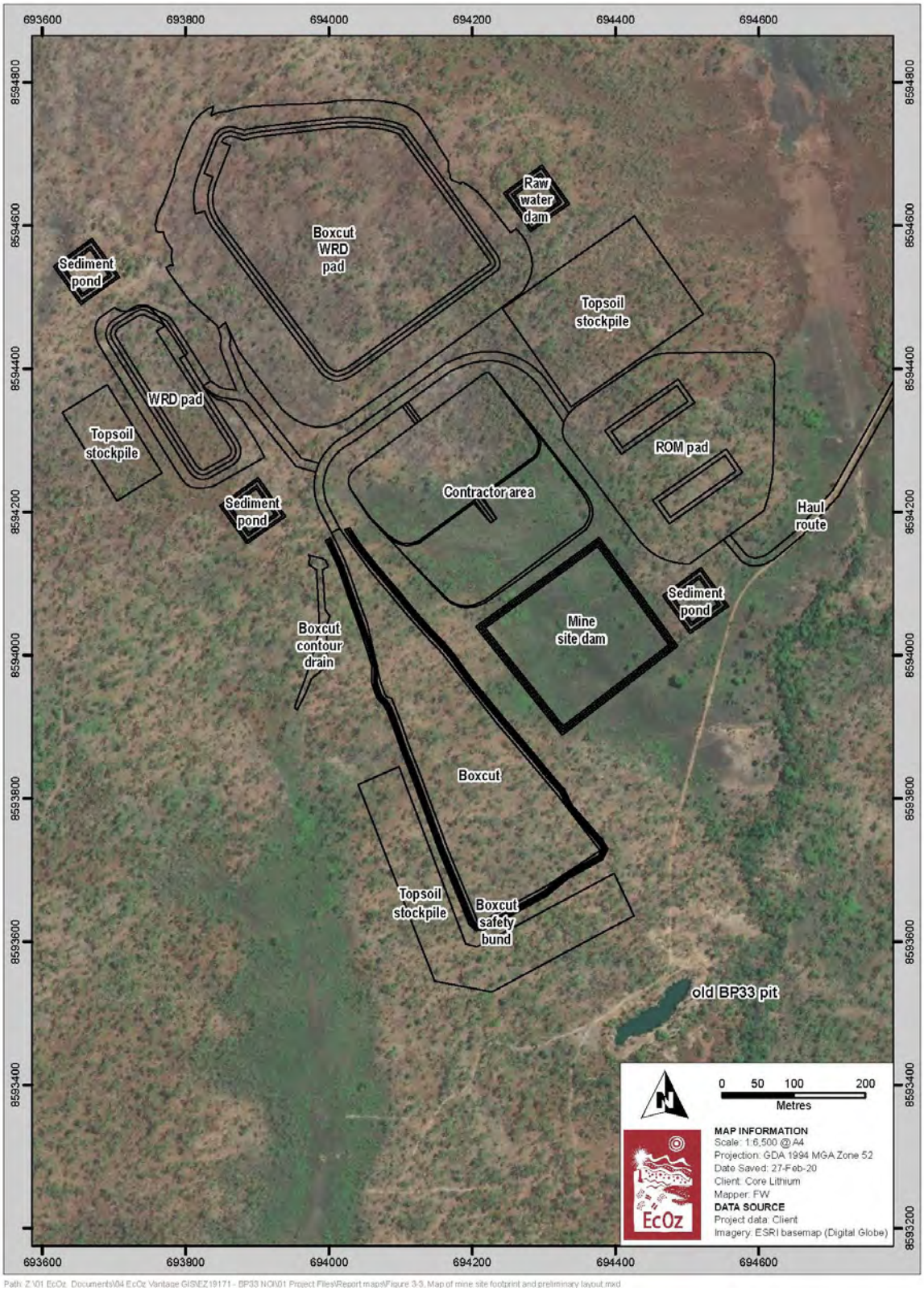



*Figure 1: BP33 Resource within the larger Bynoe Pegmatite Field and Core's Finniss Lithium Project*




Path: Z:\01 EcOz Documents\04 EcOz Vantage GIS\EZ19171 - BP33 NOI\01 Project Files\Report maps\Figure 3-3. Map of mine site footprint and preliminary layout.mxd

*Figure 2: Map of mine site footprint and preliminary layout*

Ore from the BP33 Lithium Deposit occurs in a rare element pegmatite that is a member of the Bynoe Pegmatite Field. Fresh pegmatite at BP33 is composed of coarse spodumene, quartz, albite, microcline and muscovite (in decreasing order of abundance). Spodumene, a lithium-bearing pyroxene ($LiAl(SiO_3)_2$), is the predominant lithium-bearing phase. The pegmatites are predominantly hosted within the early Proterozoic metasedimentary lithologies of the Burrell Creek Formation (BCF) and are usually conformable to the regional schistosity. The principal rock type of the BCF is phyllite, a low-grade metamorphic equivalent of an immature sandy siltstone. In fresh form, the phyllite is grey, finely bedded or cleaved, and is composed of quartz, feldspar, lithic fragments, micas and clay.

Fresh pegmatite hosting the ore is overlain by around 40 m of weathered rock and approximately 20 m of transitional rock. The box cut is required to provide geotechnically stable conditions for development of the UG portal and decline of the proposed UG mine. To achieve this, the portal needs to be developed in transitional and fresh rock requiring excavation of waste material down to at least 10 m below the oxidised zone. At BP33 the required depth of excavation is between 60 m and 70 m. This means that most of the waste rock excavated during this project will be sourced from the box cut, with a minor amount (<10%) sourced from the underground mine development. As the majority of the rock removed during construction of the box cut will be within the oxidised rock zone, a large proportion of rock stored in the Box cut WRD will be oxide material. In contrast, most waste stored in the UG WRD will comprise fresh rock. All waste rock will be used to refill the box cut and UG mine at completion of the mining operation. Some of the waste rock used for backfilling will also include some transitional and fresh rock which will have potentially undergone some atmospheric oxidation during surface storage.

As part of the mine planning and approvals process, physical and geochemical characterisation of the waste material and tailings is required to inform assessment of risks associated with acid, metalliferous (ARD), saline (SD) or neutral mine drainage (NMD); mine closure and rehabilitation. This report describes results from analysis of geochemical data provided by EcOz to EGi, and assessment of these results to determine the likelihood of acid and metalliferous, neutral mine or saline drainage as a consequence of the proposed BP33 mine project.

# 2. Samples

Sampling and analysis of waste rock was undertaken during the exploration drilling program. Fifty-four samples were selected by EcOz from holes drilled in July 2018 (FRC166 – FRC171) (Figure 3) and submitted for a limited suite of analyses comprising Total S, paste pH and EC (1:5) and exchangeable cations. A further 48 samples were selected from holes drilled during September 2019 (NRC129 and FRC212 – FRC214) (Figure 3). Four of these were surface (soil) samples submitted for paste pH and EC (1:5), KCl extractable S, bulk density, moisture, colour/texture/Emerson Class No, PSD, exchangeable cations, total metals, N & P and TOC analysis. The remaining 44 samples were submitted for a more comprehensive suite of analyses comprising Total S, acid neutralising capacity (ANC), net acid generation (NAG), paste pH and EC (1:2), exchangeable cations, soluble metals, leachable metals, and naturally occurring radioactive materials (NORM) measuring radiation dose.

Soil samples were collected from the topsoil prior to drilling. Waste rock samples were collected at each point where the material from the drill hole changed. Each lithology, and each alteration and each oxidation type within each lithology was sampled separately (compositing of samples was not undertaken) as encountered down hole. Samples were also collected from the ore zone, as well as the waste, to provide for geochemical characterisation of tailings. Field duplicates were collected at a frequency of 1 per 20 primary samples. The duplicates were taken from the same metre as the primary samples. Sufficient material to produce both the primary and duplicate sample was placed in a stainless steel bowl and thoroughly mixed to ensure a homogenous sample. The mixed sample was then split and distributed evenly amongst the required bags and jars for the primary and duplicate samples.

In addition to analysis results, EGi were also supplied with geology logs from the drilling program. Based on these logs, the spread of sample lithologies and degree of oxidation were determined. Materials with weathering codes CW, EW and HW were defined as oxide, MW and SW as transition, and FR as fresh. The results of this analysis are shown in Figure 4. Samples from drill holes FRC166 – FRC171 (2018), NRC129 and FRC212 – 214 (2019) are dominated by phyllite and pegmatite, with minor sandstone, quartz and quartz veining. Phyllite samples represented the full oxidation profile, while pegmatite samples were primarily fresh, including ore samples. The same analysis was conducted using only samples from drill holes NRC129 and FRC212 – 214, and from the sub-set of samples from these drill holes which were selected for geochemical analysis. These results are also shown in Figure 4. This analysis shows that the samples from the 2019 drill holes (Fig. 4 middle) showed similar rock type and oxidation profiles to that for the combined drill hole set (Fig. 4 top), albeit with a slightly higher representation of ore samples. Similarly, the rock type and oxidation profiles for samples used for geochemical analysis (Fig. 4 bottom) indicate that these samples reasonably represent the lithology and oxidation profile of waste rock and ore from all drill holes and therefore the waste rock and ore in the BP33 deposit overall.

Leading practice actions to minimise ARD risk through life of mine cycle suggest that during the resource definition phase of a project, geochemical testing, focusing on static testing (net acid producing potential (NAPP)/NAG), should include at least 5 – 10 samples for each key identified lithology/alteration type[1]. Given the relative homogeneity of the Burrell Creek Formation[2] and the limited number of major lithologies identified during the drilling program at BP33, the 44 samples used for this initial geochemical study would appear to adequately cover variations in rock types and alterations that will be encountered during the mining operation. As the project develops, further sampling and testing may be required to complement and verify the results of this study.

[1] Preventing Acid and Metalliferous Drainage, Leading Practice Sustainable Development Program for the Mining Industry, Commonwealth of Australia, 2016

[2] Grants Lithium Environmental Impact Statement, Appendix E Materials Characterisation Report, EcOz Environmental Consultants, October 2018

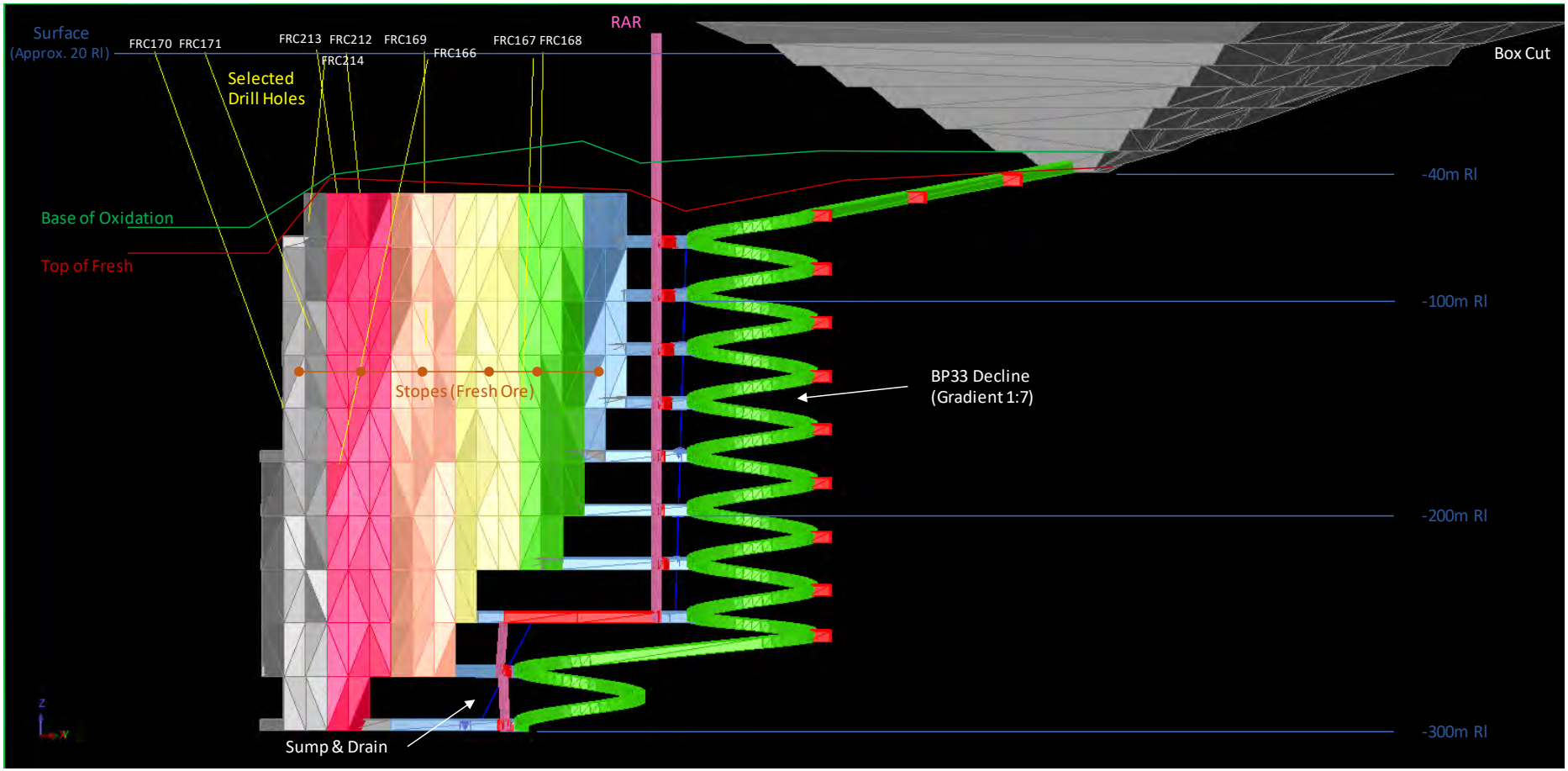



*Figure 3: Location of drill holes used for resource definition and waste rock characterisation of the BP33 deposit and relation to proposed box cut and mine development*

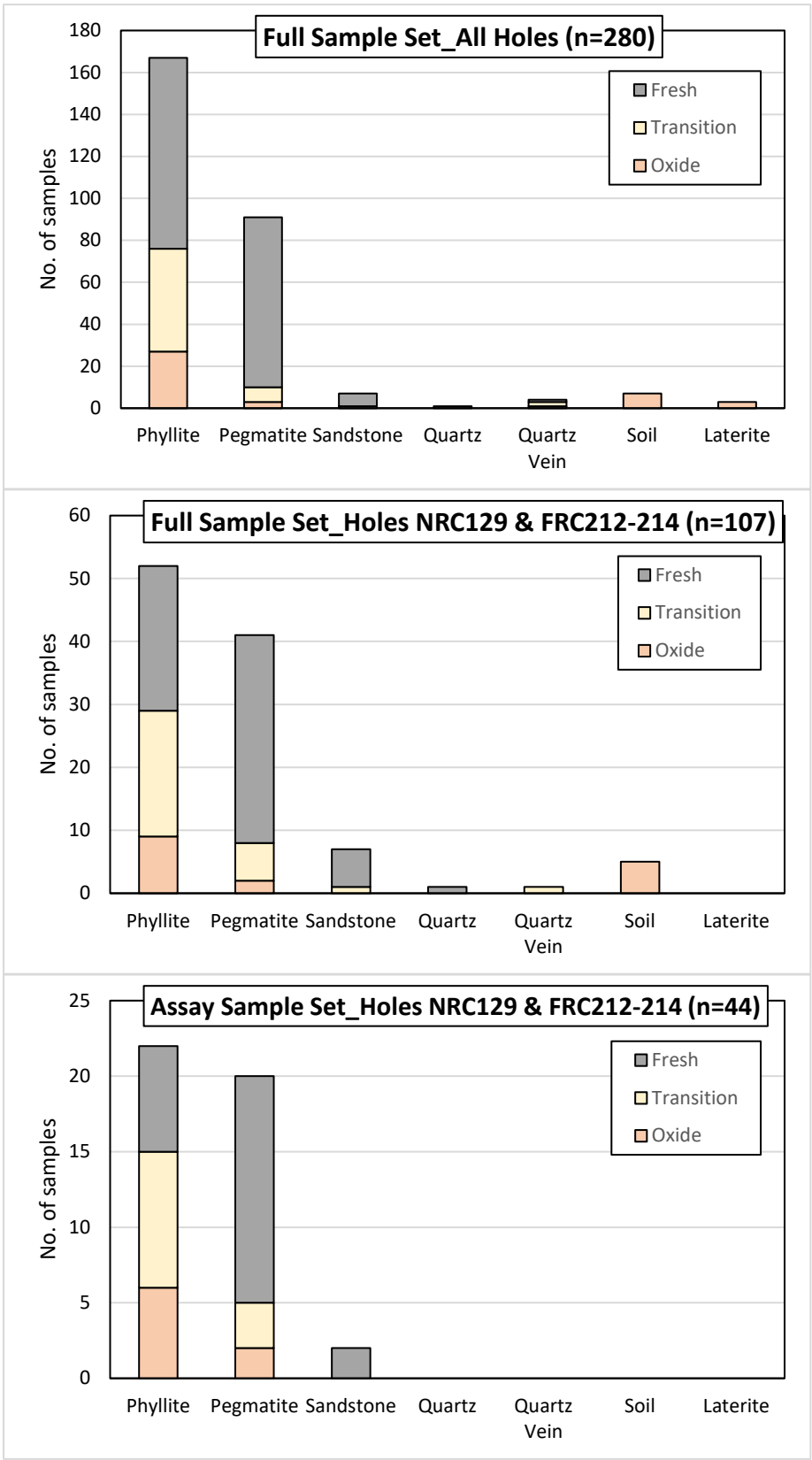



*Figure 4: Sample numbers by lithology and oxidation for the whole set of samples from drill holes from 2018/2019 (FRC166 – FRC 171, NRC129 and FRC212 – FRC214) for the BP33 project (top), all samples from the 2019 drill holes (NRC129 and FRC212 – FRC214) (middle) and samples from 2019 drill holes selected for geochemical testing (bottom).*

# 3. Results

## 3.1 Analytical Data Quality

Five field duplicate samples were submitted as a part of the analytical quality control process. These field duplicate samples were analysed for the same full suite of analyses as the 44 samples used for geochemical characterisation. Relative standard deviations (RSD) for all analyses conducted on duplicate samples were on average less than 6%, indicating that the whole analytical process including sample collection, preparation and analysis was providing acceptable precision for the analytical results. QC data reported by the analytical laboratory demonstrated satisfactory accuracy and precision in the analytical results with all duplicate analyses, laboratory spikes (QC standards) and matrix spikes providing acceptable values for repeatability and recovery.

## 3.2 ARD, NMD and SD characterisation

*ABA and NAG Testing*

Acid forming characterisation data are provided in Appendix A. Analyses included paste pH and EC, and Total S for all samples (drill holes NRC129 and FRC212 – FRC214 and FRC166 – FRC171), and also included ANC and NAG test results for samples from drill holes NRC129 and FRC212 – FRC214.

Figure 5 shows an ARD classification plot for the 44 samples for which both acid base accounting (ABA) (Total S and ANC) and NAG testing results were available. The ARD classification plot, plots NAGpH against NAPP. NAPP represents the balance between acid potential (MPA) and neutralising potential (ANC), i.e. NAPP = MPA – ANC. Where NAPP values are negative i.e. excess neutralising capacity, and NAGpH is greater than 4.5, samples are classified as non-acid forming (NAF). Conversely when samples are NAPP positive (excess acidity) and NAGpH is below 4.5, samples are classified as potentially acid forming (PAF). Where there is a conflict between NAPP and NAG results, samples are classified as uncertain (UC). In this case, further testing is usually required to resolve the uncertain classification.

For the BP33 drill hole samples, 40 of the 44 samples clearly plotted in the NAF classification. The remaining 4 samples were all NAPP negative, but with NAGpH<4.5, although two of these samples gave a NAGpH only just below 4.5. Three of the samples plotting in the UC classification were fresh or slightly weathered phyllite, with one fresh pegmatite sample.

The slightly acidic NAG liquors for the 4 samples plotting in the UC category, suggests that the neutralising capacity measured by the ANC test method (pH typically 1.5 – 2) overestimated the amount of neutralising capacity available during the NAG test (pH 3.4 – 4.4). Although the carbonate content was not determined for these samples, these results indicate there are negligible or limited carbonate neutralising minerals in these rocks and that the majority of ANC is probably derived from silicate minerals. During NAG testing of the 4 UC samples, the pH has not dropped sufficiently to result in dissolution of these silicates at a rate fast enough to provide significant neutralising capacity. This has likely resulted in the UC classification.

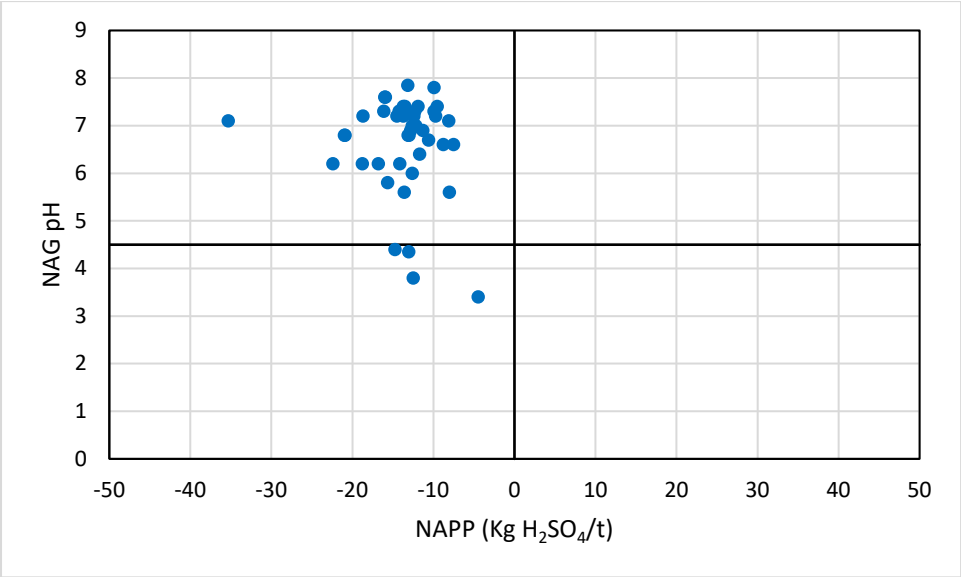



*Figure 5: ARD classification plot for samples from drill holes NRC129 and FRC212 – FRC 214*

Figure 6 shows NAGpH plotted against Total S for the ARD classification samples set. This plot shows that the majority of these materials contain very little sulphur and consequently NAGpH are circum-neutral. The plot also suggests that for samples with a Total S content above around 0.2% may have a NAGpH below 4.5, although this relationship is based on a very limited number of samples.

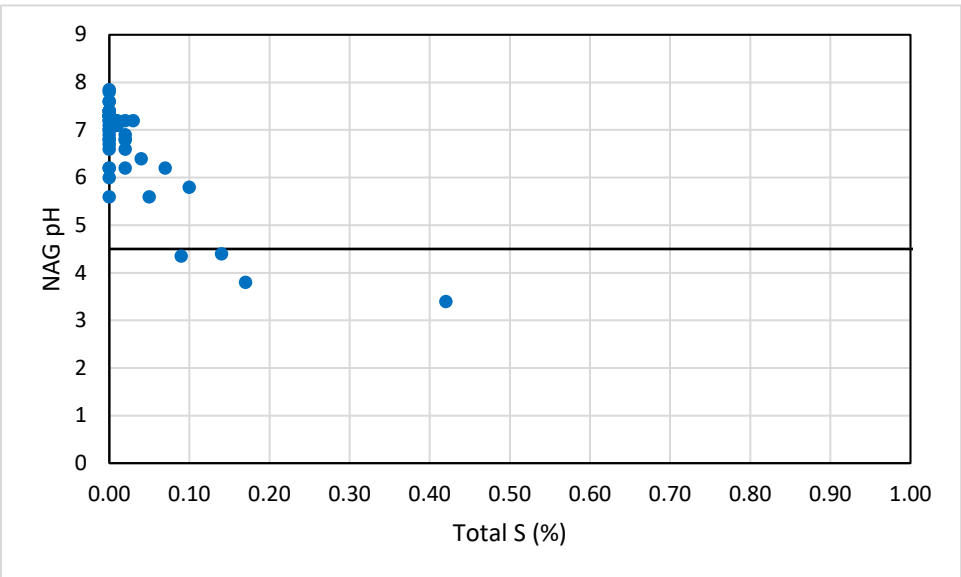



*Figure 6: NAGpH vs Total S for samples from drill holes NRC129 and FRC212 – FRC 214*

Figure 7 shows Total S results for 98 samples from drill holes NRC129 and FRC212 – FRC214 and FRC166 – FRC171. While only one sample from the 44 samples which underwent NAG testing had a Total S content above 0.2% (NAGpH 3.4), a somewhat higher percentage of samples from the samples which did not undergo NAG testing had a Total S content above 0.2%, although the number is still relatively small (8% of all samples). This suggests that while the majority of samples from these drill holes have very limited sulphur content and no potential for acidic drainage, there are a small but significant number of samples which have higher sulphur content and therefore could be potentially acid forming. The potential for limited neutralising capacity derived principally from silicate minerals in these samples, also indicates that even slightly elevated sulphur may result in acid generation. Further analysis is required to investigate the acid generating potential of these higher sulphur samples.

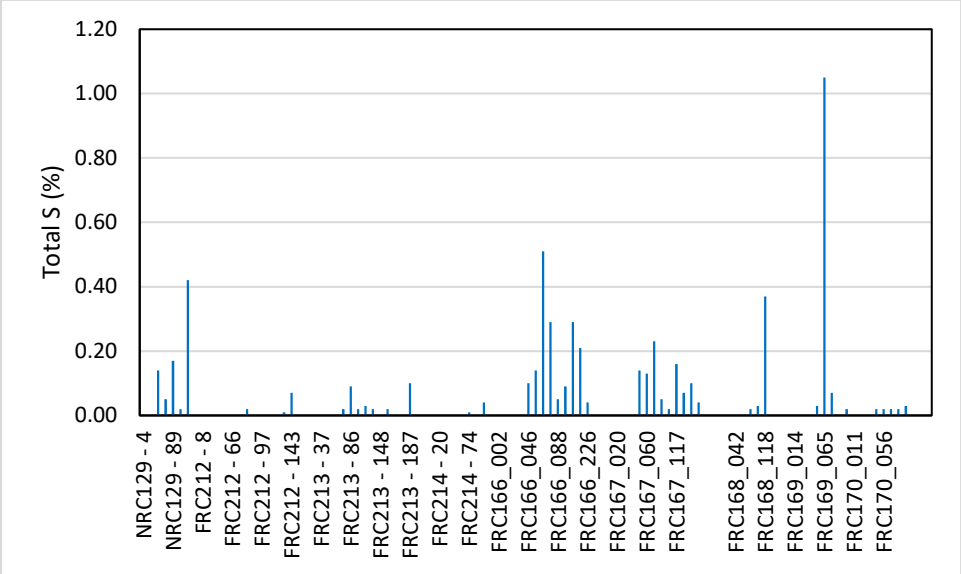



*Figure 7: Total S for samples from drill holes NRC129 and FRC212 – FRC 214 and FRC166 – FRC171*

A summary of acid base accounting (Total S and ANC) and NAG test results as a function of rock type (lithology and weathering) are provided in Table 1 and Table 2 below. Results show that oxidised phyllite is generally devoid of sulphur and therefore does not contain sulphides or metal sulphate salts that on (oxidative) dissolution will produce acidity. This is borne out by NAG test results for oxidised phyllite samples which confirm the lack of acid generation from these samples.

As the degree of oxidation decreases, the concentration of sulphur in the phyllite samples increase, as does the neutralising capacity. NAG test results suggest that the increasing sulphur content is more influential than increasing ANC on NAGpH, since NAGpH tends to decrease and NAG values increase as oxidation decreases. These results indicate that the vast majority of waste rock stored in the box cut WRD during operations will not produce acidity as most of this material will be oxidised rock. However, rock from the underground development stored in the UG WRD (Figure 2), is more likely to contain material with higher sulphur content and might therefore contain some PAF material.

Fresh pegmatite which hosts the ore (spodumene) is, like oxidised phyllite, generally barren with respect to sulphur (Table 1) and the NAG test results (Table 2) confirm the lack of acid generating potential. As ore samples appear to be exclusively NAF, tailings produced during processing of the ore is also likely to be non-acid forming.

*Table 1: Total S and ANC by rock type and weathering*

| Rock Type | Totals S (%) | | ANC (kg $H_2SO_4$/t) | |
|---|---|---|---|---|
| | Mean | Maximum | Mean | Maximum |
| Oxidised phyllite | <0.01 | <0.01 | 10 | 14 |
| Transitional phyllite | 0.05 | 0.51 | 15 | 19 |
| Fresh phyllite | 0.14 | 1.05 | 18 | 23 |
| Fresh pegmatite[1] | 0.03 | 0.09 | 18 | 36 |
| Ore | <0.01 | 0.02 | 13 | 19 |

1. Excludes ore samples

*Table 2: NAGpH and $NAG_{4.5}$ and $NAG_7$ by rock type and weathering*

| Rock Type | NAGpH | | $NAG_{4.5}$ (kg $H_2SO_4$/t) | | $NAG_7$ (kg $H_2SO_4$/t) | |
|---|---|---|---|---|---|---|
| | Mean | Minimum | Mean | Maximum | Mean | Maximum |
| Oxidised phyllite | 6.9 | 5.6 | <0.1 | <0.1 | 0.4 | 1.3 |
| Transitional phyllite | 6.8 | 4.4 | <0.1 | 0.2 | 1.1 | 4.3 |
| Fresh phyllite | 5.7 | 3.4 | 1.0 | 2.8 | 5.5 | 8.2 |
| Fresh pegmatite[1] | 6.4 | 4.4 | <0.1 | 0.3 | 0.7 | 2.4 |
| Ore | 7.1 | 6.0 | <0.1 | <0.1 | 0.7 | 3.8 |

1. Excludes ore samples

*Paste pH & EC and Soluble and Leachable Metals*

Figure 8 shows results for paste pH and EC (1:2) analysis of samples from the NRC129 and FRC212 – FRC214 drill holes. Figure 9 shows similar results (paste pH and EC (1:5)) for samples from the FRC166 – FRC171 drill holes. The only difference between the methods used for the two sample sets is the solid to water ratio (1:2 or 1:5) used to make the slurries in which pH and conductivity are measured. More dilution at the higher solid:water ratio in the 1:5 method may result in a decrease in measured conductivity but will not generally affect the measured pH to any great extent.

Results show that paste pH increases as sample depth increases with oxidised samples providing circum-neutral to slightly alkaline paste pH, increasing through transitional rock, with fresh rock paste pH generally mildly alkaline. Paste conductivities show a similar trend, with increasing conductivity as sample depth increases.

There was one sample which proved to be an exception to the above. This sample (NRC129-55), described as a transitional phyllite, gave a mildly acidic paste pH (4) and somewhat elevated EC (≈800 µS/cm). Although this sample is classified as UC (NAPP = -15 kg H2SO4/t and NAGpH = 4.4), the low Total S content of 0.14% suggests

acid generation in the longer term unlikely. Nevertheless, the short-term appearance of mildly acidic conditions suggests the presence of acidic salts resulting from sulphide oxidation, and the paste pH of around 4 is consistent with buffering from dissolution of iron hydroxy sulphate salts such as schwertmannite or jarosite.

These results indicate that highly weathered rock is likely to be quite inert, producing no acidity (sulphur content negligible) and very low salinity in any drainage from storage in the Box cut WRD. Fresh waste rock (UG WRD) and ore (tailings) are likely to produce more saline drainage in the short term, but salinities do not appear to be high for any of the samples (with one exception) examined.

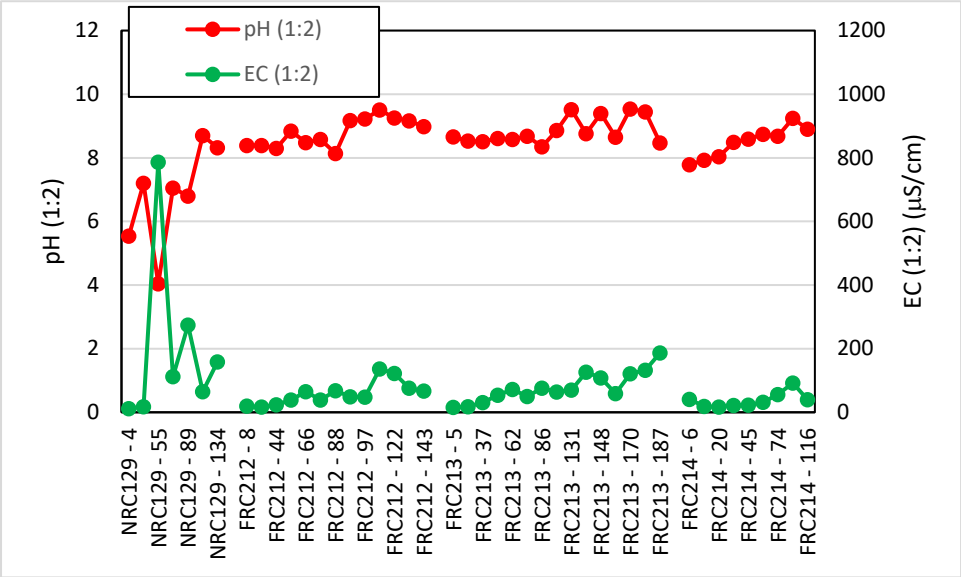



*Figure 8: Paste pH and EC (1:2) for samples from drill holes NRC129 and FRC212 – FRC 214*

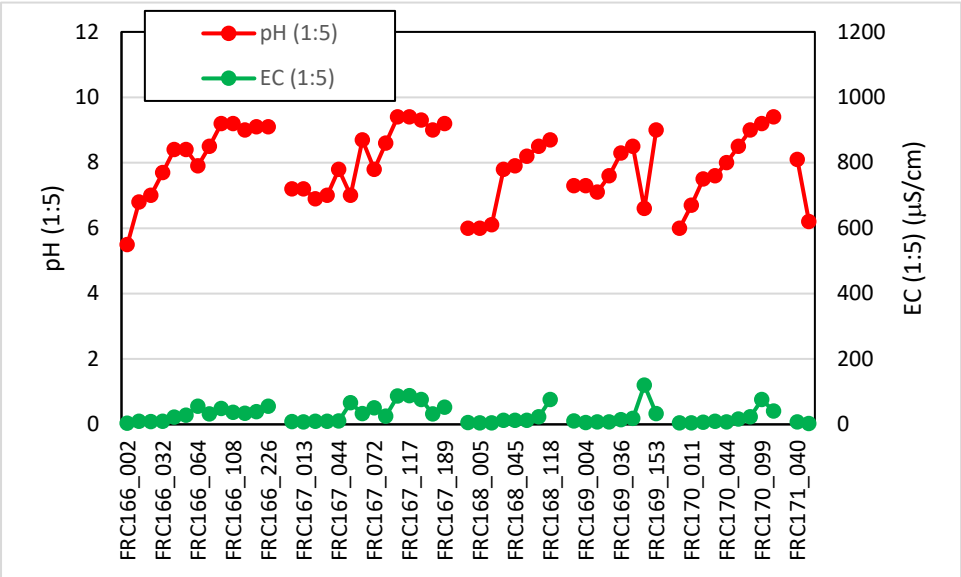



*Figure 9: Paste pH and EC (1:5) for samples from drill holes FRC166 – FRC171*

In addition to paste pH and EC measurements, the water-soluble metals and leachable metals content of selected samples from drill holes NRC129 and FRC212 – FRC214 were measured. Soluble metals were determined by mixing 10 g of solid with 50 mL of water for 1 h. The mixture was then allowed to settle and the supernatant filtered using a 0.45 μm cellulose acetate membrane. The water extract was then analysed by ICP to determine metal concentrations. Results were reported as mg/kg soluble metals. Leachable metals were determined using the toxicity characteristic leaching procedure (TCLP) method. 100 g of solid were extracted with 2 L of extraction solution #1 (sodium acetate buffer pH 4.9) for 20 h, before filtration and analysis by ICP. Results were reported as mg/L leachable metals.

In order to compare the results from soluble and leachable metals with paste pH and EC results, soluble metal results were back calculated to concentrations in mg/L in the 1:5 solid to water extract. Leachable metal concentrations were multiplied by a factor of 4 to account for the higher dilution at the 1:20 solid to liquid ratio used in the TCLP method. The adjusted results can then be correlated with paste pH and EC results, which were conducted at 1:2 solid to liquid ratio for the same samples.

Full results are provided in Appendix B (Soluble Metals) and Appendix C (Leachable Metals).

Water extracts showed that oxidised and transitional rock contain soluble iron and aluminium species, with fresh rock giving lower concentrations of these metals (Figure 10). Similarly, aluminium and iron concentrations in the water extracts of waste rock samples were generally higher than in ore samples (Table 3). These concentrations are higher than would generally be found in water extracts unless the water extract has low pH. However, solution speciation modelling suggests that the slightly alkaline pH of many of the extracts (pH ≈8.5) means that $Al(OH)_4^-$ is likely to be the dominant aluminium species, providing elevated concentrations. Without redox measurements, it is difficult to accurately model the speciation of iron in the extracts. However, results suggest that the higher than normal concentrations of iron in the water extract may result from colloidal iron that was not effectively filtered from the extract prior to analysis.

In contrast to the aluminium and iron results, lithium concentrations were higher in water extracts of fresh rock, especially for ore samples (Figure 10, Table 3). Heavy metal concentrations in water extracts were generally very low with the exception of the one sample (NRC129-55) with lower pH, which contained slightly elevated Co, Cu and Ni (Figure 11 and Figure 12). Water extracts of some fresh phyllite and siltstone samples also contained elevated concentrations of arsenic, suggesting that leachable arsenic will more likely be an issue in waste rock than in ore or tailings (Figure 13, Table 3). A few samples also displayed slightly elevated concentrations of zinc, with no distinction between waste rock and ore samples (Table 3).

*Table 3: Average soluble metals concentrations from waste and ore samples*

| Element | Average Soluble Metals (mg/L) | |
|---|---|---|
| | Waste | Ore |
| Al | 2.3 | 0.9 |
| As | 0.13 | 0.07 |
| Fe | 2.9 | 0.3 |
| Li | 0.1 | 2.1 |
| Zn | 0.1 | 0.1 |

The toxicity characteristic leaching procedure (TCLP) is an extraction method usually used to simulate leaching through a landfill. In this case, the TCLP test utilised an extraction solution buffered at pH 4.9. Paste pH results show that in most cases the pH of water in contact with these materials would be considerably higher than 4.9. Consequently, it is difficult to interpret the results of the TCLP tests in the context of the behaviour of waste rock and ore from the BP33 project. Nevertheless, the TCLP (leachable metals) results are generally in agreement with water extract results. The lower pH and longer extraction time of the TCLP procedure has

resulted in higher concentrations of aluminium and much higher concentrations of extractable iron from fresh rock samples (Figure 10). Concentrations of manganese and zinc were also higher in the TCLP leachates (Figure 12). Results from TCLP tests also support the leachability of arsenic from some fresh rock samples (Figure 13).

Whilst the results of batch extraction tests provide an insight into seepage water quality, they are not kinetic based, and the results should be considered as qualitative rather than quantitative. Factors that affect the chemistries of batch test extracts include the solid to liquid ratio used (1:5 for water and 1:20 for TCLP) and the contact time between sample and extractant (typically 1 - 24 hours). Under field conditions within a waste rock emplacement, the solid to pore water ratio at any given time will be significantly lower than the ratios used in the batch tests, but leaching will be an ongoing progression through time. Also, under field conditions only a fraction of the rock surface will be in contacted with water as it flows through waste rock pile, while in the leach tests, the rock is finely ground increasing surface area and all of the sample is contacted by extractant. Under batch leach conditions, while dissolution reactions are occurring, precipitation reactions which are likely to take place in waste rock emplacements, will be non-existent or limited. Consequently, comparisons between metal/metalloid concentrations in batch extracts as indicative of WRD drainage and water quality trigger values should be undertaken with caution.

Notwithstanding the above restraints, concentrations of soluble metals were compared with ANZECC freshwater toxicant default guideline values (DGV)[3]. The results of this comparison indicate that only aluminium and arsenic concentrations in water extracts exceed the DGV for the majority of samples tested and for a significant number of samples in the case of zinc (Figure 14). It should be noted that these guideline values apply to surface water as the receptor for the toxicant. It may be that during the short storage period (up to 3 years) of these materials in the WRDs, little or no drainage will discharge from the waste rock piles, as water hold-up times in waste rock dumps can be up to decades in length. Consequently, there may be no impact on surface water bodies in the vicinity of the WRDs. However, even if there is little or no leachate draining from the WRD, weathering during the period of surface storage may result in production of soluble or partially soluble salts. Following backfilling and rebound of the water table in the underground workings, the products of these weathering reactions may dissolve and metal/metalloids mobilised under the anoxic conditions which will prevail in saturated rock. In this case the likely receptor is groundwater. Therefore, comparison with background groundwater concentrations of aluminium, arsenic and zinc would be more appropriate, but this information is currently unavailable.

In summary, leachate test results suggest that, in general, drainage from these materials will have circum-neutral to alkaline pH and low salinity. However, results also indicate that drainage from oxidised rock stored in the Box cut WRD may contain low concentrations of aluminium and zinc. In addition, some of the fresh rock stored on the UG WRD may contain water leachable arsenic species and possibly zinc, resulting in elevated arsenic and zinc in drainage from this waste storage facility. These preliminary results suggest that further testing should be undertaken to investigate aluminium, arsenic and zinc leaching from fresh and oxidised waste rock.

Additional testing should comprise kinetic leach column (KLC) testing, which provides conditions closer to those within a WRD, with both dissolution and precipitation reactions occurring. KLC tests should be conducted under oxic conditions to simulate conditions during storage in WRD. Following a period (≈6 months) of oxic weathering , testing should be continued under saturated conditions to simulate saturated zones within the backfilled UG mine and Box cut. Samples should include oxide and transitional waste rock to investigate leaching of aluminium and zinc, and transitional and fresh waste rock samples which gave elevated arsenic and zinc levels in water extracts. Results can then be compared with background groundwater metal concentrations, which are likely to be available by this time.

[3] Australian & New Zealand Guidelines for Fresh & Marine Water Quality 2018: Toxicant default guideline values, https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/search#tox-293

Oxide/transitional waste rock for KLC testing should be made by generating composite samples from the following:

- NRC129-20 to 68 plus
- FRC212-15 to 81 plus
- FRC213-5 to 67 plus
- FRC214-6 to 45

Transitional/fresh waste rock for KLC testing should be made by generating composite samples from the following:

- NRC129-34 plus
- FRC212- 66 to 88 plus
- FRC213-86 to 131 plus
- FRC214-50 to 74

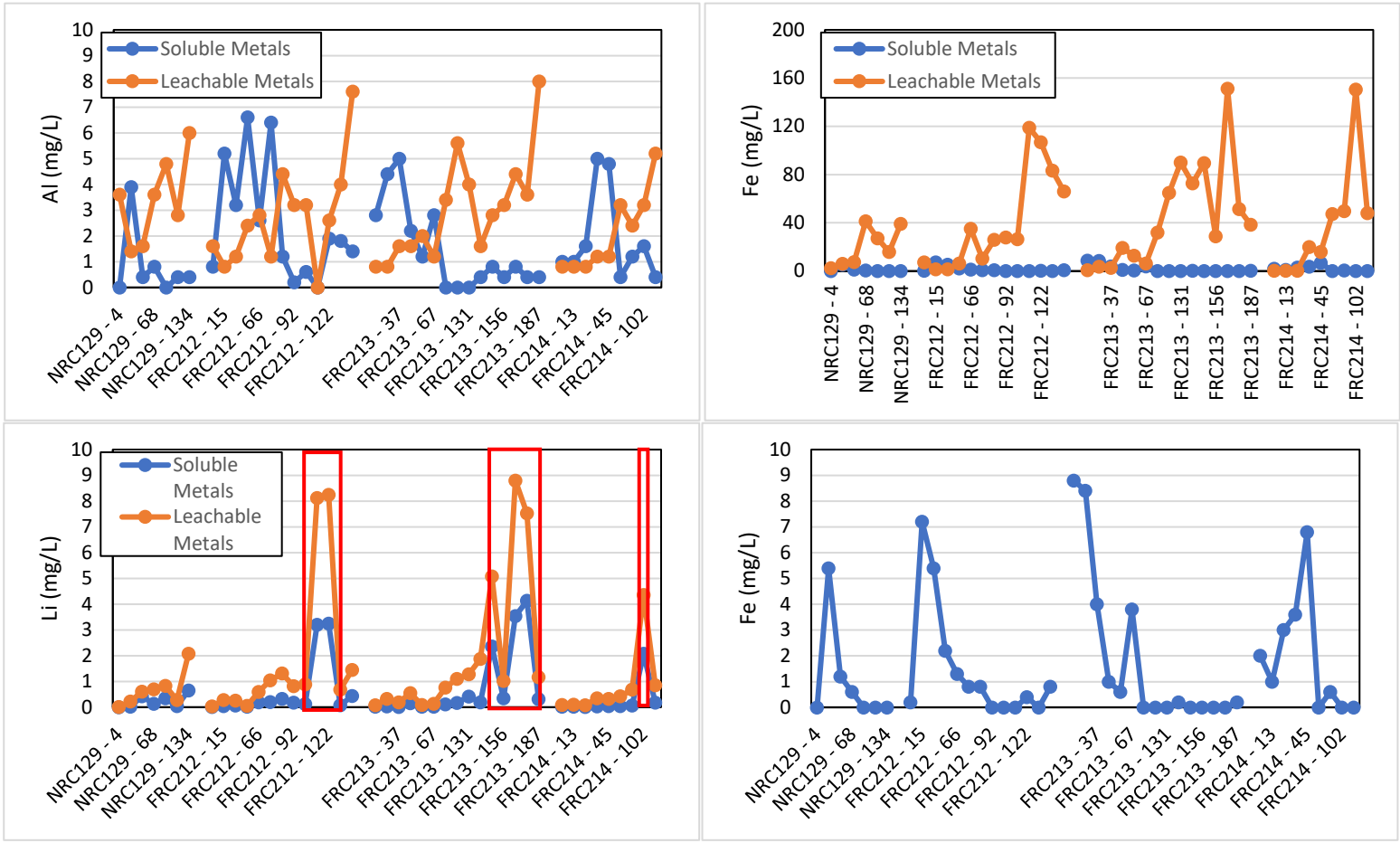



*Figure 10: Soluble and leachable Al (top left), Fe (top right), soluble Fe (expanded axis, bottom right) and soluble and leachable Li (bottom left) for samples from drill holes NRC129 and FRC212 – FRC214. Red boxes highlight ore samples. Note, soluble metals are plotted as concentrations in the extract (mg/L) only, but are reported as amount extracted (mg/kg) and concentrations (mg/L) in Appendix B. Leachable metals are plotted as the original leachate concentrations (Appendix C) multiplied by a factor of 4 to allow comparison with soluble metals. See text for explanation.*

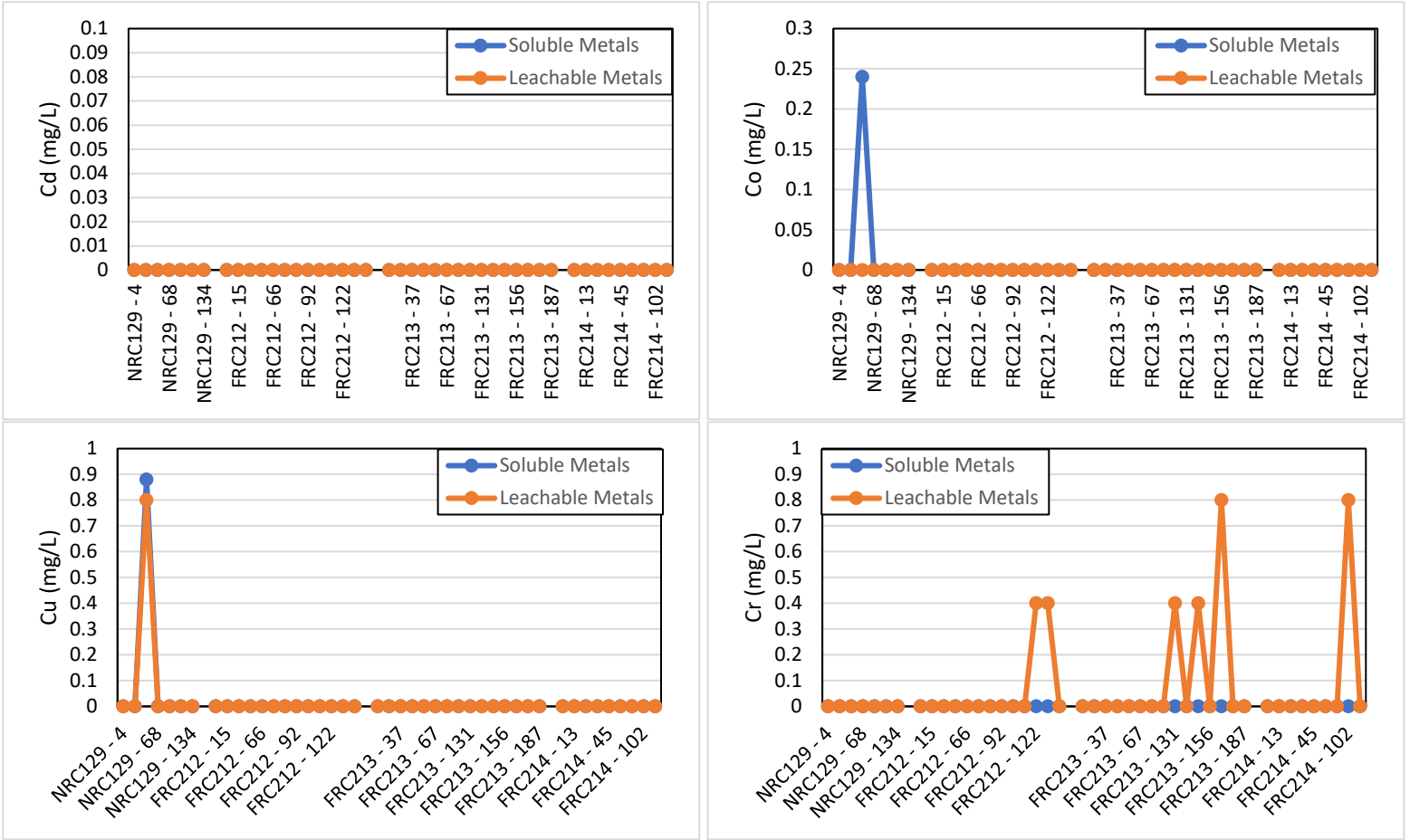



*Figure 11: Soluble and leachable heavy metals for samples from drill holes NRC129 and FRC212 – FRC214. Note, soluble metals are plotted as concentrations in the extract (mg/L) only, but are reported as amount extracted (mg/kg) and concentrations (mg/L) in Appendix B. Leachable metals are plotted as the original leachate concentrations (Appendix C) multiplied by a factor of 4 to allow comparison with soluble metals. See text for explanation.*

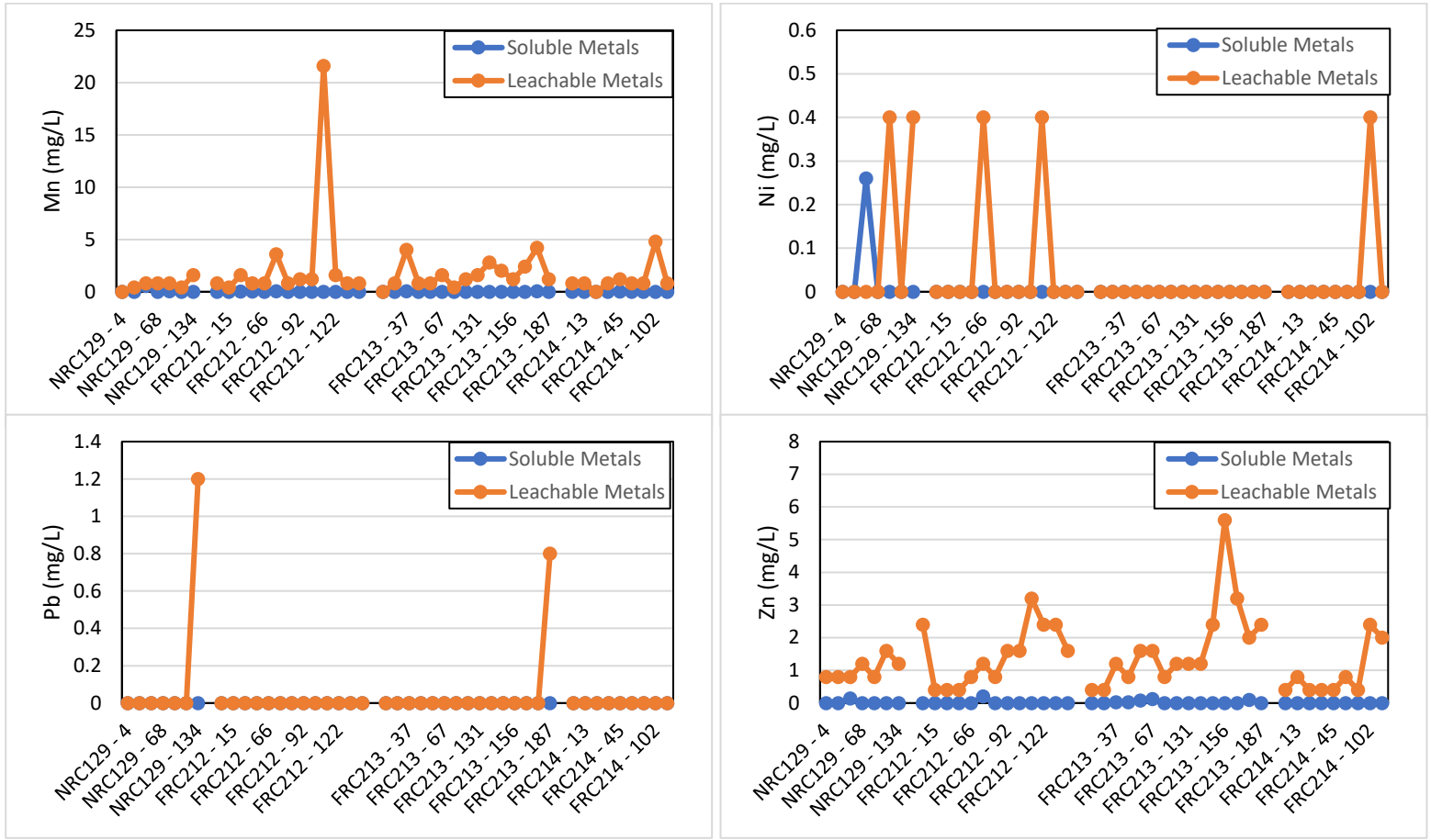



*Figure 12: Soluble and leachable heavy metals for samples from drill holes NRC129 and FRC212 – FRC214. Note, soluble metals are plotted as concentrations in the extract (mg/L) only, but are reported as amount extracted (mg/kg) and concentrations (mg/L) in Appendix B. Leachable metals are plotted as the original leachate concentrations (Appendix C) multiplied by a factor of 4 to allow comparison with soluble metals. See text for explanation.*

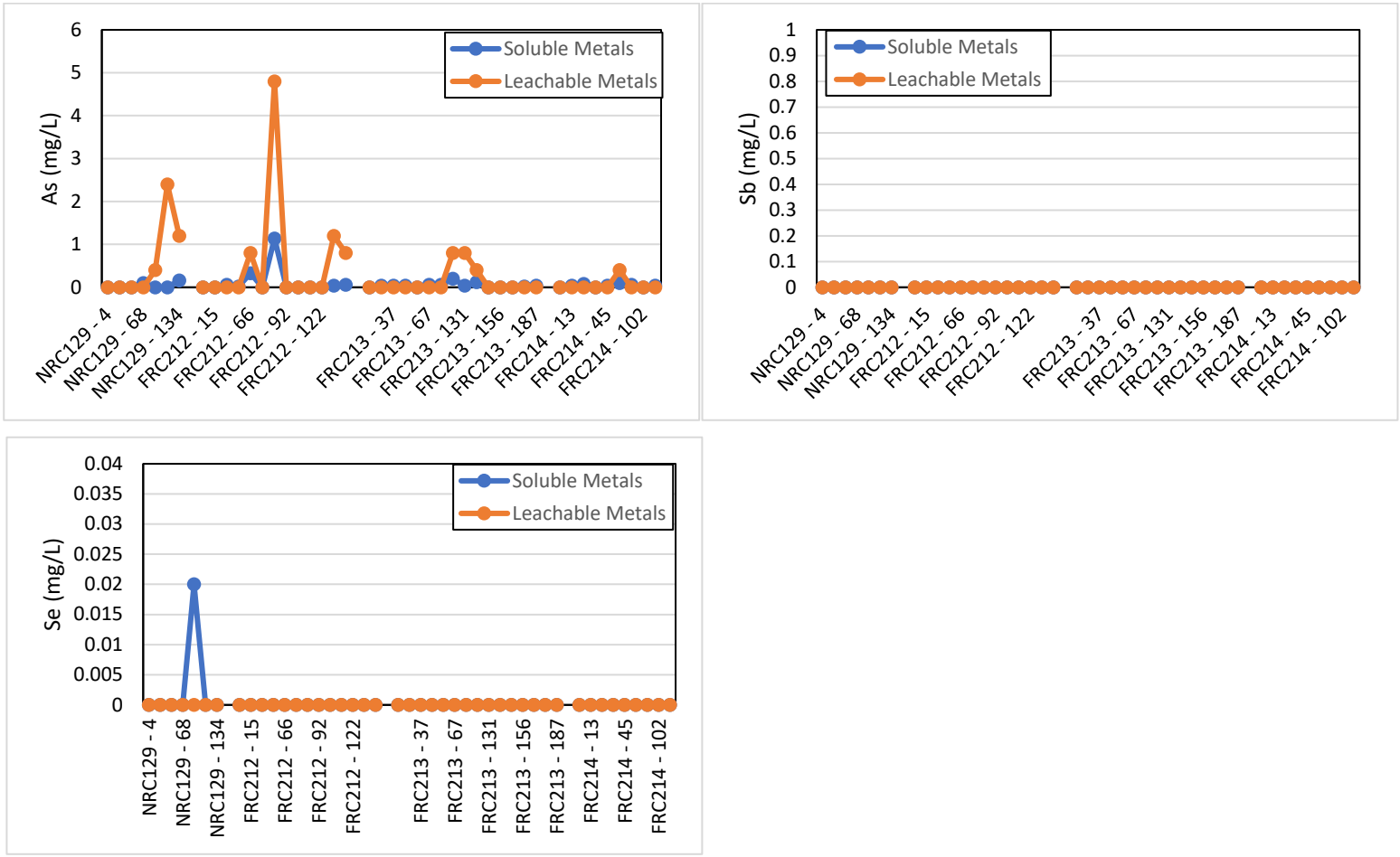



*Figure 13: Soluble and leachable metalloids for samples from drill holes NRC129 and FRC212 – FRC214. Note, soluble metalloids are plotted as concentrations in the extract (mg/L) only, but are reported as amount extracted (mg/kg) and concentrations (mg/L) in Appendix B. Leachable metalloids are plotted as the original leachate concentrations (Appendix C) multiplied by a factor of 4 to allow comparison with soluble metalloids. See text for explanation.*

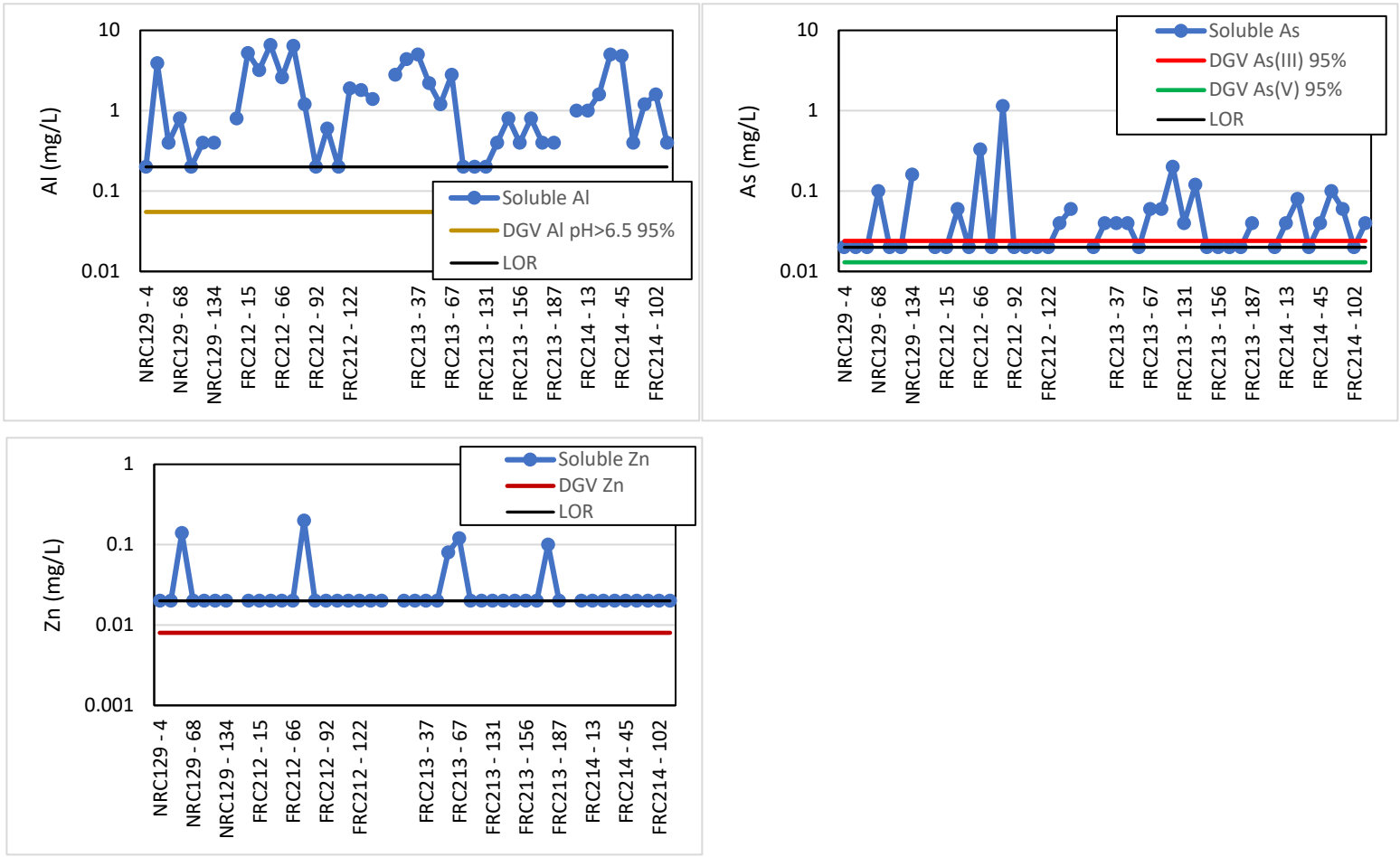



*Figure 14: Soluble Al, As and Zn for samples from drill holes NRC129 and FRC212 – FRC214 and corresponding ANZECC freshwater default guideline values and method reporting limits (LOR). Note, soluble metalloids are plotted as concentrations in the extract (mg/L) only, but are reported as amount extracted (mg/kg) and concentrations (mg/L) in Appendix B. See text for explanation.*

## 3.3 Naturally Occurring Radioactive Material (NORM)

Naturally occurring radioactive material (NORM) was assessed on samples from the NRC129 and FRC212 – FRC214 drill holes used in the waste characterisation. All testing was undertaken using RadEye B20 – ER contamination meter (SN 32215 Calibrated 15/04/2019) by registered NT Radiation Advisor Accreditation Number 10/00054A. This meter characterises alpha, beta and gamma radiation. The results are recorded in μSv/h and are provided in Appendix D.

The average radiation dose in Australia over a one year period is around 1.5 mSv[4]. Assuming exposure to the materials tested here for an average of 45 h per week (average working hours for Australian mine workers), this would provide an additional dose of 0.3 mSv. The recommended dose limit for occupational exposure in Australia is 20 mSv/year (averaged over a period of 5 years)[5]. The results from radiation dose measurements for the drill core samples from the BP33 deposit measured here, indicate that these materials are unlikely to contribute significantly to workers radiation exposure and that further testing is unwarranted.

## 3.4 Soil Characterisation

Soil characterisation results for four soil samples taken at the surface of drill holes NRC129-0, FRC212-0, FRC213-0 and FRC214-0 are given in Appendix E.

The four samples were logged as completely weathered, and they were variously described as sandy loam, sandy clay loam or clay loam. However, the clay fractions were relatively low (i.e. between 7 to 11% of the minus 2 mm sized material) and the particle size distributions indicate that typical surface soil at the site is a sandy loam that in some locations also has a significant gravel content. Soil stability was assessed using the Emerson test, which measures the tendency of the clay fraction of a soil to go into colloidal suspension (i.e. disperse). All four soils were classed at 7, which means the soil samples were non-dispersive.

In addition to particle size analysis, the soil characterisation program included measurements of a number of parameters pertaining to soil fertility. They included pH and electrical conductivity (EC), cation exchange capacity (CEC) and exchangeable cations, analysis of trace metals, determination of soil nitrogen, potassium and phosphorus, and measurements of carbon and soil organic matter. The main findings with respect to soil fertility, based on guidelines by Agriculture Victoria[6], are as follows:

*Slightly Acidic Soil pH*

Values ranged from 5.3 to 5.8, which indicate the soil is slightly acidic, but within the range that is generally acceptable for plant growth.

*Non-Saline*

The ECs ranged from 14 to 33 μS/cm, which is at the low end of the typical range for soil. The EC values are indicative of low contents of soluble salts and hence the soils can be considered non-saline. Also, as exchangeable sodium values were negligible the soils can be considered non-sodic.

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[4] Radiation Information sheet, Naturally occurring radioactive material (NORM), Environmental Protection Authority South Australia, Issued December 2017

[5] Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005) Radiation Protection Series Publication No. 9, ARPANSA 2005

[6] Agriculture Victoria, Victoria State Government (2020). Accessed 20 February 2020. < http://agriculture.vic.gov.au/agriculture/farm-management/business-management/ems-in-victorian-agriculture/environmental-monitoring-tools/soil-fertility >

*Low CEC and Exchangeable Cations*

The soils CECs were less than 1, which signifies they have minimal capacity for cation exchange. The low CECs are consistent with the soils being sandy and containing little organic matter (i.e. clay and organic matter are the two main contributors of CEC in typical fertile soil; a loam typically has an CEC around 5 meq/100 gm and a clay up to 20 meq/100g). Calcium and magnesium were the dominant exchange cations. There was no evidence of exchangeable sodium or aluminium, which are not plant nutrients, and can be detrimental to growth if present in excess. Exchangeable sodium and exchangeable aluminium were both less than the 0.1 meq/100g limit of analytical detection.

*Low Fertility*

Extractable phosphorus was determined by the Colwell test. The extractable phosphorus contents of the four soil samples were less than the 5 mg/kg detection limit. As a guide, an available P content of around 20 mg/kg is generally considered adequate for good plant growth.

Extractable potassium was also determined by the Colwell test. The extractable potassium contents varied. One sample (FRC213-0) contained 341 mg/kg, which is relatively high for a sandy loam. However, the other three samples contained less than 140 mg/kg extractable potassium, which rates as low to marginal for plant growth.

Nitrogen is also essential for plant growth but nitrogen testing is generally of limited value when assessing soil fertility as the levels of soil nitrate and ammonium (which plants adsorbed) fluctuate widely with soil and weather conditions over short periods of time. Total N contents for the soils ranged from 410 to 790 mg/kg but most was likely present as organic matter. Nitrate which can be utilise by plants was low (<1 mg/kg).

*Low Trace Elements*

One sample had a marginally elevated arsenic content of 15 mg/kg, but otherwise the concentrations of trace metals (Cd, Cr, Cu, Ni, Pb, Zn, Li, Sn and Hg) were at, or in most cases much less than, the respective median concentrations typically reported for soils from non-mineralised areas.

*Low Organic Matter*

The total carbon contents ranged from 0.6 to 1.1 %C, which converts to between 1 to 2 % organic matter. An organic matter content exceeding 2% is generally desirable for plant growth and to maintain good soil physical structure.

*Summary*

Overall, the results for the four samples suggest that soil at the site is an infertile, gravelly sandy loam. The Emerson test indicates that the soil should be non-dispersive, but given the low organic matter level and sandy texture the soil likely has poor structure and limited water-holding capacity, and therefore could be susceptible to erosion under wet conditions. It is expected successful rehabilitation will require increasing the physical and chemical fertility of the soil to some extent, consistent with the proposed final end use.

# APPENDIX A - ABA & NAG Test Results

| Sample details | | | | | | | | Net Acid Generation | | | Acid Base Accouting | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Sample ID | Depth | Lithology | Weathering | Sample Type | pH (1:2)[1] or (1:5)[2] | EC (1:2)$_1$ or (1:5)[2] | NAGpH | NAG (pH 4.5) | NAG (pH 7.0) | NAPP | MPA | Total S (LECO) | ANC | Fizz Rating | ANC/MPA |
| | | | | | | pH Unit | µS/cm | pH Unit | kg H2SO4/t | kg H2SO4/t | kg H2SO4/t | kg H2SO4/t | % | kg H2SO4/t | Fizz Unit | |
| | | | | | | 0.1 | 1 | 0.1 | 0.1 | 0.1 | 0.5 | 0.3 | 0.01 | 0.5 | | |
| 10/09/2019 | NRC129 - 4 | 4 | Py | EW | Waste | 5.5 | 12 | 5.6 | <0.1 | 1.3 | -8 | <0.3 | <0.01 | 8 | 1 | >27 |
| 10/09/2019 | NRC129 - 20 | 20 | Py | MW | Waste | 7.2 | 18 | 7.3 | <0.1 | <0.1 | -12 | <0.3 | <0.01 | 12 | 1 | >41 |
| 10/09/2019 | NRC129 - 55 | 55 | Py | SW | Waste | 4.0 | 786 | 4.4 | 0.2 | 2.5 | -15 | 4.3 | 0.14 | 19 | 1 | 4.4 |
| 10/09/2019 | NRC129 - 68 | 68 | Sst | Fr | Waste | 7.1 | 112 | 5.6 | <0.1 | 3 | -14 | 1.5 | 0.05 | 15 | 1 | 10 |
| 10/09/2019 | NRC129 - 89 | 89 | Py | Fr | Waste | 6.8 | 274 | 3.8 | 1.7 | 6.7 | -12 | 5.2 | 0.17 | 18 | 1 | 3.4 |
| 10/09/2019 | NRC129 - 98 | 98 | Pg | Fr | Waste | 8.7 | 65 | 6.9 | <0.1 | 0.4 | -13 | 0.6 | 0.02 | 13 | 1 | 22 |
| 10/09/2019 | NRC129 - 134 | 134 | Py | Fr | Waste | 8.3 | 159 | 3.4 | 5.5 | 8.2 | -4 | 13 | 0.42 | 17 | 1 | 1.3 |
| | | | | | | | | | | | | | | | | |
| 10/09/2019 | FRC212 - 8 | 8 | Pg | HW | Waste | 8.4 | 19 | 6.6 | <0.1 | 0.7 | -8 | <0.3 | <0.01 | 8 | 1 | >25 |
| 10/09/2019 | FRC212 - 15 | 15 | Py | MW | Waste | 8.4 | 17 | 7.4 | <0.1 | <0.1 | -12 | <0.3 | <0.01 | 12 | 1 | >40 |
| 10/09/2019 | FRC212 - 44 | 44 | Py | MW | Waste | 8.3 | 24 | 7.3 | <0.1 | <0.1 | -16 | <0.3 | <0.01 | 16 | 1 | >54 |
| 10/09/2019 | FRC212 - 53 | 53 | Pg | MW | Waste | 8.8 | 39 | 7.0 | <0.1 | <0.1 | -13 | <0.3 | <0.01 | 13 | 1 | >42 |
| 11/09/2019 | FRC212 - 66 | 66 | Py | SW | Waste | 8.5 | 65 | 6.2 | <0.1 | 4.3 | -14 | <0.3 | <0.01 | 14 | 1 | >47 |
| 11/09/2019 | FRC212 - 81 | 81 | Pg | Fr | Waste | 8.6 | 39 | 6.8 | <0.1 | 1 | -13 | <0.3 | <0.01 | 13 | 1 | >44 |
| 11/09/2019 | FRC212 - 88 | 88 | Py | Fr | Waste | 8.1 | 68 | 6.2 | <0.1 | 2.4 | -22 | 0.6 | 0.02 | 23 | 1 | 38 |
| 11/09/2019 | FRC212 - 92 | 92 | Pg | Fr | Waste | 9.2 | 49 | 7.2 | <0.1 | <0.1 | -12 | <0.3 | <0.01 | 12 | 1 | >41 |
| 11/09/2019 | FRC212 - 97 | 97 | Pg | Fr | Ore | 9.2 | 48 | 6.0 | <0.1 | 3.8 | -13 | <0.3 | <0.01 | 13 | 1 | >42 |
| 11/09/2019 | FRC212 - 109 | 109 | Pg | Fr | Ore | 9.5 | 136 | 7.6 | <0.1 | <0.1 | -16 | <0.3 | <0.01 | 16 | 1 | >53 |
| 11/09/2019 | FRC212 - 122 | 122 | Pg | Fr | Ore | 9.3 | 122 | 7.0 | <0.1 | 0.9 | -12 | <0.3 | <0.01 | 12 | 1 | >41 |
| 11/09/2019 | FRC212 - 131 | 131 | Pg | Fr | Waste | 9.2 | 76 | 7.1 | <0.1 | <0.1 | -35 | 0.3 | 0.01 | 36 | 1 | 116 |
| 11/09/2019 | FRC212 - 143 | 143 | Py | Fr | Waste | 9.0 | 68 | 6.2 | <0.1 | 1.1 | -19 | 2.1 | 0.07 | 21 | 1 | 10 |
| | | | | | | | | | | | | | | | | |
| 11/09/2019 | FRC213 - 5 | 5 | Py | HW | Waste | 8.7 | 15 | 6.7 | <0.1 | 0.9 | -11 | <0.3 | <0.01 | 11 | 1 | >35 |
| 11/09/2019 | FRC213 - 26 | 26 | Py | MW | Waste | 8.5 | 18 | 7.4 | <0.1 | <0.1 | -14 | <0.3 | <0.01 | 14 | 1 | >45 |
| 11/09/2019 | FRC213 - 37 | 37 | Pg | HW | Waste | 8.5 | 31 | 7.6 | <0.1 | <0.1 | -16 | <0.3 | <0.01 | 16 | 1 | >53 |
| 11/09/2019 | FRC213 - 58 | 58 | Py | SW | Waste | 8.6 | 54 | 6.2 | <0.1 | 3 | -17 | <0.3 | <0.01 | 17 | 1 | >56 |
| 11/09/2019 | FRC213 - 62 | 62 | Pg | SW | Waste | 8.6 | 72 | 6.8 | <0.1 | 0.9 | -13 | <0.3 | <0.01 | 13 | 1 | >43 |
| 11/09/2019 | FRC213 - 67 | 67 | Pg | SW | Waste | 8.7 | 50 | 6.8 | <0.1 | 0.9 | -21 | 0.6 | 0.02 | 22 | 1 | 35 |
| 11/09/2019 | FRC213 - 86 | 86 | Pg | Fr | Waste | 8.3 | 76 | 4.4 | 0.25 | 2.4 | -13 | 2.8 | 0.09 | 16 | 1 | 5.7 |
| 11/09/2019 | FRC213 - 107 | 107 | Sst | Fr | Waste | 8.9 | 64 | 6.8 | <0.1 | 0.6 | -21 | 0.6 | 0.02 | 22 | 1 | 35 |
| 11/09/2019 | FRC213 - 131 | 131 | Py | Fr | Waste | 9.5 | 70 | 7.2 | <0.1 | <0.1 | -14 | 0.9 | 0.03 | 15 | 1 | 17 |
| 14/09/2019 | FRC213 - 142 | 142 | Pg | Fr | Ore | 8.8 | 126 | 7.2 | <0.1 | <0.1 | -19 | 0.6 | 0.02 | 19 | 1 | 32 |
| 14/09/2019 | FRC213 - 148 | 148 | Pg | Fr | Ore | 9.4 | 109 | 7.8 | <0.1 | <0.1 | -10 | <0.3 | <0.01 | 10 | 1 | >33 |
| 14/09/2019 | FRC213 - 156 | 156 | Pg | Fr | Ore | 8.7 | 59 | 6.6 | <0.1 | 0.8 | -9 | 0.6 | 0.02 | 9 | 1 | 15 |
| 14/09/2019 | FRC213 - 170 | 170 | Pg | Fr | Ore | 9.5 | 121 | 7.3 | <0.1 | <0.1 | -10 | <0.3 | <0.01 | 10 | 1 | >33 |
| 14/09/2019 | FRC213 - 178 | 178 | Pg | Fr | Ore | 9.4 | 132 | 7.9 | <0.1 | <0.1 | -13 | <0.3 | <0.01 | 13 | 1 | >44 |
| 14/09/2019 | FRC213 - 187 | 187 | Py | Fr | Waste | 8.5 | 186 | 5.8 | <0.1 | 0.9 | -16 | 3.1 | 0.10 | 19 | 1 | 6.1 |

| Sample details | | | | | | | | Net Acid Generation | | | Acid Base Accouting | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Sample ID | Depth | Lithology | Weathering | Sample Type | pH (1:2)[1] or (1:5)[2] | EC (1:2)$_1$ or (1:5)[2] | NAGpH | NAG (pH 4.5) | NAG (pH 7.0) | NAPP | MPA | Total S (LECO) | ANC | Fizz Rating | ANC/MPA |
| | | | | | | pH Unit | µS/cm | pH Unit | kg H2SO4/t | kg H2SO4/t | kg H2SO4/t | kg H2SO4/t | % | kg H2SO4/t | Fizz Unit | |
| | | | | | | 0.1 | 1 | 0.1 | 0.1 | 0.1 | 0.5 | 0.3 | 0.01 | 0.5 | | |
| 14/09/2019 | FRC214 - 6 | 6 | Py | CW | Waste | 7.8 | 41 | 7.4 | <0.1 | <0.1 | -10 | <0.3 | <0.01 | 10 | 1 | >32 |
| 14/09/2019 | FRC214 - 13 | 13 | Py/Qv | HW | Waste | 7.9 | 19 | 7.1 | <0.1 | <0.1 | -8 | <0.3 | <0.01 | 8 | 1 | >27 |
| 14/09/2019 | FRC214 - 20 | 20 | Py | CW | Waste | 8.0 | 17 | 7.2 | <0.1 | <0.1 | -10 | <0.3 | <0.01 | 10 | 1 | >32 |
| 14/09/2019 | FRC214 - 34 | 34 | Py | HW | Waste | 8.5 | 22 | 7.4 | <0.1 | <0.1 | -14 | <0.3 | <0.01 | 14 | 1 | >46 |
| 14/09/2019 | FRC214 - 45 | 45 | Py | MW | Waste | 8.6 | 23 | 7.3 | <0.1 | <0.1 | -14 | <0.3 | <0.01 | 14 | 1 | >47 |
| 14/09/2019 | FRC214 - 50 | 50 | Py | SW | Waste | 8.7 | 32 | 7.3 | <0.1 | <0.1 | -14 | <0.3 | <0.01 | 14 | 1 | >46 |
| 14/09/2019 | FRC214 - 74 | 74 | Py | Fr | Waste | 8.7 | 56 | 7.2 | <0.1 | <0.1 | -14 | 0.3 | 0.01 | 14 | 1 | 46 |
| 14/09/2019 | FRC214 - 102 | 102 | Pg | Fr | Ore | 9.2 | 92 | 6.9 | <0.1 | 0.5 | -11 | <0.3 | <0.01 | 11 | 1 | >38 |
| 14/09/2019 | FRC214 - 116 | 116 | Pg | Fr | Waste | 8.9 | 40 | 6.4 | <0.1 | 0.4 | -12 | 1.2 | 0.04 | 13 | 1 | 11 |
| | | | | | | | | | | | | | | | | |
| 6/07/2018 | FRC166_002 | 2 | Laterite | CW | Waste | 5.5 | 3 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_008 | 8 | Py | CW | Waste | 6.8 | 9 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_018 | 18 | Py | HW | Waste | 7.0 | 8 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_032 | 32 | Py | HW | Waste | 7.7 | 9 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_046 | 46 | Py | MW | Waste | 8.4 | 22 | N/D | N/D | N/D | N/D | 3.1 | 0.1 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_052 | 52 | Py | SW | Waste | 8.4 | 28 | N/D | N/D | N/D | N/D | 4.3 | 0.14 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_064 | 64 | Py | SW | Waste | 7.9 | 55 | N/D | N/D | N/D | N/D | 16 | 0.51 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_075 | 75 | Py | FR | Waste | 8.5 | 32 | N/D | N/D | N/D | N/D | 8.9 | 0.29 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_088 | 88 | Py | FR | Waste | 9.2 | 48 | N/D | N/D | N/D | N/D | 1.5 | 0.05 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_108 | 108 | Py | FR | Waste | 9.2 | 37 | N/D | N/D | N/D | N/D | 2.8 | 0.09 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_144 | 144 | Py | FR | Waste | 9.00 | 34 | N/D | N/D | N/D | N/D | 8.9 | 0.29 | N/D | N/D | N/D |
| 6/07/2018 | FRC166_152 | 152 | Py | FR | Waste | 9.1 | 39 | N/D | N/D | N/D | N/D | 6.4 | 0.21 | N/D | N/D | N/D |
| 7/07/2018 | FRC166_226 | 226 | Py | FR | Waste | 9.1 | 55 | N/D | N/D | N/D | N/D | 1.2 | 0.04 | N/D | N/D | N/D |
| | | | | | | | | | | | | | | | | |
| 8/07/2018 | FRC167_004 | 4 | Py | CW | Waste | 7.2 | 8 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_013 | 13 | Py | HW | Waste | 7.2 | 7 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_020 | 20 | Py | HW | Waste | 6.9 | 9 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_031 | 31 | Py | HW | Waste | 7.0 | 9 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_044 | 44 | Py | MW | Waste | 7.8 | 10 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_049 | 49 | Py | MW | Waste | 7.00 | 66 | N/D | N/D | N/D | N/D | 4.3 | 0.14 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_060 | 60 | Py | SW | Waste | 8.7 | 33 | N/D | N/D | N/D | N/D | 4.0 | 0.13 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_072 | 72 | Py/SST | FR | Waste | 7.8 | 50 | N/D | N/D | N/D | N/D | 7.0 | 0.23 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_076 | 76 | Py/QV | FR | Waste | 8.6 | 25 | N/D | N/D | N/D | N/D | 1.5 | 0.05 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_098 | 98 | Py/QV | FR | Waste | 9.4 | 87 | N/D | N/D | N/D | N/D | 0.6 | 0.02 | N/D | N/D | N/D |
| 8/07/2018 | FRC167_117 | 117 | Py/SST | FR | Waste | 9.4 | 88 | N/D | N/D | N/D | N/D | 4.9 | 0.16 | N/D | N/D | N/D |
| 9/07/2018 | FRC167_126 | 126 | PEG/PY | FR | Waste | 9.3 | 76 | N/D | N/D | N/D | N/D | 2.1 | 0.07 | N/D | N/D | N/D |
| 9/07/2018 | FRC167_140 | 140 | Py/SST | FR | Waste | 9.00 | 32 | N/D | N/D | N/D | N/D | 3.1 | 0.1 | N/D | N/D | N/D |
| 9/07/2018 | FRC167_189 | 189 | Py/SST | FR | Waste | 9.2 | 52 | N/D | N/D | N/D | N/D | 1.2 | 0.04 | N/D | N/D | N/D |
| 10/07/2018 | FRC168_001 | 1 | laterite | CW | Waste | 6.0 | 5 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 10/07/2018 | FRC168_005 | 5 | PY | CW | Waste | 6.0 | 4 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 10/07/2018 | FRC168_017 | 17 | PY | HW | Waste | 6.1 | 4 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 10/07/2018 | FRC168_042 | 42 | PY | MW | Waste | 7.8 | 12 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 10/07/2018 | FRC168_045 | 45 | PY | MW | Waste | 7.9 | 12 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |

| Sample details | | | | | | | | Net Acid Generation | | | Acid Base Accouting | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Sample ID | Depth | Lithology | Weathering | Sample Type | pH (1:2)[1] or (1:5)[2] | EC (1:2)$_1$ or (1:5)[2] | NAGpH | NAG (pH 4.5) | NAG (pH 7.0) | NAPP | MPA | Total S (LECO) | ANC | Fizz Rating | ANC/MPA |
| | | | | | | pH Unit | µS/cm | pH Unit | kg H2SO4/t | kg H2SO4/t | kg H2SO4/t | kg H2SO4/t | % | kg H2SO4/t | Fizz Unit | |
| | | | | | | 0.1 | 1 | 0.1 | 0.1 | 0.1 | 0.5 | 0.3 | 0.01 | 0.5 | | |
| 11/07/2018 | FRC168_052 | 52 | PY | SW | Waste | 8.2 | 12 | N/D | N/D | N/D | N/D | 0.6 | 0.02 | N/D | N/D | N/D |
| 11/07/2018 | FRC168_060 | 60 | PY | MW | Waste | 8.5 | 23 | N/D | N/D | N/D | N/D | 0.9 | 0.03 | N/D | N/D | N/D |
| 11/07/2018 | FRC168_118 | 118 | PY | FR | Waste | 8.7 | 76 | N/D | N/D | N/D | N/D | 11 | 0.37 | N/D | N/D | N/D |
| | | | | | | | | | | | | | | | | |
| 12/07/2018 | FRC169_002 | 2 | Laterite | CW | Waste | 7.3 | 10 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 12/07/2018 | FRC169_004 | 4 | PY | CW | Waste | 7.3 | 5 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 12/07/2018 | FRC169_014 | 14 | PY | HW | Waste | 7.1 | 7 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 12/07/2018 | FRC169_026 | 26 | PY | HW | Waste | 7.6 | 7 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 12/07/2018 | FRC169_036 | 36 | PY/SST | MW | Waste | 8.3 | 14 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 12/07/2018 | FRC169_057 | 57 | PY/SST | SW | Waste | 8.5 | 18 | N/D | N/D | N/D | N/D | 0.9 | 0.03 | N/D | N/D | N/D |
| 12/07/2018 | FRC169_065 | 65 | PY | FR | Waste | 6.6 | 120 | N/D | N/D | N/D | N/D | 32 | 1.05 | N/D | N/D | N/D |
| 14/07/2018 | FRC169_153 | 153 | PY | FR | Waste | 9.0 | 33 | N/D | N/D | N/D | N/D | 2.1 | 0.07 | N/D | N/D | N/D |
| | | | | | | | | | | | | | | | | |
| 15/07/2018 | FRC170_004 | 4 | SOIL | CW | Waste | 6.0 | 4 | N/D | N/D | N/D | N/D | 0.6 | 0.02 | N/D | N/D | N/D |
| 15/07/2018 | FRC170_011 | 11 | PY | CW | Waste | 6.7 | 4 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 15/07/2018 | FRC170_023 | 23 | PY | HW | Waste | 7.5 | 6 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 15/07/2018 | FRC170_035 | 35 | PY | HW | Waste | 7.6 | 9 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 15/07/2018 | FRC170_044 | 44 | PY | MW | Waste | 8.0 | 7 | N/D | N/D | N/D | N/D | 0.6 | 0.02 | N/D | N/D | N/D |
| 15/07/2018 | FRC170_056 | 56 | PY | SW | Waste | 8.5 | 16 | N/D | N/D | N/D | N/D | 0.6 | 0.02 | N/D | N/D | N/D |
| 15/07/2018 | FRC170_064 | 64 | PY | FR | Waste | 9.0 | 23 | N/D | N/D | N/D | N/D | 0.6 | 0.02 | N/D | N/D | N/D |
| 15/07/2018 | FRC170_099 | 99 | PY | FR | Waste | 9.2 | 76 | N/D | N/D | N/D | N/D | 0.6 | 0.02 | N/D | N/D | N/D |
| 16/07/2018 | FRC170_142 | 142 | PY | FR | Waste | 9.4 | 41 | N/D | N/D | N/D | N/D | 0.9 | 0.03 | N/D | N/D | N/D |
| | | | | | Waste | | | | | | | | | | | |
| 18/07/2018 | FRC171_040 | 40 | PY | MW | Waste | 8.1 | 7 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |
| 14/07/2018 | FRC171_065 | 65 | PY/QV | SW | Waste | 6.2 | 2 | N/D | N/D | N/D | N/D | <0.3 | <0.01 | N/D | N/D | N/D |

1. pH and EC (1:2) conducted samples from drill holes NRC129 and FRC212-214
2. pH and EC (1:5) conducted samples from drill holes FRC166-171

# APPENDIX B – Water Soluble Metals

| Sample details | | | | | | Soluble Metals by ICPAES | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Sample ID | Depth | Lithology | Weathering | Sample Type | Aluminium | | Antimony | | Arsenic | | Cadmium | | Chromium | | Cobalt | | Copper | | Iron | | Lead | | Manganese | | Nickel | | Selenium | |
| | | | | | | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L |
| | | | | | | 1 | | 0.1 | | 0.1 | | 0.1 | | 0.1 | | 0.1 | | 0.1 | | 1 | | 0.1 | | 0.1 | | 0.1 | | 0.1 | |
| 10/09/2019 | NRC129 - 4 | 4 | Py | EW | Waste | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 10/09/2019 | NRC129 - 20 | 20 | Py | MW | Waste | 20 | 3.9 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 27 | 5.4 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 10/09/2019 | NRC129 - 55 | 55 | Py | SW | Waste | 2 | 0.4 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 1.2 | 0.2 | 4.4 | 0.9 | 6 | 1.2 | <0.1 | <0.02 | 2.8 | 0.6 | 1.3 | 0.3 | <0.1 | <0.02 |
| 10/09/2019 | NRC129 - 68 | 68 | Sst | Fr | Waste | 4 | 0.8 | <0.1 | <0.02 | 0.5 | 0.10 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 3 | 0.6 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 10/09/2019 | NRC129 - 89 | 89 | Py | Fr | Waste | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | 0.3 | 0.06 | <0.1 | <0.02 | 0.1 | 0.02 |
| 10/09/2019 | NRC129 - 98 | 98 | Pg | Fr | Waste | 2 | 0.4 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 10/09/2019 | NRC129 - 134 | 134 | Py | Fr | Waste | 2 | 0.4 | <0.1 | <0.02 | 0.8 | 0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10/09/2019 | FRC212 - 8 | 8 | Pg | HW | Waste | 4 | 0.8 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 1 | 0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 10/09/2019 | FRC212 - 15 | 15 | Py | MW | Waste | 26 | 5.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 36 | 7.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 10/09/2019 | FRC212 - 44 | 44 | Py | MW | Waste | 16 | 3.2 | <0.1 | <0.02 | 0.3 | 0.1 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 27 | 5.4 | <0.1 | <0.02 | 0.1 | 0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 10/09/2019 | FRC212 - 53 | 53 | Pg | MW | Waste | 33 | 6.6 | <0.1 | <0.02 | 0.1 | 0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 11 | 2.2 | <0.1 | <0.02 | 0.1 | 0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 66 | 66 | Py | SW | Waste | 13.0 | 2.6 | <0.1 | <0.02 | 1.7 | 0.3 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 6.5 | 1.3 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 81 | 81 | Pg | Fr | Waste | 32 | 6.4 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 4 | 0.8 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 88 | 88 | Py | Fr | Waste | 6 | 1.2 | <0.1 | <0.02 | 5.7 | 1.1 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 4 | 0.8 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 92 | 92 | Pg | Fr | Waste | 1 | 0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 97 | 97 | Pg | Fr | Ore | 3 | 0.6 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 109 | 109 | Pg | Fr | Ore | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 122 | 122 | Pg | Fr | Ore | 10 | 1.9 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 2 | 0.4 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 131 | 131 | Pg | Fr | Waste | 9 | 1.8 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC212 - 143 | 143 | Py | Fr | Waste | 7 | 1.4 | <0.1 | <0.02 | 0.3 | 0.06 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 4 | 0.8 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11/09/2019 | FRC213 - 5 | 5 | Py | HW | Waste | 14 | 2.8 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 44 | 8.8 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC213 - 26 | 26 | Py | MW | Waste | 22 | 4.4 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 42 | 8.4 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC213 - 37 | 37 | Pg | HW | Waste | 25 | 5.0 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 20 | 4.0 | <0.1 | <0.02 | 0.3 | 0.06 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC213 - 58 | 58 | Py | SW | Waste | 11 | 2.2 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 5 | 1.0 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC213 - 62 | 62 | Pg | SW | Waste | 6 | 1.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 3 | 0.6 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC213 - 67 | 67 | Pg | SW | Waste | 14 | 2.8 | <0.1 | <0.02 | 0.3 | 0.1 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 19 | 3.8 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC213 - 86 | 86 | Pg | Fr | Waste | <1 | <0.2 | <0.1 | <0.02 | 0.3 | 0.06 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC213 - 107 | 107 | Sst | Fr | Waste | <1 | <0.2 | <0.1 | <0.02 | 1 | 0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 11/09/2019 | FRC213 - 131 | 131 | Py | Fr | Waste | <1 | <0.2 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC213 - 142 | 142 | Pg | Fr | Ore | 2 | 0.4 | <0.1 | <0.02 | 0.6 | 0.1 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 1 | 0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC213 - 148 | 148 | Pg | Fr | Ore | 4 | 0.8 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC213 - 156 | 156 | Pg | Fr | Ore | 2 | 0.4 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC213 - 170 | 170 | Pg | Fr | Ore | 4 | 0.8 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC213 - 178 | 178 | Pg | Fr | Ore | 2 | 0.4 | <0.1 | <0.02 | 0.1 | 0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | 0.3 | 0.05 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC213 - 187 | 187 | Py | Fr | Waste | 2 | 0.4 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 1 | 0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 14/09/2019 | FRC214 - 6 | 6 | Py | CW | Waste | 5 | 1.0 | <0.1 | <0.02 | 0.2 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 10 | 2.0 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC214 - 13 | 13 | Py/Qv | HW | Waste | 5 | 1.0 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 5 | 1.0 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC214 - 20 | 20 | Py | CW | Waste | 8 | 1.6 | <0.1 | <0.02 | 0.4 | 0.08 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 15 | 3.0 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC214 - 34 | 34 | Py | HW | Waste | 25 | 5.0 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 18 | 3.6 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC214 - 45 | 45 | Py | MW | Waste | 24 | 4.8 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 34 | 6.8 | <0.1 | <0.02 | 0.1 | 0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC214 - 50 | 50 | Py | SW | Waste | 2 | 0.4 | <0.1 | <0.02 | 0.5 | 0.1 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC214 - 74 | 74 | Py | Fr | Waste | 6 | 1.2 | <0.1 | <0.02 | 0.3 | 0.06 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | 3 | 0.6 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC214 - 102 | 102 | Pg | Fr | Ore | 8 | 1.6 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |
| 14/09/2019 | FRC214 - 116 | 116 | Pg | Fr | Waste | 2 | 0.4 | <0.1 | <0.02 | 0.2 | 0.04 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <1 | <0.2 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 | <0.1 | <0.02 |

| Sample details | | | | | | Tin | | Zinc | | Soluble Metals by ICPMS - Lithium | | Soluble Mercury by FIMS - Mercury | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Sample ID | Depth | Lithology | Weathering | Sample Type | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L | mg/kg | mg/L |
| | | | | | | 0.1 | | 0.1 | | 0.01 | | 0.0005 | |
| 10/09/2019 | NRC129 - 4 | 4 | Py | EW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | <0.01 | <0.002 | <0.0005 | <0.0001 |
| 10/09/2019 | NRC129 - 20 | 20 | Py | MW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.09 | 0.02 | <0.0005 | <0.0001 |
| 10/09/2019 | NRC129 - 55 | 55 | Py | SW | Waste | <0.1 | <0.02 | 0.7 | 0.14 | 2.1 | 0.43 | <0.0005 | <0.0001 |
| 10/09/2019 | NRC129 - 68 | 68 | Sst | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.66 | 0.13 | <0.0005 | <0.0001 |
| 10/09/2019 | NRC129 - 89 | 89 | Py | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 1.7 | 0.35 | <0.0005 | <0.0001 |
| 10/09/2019 | NRC129 - 98 | 98 | Pg | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.2 | 0.04 | <0.0005 | <0.0001 |
| 10/09/2019 | NRC129 - 134 | 134 | Py | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 3.2 | 0.64 | <0.0005 | <0.0001 |
| | | | | | | | | | | | | | |
| 10/09/2019 | FRC212 - 8 | 8 | Pg | HW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.02 | 0.004 | <0.0005 | <0.0001 |
| 10/09/2019 | FRC212 - 15 | 15 | Py | MW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.19 | 0.04 | <0.0005 | <0.0001 |
| 10/09/2019 | FRC212 - 44 | 44 | Py | MW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.31 | 0.06 | <0.0005 | <0.0001 |
| 10/09/2019 | FRC212 - 53 | 53 | Pg | MW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.10 | 0.02 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 66 | 66 | Py | SW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.92 | 0.18 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 81 | 81 | Pg | Fr | Waste | 0.2 | 0.04 | 1 | 0.20 | 0.97 | 0.19 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 88 | 88 | Py | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 1.6 | 0.32 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 92 | 92 | Pg | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.90 | 0.18 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 97 | 97 | Pg | Fr | Ore | <0.1 | <0.02 | <0.1 | <0.02 | 0.61 | 0.12 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 109 | 109 | Pg | Fr | Ore | <0.1 | <0.02 | <0.1 | <0.02 | 16 | 3.2 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 122 | 122 | Pg | Fr | Ore | <0.1 | <0.02 | <0.1 | <0.02 | 16 | 3.2 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 131 | 131 | Pg | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.39 | 0.08 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC212 - 143 | 143 | Py | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 2.2 | 0.44 | <0.0005 | <0.0001 |
| | | | | | | | | | | | | | |
| 11/09/2019 | FRC213 - 5 | 5 | Py | HW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.07 | 0.01 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC213 - 26 | 26 | Py | MW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.15 | 0.03 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC213 - 37 | 37 | Pg | HW | Waste | <0.1 | <0.02 | 0.1 | 0.02 | 0.06 | 0.01 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC213 - 58 | 58 | Py | SW | Waste | <0.1 | <0.02 | 0.1 | 0.02 | 0.75 | 0.15 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC213 - 62 | 62 | Pg | SW | Waste | <0.1 | <0.02 | 0.4 | 0.08 | 0.10 | 0.02 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC213 - 67 | 67 | Pg | SW | Waste | <0.1 | <0.02 | 0.6 | 0.12 | 0.09 | 0.02 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC213 - 86 | 86 | Pg | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.53 | 0.11 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC213 - 107 | 107 | Sst | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.84 | 0.17 | <0.0005 | <0.0001 |
| 11/09/2019 | FRC213 - 131 | 131 | Py | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 2.1 | 0.41 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC213 - 142 | 142 | Pg | Fr | Ore | <0.1 | <0.02 | <0.1 | <0.02 | 0.91 | 0.18 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC213 - 148 | 148 | Pg | Fr | Ore | <0.1 | <0.02 | <0.1 | <0.02 | 12 | 2.4 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC213 - 156 | 156 | Pg | Fr | Ore | <0.1 | <0.02 | <0.1 | <0.02 | 1.7 | 0.34 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC213 - 170 | 170 | Pg | Fr | Ore | <0.1 | <0.02 | <0.1 | <0.02 | 18 | 3.5 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC213 - 178 | 178 | Pg | Fr | Ore | <0.1 | <0.02 | 0.5 | 0.10 | 21 | 4.1 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC213 - 187 | 187 | Py | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 1.6 | 0.32 | <0.0005 | <0.0001 |
| | | | | | | | | | | | | | |
| 14/09/2019 | FRC214 - 6 | 6 | Py | CW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.08 | 0.02 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC214 - 13 | 13 | Py/Qv | HW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.07 | 0.01 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC214 - 20 | 20 | Py | CW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.06 | 0.01 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC214 - 34 | 34 | Py | HW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.16 | 0.03 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC214 - 45 | 45 | Py | MW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.20 | 0.04 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC214 - 50 | 50 | Py | SW | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.20 | 0.04 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC214 - 74 | 74 | Py | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.31 | 0.06 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC214 - 102 | 102 | Pg | Fr | Ore | <0.1 | <0.02 | <0.1 | <0.02 | 10 | 2.1 | <0.0005 | <0.0001 |
| 14/09/2019 | FRC214 - 116 | 116 | Pg | Fr | Waste | <0.1 | <0.02 | <0.1 | <0.02 | 0.86 | 0.17 | <0.0005 | <0.0001 |

# APPENDIX C – TCLP Results

| Sample details | | | | | | TCLP Leach | | | | Leachable Metals by ICPAES | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Sample ID | Depth | Lithology | Weathering | Sample Type | Initial pH | After HCl pH | Extraction Fluid Number | Final pH | Aluminium | Antimony | Arsenic | Cadmium | Chromium | Cobalt | Copper | Iron | Lead | Manganese | Nickel | Selenium | Tin | Zinc | Lithium | Mercury |
| | | | | | | pH Unit | pH Unit | | pH Unit | 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 |
| | | | | | | **0.1** | **0.1** | **1** | **0.1** | **0.1** | **0.1** | **0.1** | **0.05** | **0.1** | **0.1** | **0.1** | **0.1** | **0.1** | **0.1** | **0.1** | **0.05** | **0.1** | **0.1** | **0.001** | **0.001** |
| 10/09/2019 | NRC129 - 4 | 4 | Py | EW | Waste | 6.5 | 1.6 | 1 | 4.9 | 0.9 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.6 | <0.1 | <0.1 | <0.1 | <0.05 | <0.1 | 0.2 | 0.002 | <0.0010 |
| 10/09/2019 | NRC129 - 20 | 20 | Py | MW | Waste | 7.05 | 1.7 | 1 | 4.9 | 0.35 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 1.5 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | 0.2 | 0.0565 | <0.1 |
| 10/09/2019 | NRC129 - 55 | 55 | Py | SW | Waste | 8.5 | 1.7 | 1 | 4.9 | 0.4 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | 0.2 | 1.9 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.2 | 0.151 | <0.0010 |
| 10/09/2019 | NRC129 - 68 | 68 | Sst | Fr | Waste | 8.7 | 1.8 | 1 | 4.9 | 0.9 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 10.3 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.3 | 0.174 | <0.0010 |
| 10/09/2019 | NRC129 - 89 | 89 | Py | Fr | Waste | 8.5 | 1.7 | 1 | 4.9 | 1.2 | <0.1 | 0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 6.8 | <0.1 | 0.2 | 0.1 | <0.05 | <0.1 | 0.2 | 0.206 | <0.0010 |
| 10/09/2019 | NRC129 - 98 | 98 | Pg | Fr | Waste | 8.7 | 1.7 | 1 | 4.9 | 0.7 | <0.1 | 0.6 | <0.05 | <0.1 | <0.1 | <0.1 | 4 | <0.1 | 0.1 | <0.1 | <0.05 | <0.1 | 0.4 | 0.068 | <0.0010 |
| 10/09/2019 | NRC129 - 134 | 134 | Py | Fr | Waste | 9.2 | 1.5 | 1 | 4.9 | 1.5 | <0.1 | 0.3 | <0.05 | <0.1 | <0.1 | <0.1 | 9.8 | 0.3 | 0.4 | 0.1 | <0.05 | <0.1 | 0.3 | 0.519 | <0.0010 |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10/09/2019 | FRC212 - 8 | 8 | Pg | HW | Waste | 8 | 1.4 | 1 | 4.9 | 0.4 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 1.8 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.6 | 0.008 | <0.0010 |
| 10/09/2019 | FRC212 - 15 | 15 | Py | MW | Waste | 8.1 | 1.7 | 1 | 4.9 | 0.2 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.4 | <0.1 | 0.1 | <0.1 | <0.05 | <0.1 | 0.1 | 0.069 | <0.0010 |
| 10/09/2019 | FRC212 - 44 | 44 | Py | MW | Waste | 8.1 | 1.6 | 1 | 4.9 | 0.3 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.4 | <0.1 | 0.4 | <0.1 | <0.05 | <0.1 | 0.1 | 0.064 | <0.0010 |
| 10/09/2019 | FRC212 - 53 | 53 | Pg | MW | Waste | 8 | 1.5 | 1 | 4.9 | 0.6 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 1.6 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.1 | 0.014 | <0.0010 |
| 11/09/2019 | FRC212 - 66 | 66 | Py | SW | Waste | 8.5 | 1.6 | 1 | 4.9 | 0.7 | <0.1 | 0.2 | <0.1 | <0.1 | <0.1 | <0.1 | 8.75 | <0.1 | 0.2 | 0.1 | <0.1 | <0.1 | 0.2 | 0.148 | <0.1 |
| 11/09/2019 | FRC212 - 81 | 81 | Pg | Fr | Waste | 8.5 | 1.6 | 1 | 4.9 | 0.3 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 2.6 | <0.1 | 0.9 | <0.1 | <0.05 | <0.1 | 0.3 | 0.259 | <0.0010 |
| 11/09/2019 | FRC212 - 88 | 88 | Py | Fr | Waste | 8.5 | 1.6 | 1 | 4.9 | 1.1 | <0.1 | 1.2 | <0.05 | <0.1 | <0.1 | <0.1 | 6.5 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.2 | 0.329 | <0.0010 |
| 11/09/2019 | FRC212 - 92 | 92 | Pg | Fr | Waste | 9 | 1.5 | 1 | 4.9 | 0.8 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 7 | <0.1 | 0.3 | <0.1 | <0.05 | <0.1 | 0.4 | 0.205 | <0.0010 |
| 11/09/2019 | FRC212 - 97 | 97 | Pg | Fr | Ore | 9 | 1.5 | 1 | 4.9 | 0.8 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 6.6 | <0.1 | 0.3 | <0.1 | <0.05 | <0.1 | 0.4 | 0.221 | <0.0010 |
| 11/09/2019 | FRC212 - 109 | 109 | Pg | Fr | Ore | 9.2 | 1.5 | 1 | 4.9 | <0.1 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 29.7 | <0.1 | 5.4 | 0.1 | <0.05 | <0.1 | 0.8 | 2.03 | <0.0010 |
| 11/09/2019 | FRC212 - 122 | 122 | Pg | Fr | Ore | 9.3 | 1.5 | 1 | 4.9 | 0.65 | <0.1 | <0.1 | <0.05 | 0.1 | <0.1 | <0.1 | 26.7 | <0.1 | 0.4 | <0.1 | <0.05 | <0.1 | 0.6 | 2.06 | <0.0010 |
| 11/09/2019 | FRC212 - 131 | 131 | Pg | Fr | Waste | 9.1 | 1.5 | 1 | 4.9 | 1 | <0.1 | 0.3 | <0.05 | 0.1 | <0.1 | <0.1 | 20.8 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.6 | 0.17 | <0.0010 |
| 11/09/2019 | FRC212 - 143 | 143 | Py | Fr | Waste | 9 | 1.5 | 1 | 4.9 | 1.9 | <0.1 | 0.2 | <0.05 | <0.1 | <0.1 | <0.1 | 16.5 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.4 | 0.362 | <0.0010 |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11/09/2019 | FRC213 - 5 | 5 | Py | HW | Waste | 8 | 1.6 | 1 | 4.9 | 0.2 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.2 | <0.1 | <0.1 | <0.1 | <0.05 | <0.1 | 0.1 | 0.019 | <0.0010 |
| 11/09/2019 | FRC213 - 26 | 26 | Py | MW | Waste | 7.9 | 1.5 | 1 | 4.9 | 0.2 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.9 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.1 | 0.081 | <0.0010 |
| 11/09/2019 | FRC213 - 37 | 37 | Pg | HW | Waste | 7.9 | 1.6 | 1 | 4.9 | 0.4 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.7 | <0.1 | 1 | <0.1 | <0.05 | <0.1 | 0.3 | 0.046 | <0.0010 |
| 11/09/2019 | FRC213 - 58 | 58 | Py | SW | Waste | 8.3 | 1.6 | 1 | 4.9 | 0.4 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 4.8 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.2 | 0.136 | <0.0010 |
| 11/09/2019 | FRC213 - 62 | 62 | Pg | SW | Waste | 8.2 | 1.6 | 1 | 4.9 | 0.5 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 3.2 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.4 | 0.022 | <0.0010 |
| 11/09/2019 | FRC213 - 67 | 67 | Pg | SW | Waste | 8.3 | 1.7 | 1 | 4.9 | 0.3 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 1.6 | <0.1 | 0.4 | <0.1 | <0.05 | <0.1 | 0.4 | 0.032 | <0.0010 |
| 11/09/2019 | FRC213 - 86 | 86 | Pg | Fr | Waste | 8.75 | 1.6 | 1 | 4.9 | 0.85 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 8 | <0.1 | 0.1 | <0.1 | <0.05 | <0.1 | 0.2 | 0.1905 | <0.0010 |
| 11/09/2019 | FRC213 - 107 | 107 | Sst | Fr | Waste | 8.7 | 1.6 | 1 | 4.9 | 1.4 | <0.1 | 0.2 | <0.05 | <0.1 | <0.1 | <0.1 | 16.2 | <0.1 | 0.3 | <0.1 | <0.05 | <0.1 | 0.3 | 0.274 | <0.0010 |
| 11/09/2019 | FRC213 - 131 | 131 | Py | Fr | Waste | 9 | 1.6 | 1 | 4.9 | 1 | <0.1 | 0.2 | <0.05 | 0.1 | <0.1 | <0.1 | 22.5 | <0.1 | 0.4 | <0.1 | <0.05 | <0.1 | 0.3 | 0.319 | <0.0010 |
| 14/09/2019 | FRC213 - 142 | 142 | Pg | Fr | Ore | 8 | 1.3 | 1 | 5 | 0.4 | <0.1 | 0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 18.2 | <0.1 | 0.7 | <0.1 | <0.05 | <0.1 | 0.3 | 0.467 | <0.0010 |
| 14/09/2019 | FRC213 - 148 | 148 | Pg | Fr | Ore | 8.6 | 1.2 | 1 | 5 | 0.7 | <0.1 | <0.1 | <0.05 | 0.1 | <0.1 | <0.1 | 22.4 | <0.1 | 0.5 | <0.1 | <0.05 | <0.1 | 0.6 | 1.27 | <0.0010 |
| 14/09/2019 | FRC213 - 156 | 156 | Pg | Fr | Ore | 7.7 | 1.3 | 1 | 5.1 | 0.8 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 7.2 | <0.1 | 0.3 | <0.1 | <0.05 | <0.1 | 1.4 | 0.255 | <0.0010 |
| 14/09/2019 | FRC213 - 170 | 170 | Pg | Fr | Ore | 8.9 | 1.3 | 1 | 5.2 | 1.1 | <0.1 | <0.1 | <0.05 | 0.2 | <0.1 | <0.1 | 37.8 | <0.1 | 0.6 | <0.1 | <0.05 | <0.1 | 0.8 | 2.2 | <0.0010 |
| 14/09/2019 | FRC213 - 178 | 178 | Pg | Fr | Ore | 8.8 | 1.3 | 1 | 5 | 0.9 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 12.85 | <0.1 | 1.05 | <0.1 | <0.05 | <0.1 | 0.5 | 1.88 | <0.0010 |
| 14/09/2019 | FRC213 - 187 | 187 | Py | Fr | Waste | 8.8 | 1.2 | 1 | 5.2 | 2 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 9.6 | 0.2 | 0.3 | <0.1 | <0.05 | <0.1 | 0.6 | 0.291 | <0.0010 |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| 14/09/2019 | FRC214 - 6 | 6 | Py | CW | Waste | 7.4 | 1.3 | 1 | 4.9 | 0.2 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.1 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.1 | 0.022 | <0.0010 |
| 14/09/2019 | FRC214 - 13 | 13 | Py/Qv | HW | Waste | 7.4 | 1.4 | 1 | 4.9 | 0.2 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.1 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.2 | 0.024 | <0.0010 |
| 14/09/2019 | FRC214 - 20 | 20 | Py | CW | Waste | 6.2 | 1.3 | 1 | 4.9 | 0.2 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.05 | <0.1 | 0.1 | 0.02 | <0.0010 |
| 14/09/2019 | FRC214 - 34 | 34 | Py | HW | Waste | 6.4 | 1.3 | 1 | 4.9 | 0.3 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 5 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.1 | 0.086 | <0.0010 |
| 14/09/2019 | FRC214 - 45 | 45 | Py | MW | Waste | 6.9 | 1.3 | 1 | 4.9 | 0.3 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 4 | <0.1 | 0.3 | <0.1 | <0.05 | <0.1 | 0.1 | 0.081 | <0.0010 |
| 14/09/2019 | FRC214 - 50 | 50 | Py | SW | Waste | 7.6 | 1.3 | 1 | 4.9 | 0.8 | <0.1 | 0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 11.8 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.2 | 0.106 | <0.0010 |
| 14/09/2019 | FRC214 - 74 | 74 | Py | Fr | Waste | 7.9 | 1.3 | 1 | 4.9 | 0.6 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 12.4 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.1 | 0.17 | <0.0010 |
| 14/09/2019 | FRC214 - 102 | 102 | Pg | Fr | Ore | 8.4 | 1.4 | 1 | 5 | 0.8 | <0.1 | <0.1 | <0.05 | 0.2 | <0.1 | <0.1 | 37.6 | <0.1 | 1.2 | 0.1 | <0.05 | <0.1 | 0.6 | 1.09 | <0.0010 |
| 14/09/2019 | FRC214 - 116 | 116 | Pg | Fr | Waste | 8.2 | 1.4 | 1 | 4.9 | 1.3 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 | <0.1 | 12 | <0.1 | 0.2 | <0.1 | <0.05 | <0.1 | 0.5 | 0.213 | <0.0010 |

# APPENDIX D – Naturally Occurring Radioactive Materials (NORM)

| Sample details | | | | | | NORM | |
|---|---|---|---|---|---|---|---|
| Sample Date | Sample ID | Depth | Lithology | Weathering | Sample Type | Radeye B20 Contamination Meter Alpha/Beta/Gamma SN 32215 Calibrated 15/04/19 | |
| | | | | | | µSv/h | mSv/yr[1] |
| | | | | | | Bkd 0.10 | 0.22 |
| 10/09/2019 | NRC129 - 4 | 4 | Py | EW | Waste | 0.14 | 0.30 |
| 10/09/2019 | NRC129 - 20 | 20 | Py | MW | Waste | 0.13 | 0.27 |
| 10/09/2019 | NRC129 - 55 | 55 | Py | SW | Waste | 0.14 | 0.30 |
| 10/09/2019 | NRC129 - 68 | 68 | Sst | Fr | Waste | 0.13 | 0.28 |
| 10/09/2019 | NRC129 - 89 | 89 | Py | Fr | Waste | 0.12 | 0.26 |
| 10/09/2019 | NRC129 - 98 | 98 | Pg | Fr | Waste | 0.14 | 0.30 |
| 10/09/2019 | NRC129 - 134 | 134 | Py | Fr | Waste | 0.15 | 0.32 |
| | | | | | | | |
| 10/09/2019 | FRC212 - 8 | 8 | Pg | HW | Waste | 0.16 | 0.35 |
| 10/09/2019 | FRC212 - 15 | 15 | Py | MW | Waste | 0.14 | 0.30 |
| 10/09/2019 | FRC212 - 44 | 44 | Py | MW | Waste | 0.15 | 0.32 |
| 10/09/2019 | FRC212 - 53 | 53 | Pg | MW | Waste | 0.12 | 0.26 |
| 11/09/2019 | FRC212 - 66 | 66 | Py | SW | Waste | 0.18 | 0.38 |
| 11/09/2019 | FRC212 - 81 | 81 | Pg | Fr | Waste | 0.22 | 0.48 |
| 11/09/2019 | FRC212 - 88 | 88 | Py | Fr | Waste | 0.20 | 0.43 |
| 11/09/2019 | FRC212 - 92 | 92 | Pg | Fr | Waste | 0.15 | 0.32 |
| 11/09/2019 | FRC212 - 97 | 97 | Pg | Fr | Ore | 0.11 | 0.24 |
| 11/09/2019 | FRC212 - 109 | 109 | Pg | Fr | Ore | 0.17 | 0.37 |
| 11/09/2019 | FRC212 - 122 | 122 | Pg | Fr | Ore | 0.17 | 0.37 |
| 11/09/2019 | FRC212 - 131 | 131 | Pg | Fr | Waste | 0.15 | 0.32 |
| 11/09/2019 | FRC212 - 143 | 143 | Py | Fr | Waste | 0.17 | 0.37 |
| | | | | | | | |
| 11/09/2019 | FRC213 - 5 | 5 | Py | HW | Waste | 0.13 | 0.28 |
| 11/09/2019 | FRC213 - 26 | 26 | Py | MW | Waste | 0.17 | 0.37 |
| 11/09/2019 | FRC213 - 37 | 37 | Pg | HW | Waste | 0.14 | 0.30 |
| 11/09/2019 | FRC213 - 58 | 58 | Py | SW | Waste | 0.13 | 0.28 |
| 11/09/2019 | FRC213 - 62 | 62 | Pg | SW | Waste | 0.16 | 0.35 |
| 11/09/2019 | FRC213 - 67 | 67 | Pg | SW | Waste | 0.17 | 0.37 |
| 11/09/2019 | FRC213 - 86 | 86 | Pg | Fr | Waste | 0.14 | 0.30 |
| 11/09/2019 | FRC213 - 107 | 107 | Sst | Fr | Waste | 0.16 | 0.35 |
| 11/09/2019 | FRC213 - 131 | 131 | Py | Fr | Waste | 0.17 | 0.37 |
| 14/09/2019 | FRC213 - 142 | 142 | Pg | Fr | Ore | 0.11 | 0.24 |
| 14/09/2019 | FRC213 - 148 | 148 | Pg | Fr | Ore | 0.14 | 0.30 |
| 14/09/2019 | FRC213 - 156 | 156 | Pg | Fr | Ore | 0.15 | 0.32 |
| 14/09/2019 | FRC213 - 170 | 170 | Pg | Fr | Ore | 0.13 | 0.28 |
| 14/09/2019 | FRC213 - 178 | 178 | Pg | Fr | Ore | 0.17 | 0.36 |
| 14/09/2019 | FRC213 - 187 | 187 | Py | Fr | Waste | 0.19 | 0.41 |

| Sample details | | | | | | NORM | |
|---|---|---|---|---|---|---|---|
| Sample Date | Sample ID | Depth | Lithology | Weathering | Sample Type | Radeye B20 Contamination Meter Alpha/Beta/Gamma SN 32215 Calibrated 15/04/19 | |
| | | | | | | µSv/h | mSv/yr[1] |
| | | | | | | **Bkd 0.10** | **0.22** |
| 14/09/2019 | FRC214 - 6 | 6 | Py | CW | Waste | 0.22 | 0.48 |
| 14/09/2019 | FRC214 - 13 | 13 | Py/Qv | HW | Waste | 0.21 | 0.45 |
| 14/09/2019 | FRC214 - 20 | 20 | Py | CW | Waste | 0.15 | 0.32 |
| 14/09/2019 | FRC214 - 34 | 34 | Py | HW | Waste | 0.15 | 0.32 |
| 14/09/2019 | FRC214 - 45 | 45 | Py | MW | Waste | 0.19 | 0.41 |
| 14/09/2019 | FRC214 - 50 | 50 | Py | SW | Waste | 0.16 | 0.35 |
| 14/09/2019 | FRC214 - 74 | 74 | Py | Fr | Waste | 0.14 | 0.30 |
| 14/09/2019 | FRC214 - 102 | 102 | Pg | Fr | Ore | 0.18 | 0.39 |
| 14/09/2019 | FRC214 - 116 | 116 | Pg | Fr | Waste | 0.12 | 0.26 |

1. Calculated assuming exposure across a 1 year period using a 45 h working week on average

# APPENDIX E – Soil Characterisation

**APPENDIX E: Soil characterisation**

| Parameter | Units | LOR | NRC129 - 0 | FRC212 - 0 | FRC213 - 0 | FRC214 - 0 |
|---|---|---|---|---|---|---|
| **Sample Location** | | | | | | |
| Easting | | | 694439 | 694384 | 694362 | 694455 |
| Northing | | | 8593567 | 8593490 | 8593491 | 8593410 |
| **Sample Description** | | | | | | |
| Depth | | | 0 | 0 | 0 | 0 |
| Lithology | | | Soil (SO) | Soil (SO) | Soil (SO) | Soil (SO) |
| Color | | | Dark Gray | Light Olive Brown | Grayish Brown | Dark Gray |
| Texture | | | Sandy Loam | Sandy Clay Loam | Clay Loam | Loamy Sand |
| Weathering | | | Completely Weathered | Completely Weathered | Completely Weathered | Completely Weathered |
| **General** | | | | | | |
| Bulk Density | kg/m3 | 1 | 3180 | 3170 | 3160 | 2030 |
| Moisture Content | % | 0.1 | 3 | 0.4 | 1.1 | <0.1 |
| Emerson Class Number | | | 7 | 7 | 7 | 7 |
| pH Value | pH Unit | 0.1 | 5.7 | 5.7 | 5.8 | 5.3 |
| Electrical Conductivity @ 25Â°C | ÂµS/cm | 1 | 17 | 33 | 17 | 14 |
| **Particle sizing** | | | | | | |
| +75Âµm | % | 1 | 67 | 61 | ---- | 65 |
| +150Âµm | % | 1 | 37 | 36 | ---- | 26 |
| +300Âµm | % | 1 | 19 | 26 | ---- | 8 |
| +425Âµm | % | 1 | 16 | 25 | ---- | 5 |
| +600Âµm | % | 1 | 14 | 24 | ---- | 3 |
| +1180Âµm | % | 1 | 13 | 22 | ---- | <1 |
| +2.36mm | % | 1 | 12 | 19 | ---- | <1 |
| +4.75mm | % | 1 | 10 | 14 | ---- | <1 |
| +9.5mm | % | 1 | 2 | 2 | ---- | <1 |
| +19.0mm | % | 1 | <1 | <1 | ---- | <1 |
| +37.5mm | % | 1 | <1 | <1 | ---- | <1 |
| +75.0mm | % | 1 | <1 | <1 | ---- | <1 |
| **Classification based on particle size** | | | | | | |
| Clay (<2 Âµm) | % | 1 | 11 | 9 | ---- | 7 |
| Silt (2-60 Âµm) | % | 1 | 18 | 23 | ---- | 22 |
| Sand (0.06-2.00 mm) | % | 1 | 59 | 48 | ---- | 71 |
| Gravel (>2mm) | % | 1 | 12 | 20 | ---- | <1 |
| Cobbles (>6cm) | % | 1 | <1 | <1 | ---- | <1 |
| **Exchangeable Cations** | | | | | | |
| Cation Exchange Capacity | meq/100g | 0.1 | 0.6 | 0.9 | 0.6 | 0.3 |
| Exchangeable Calcium | meq/100g | 0.1 | 0.2 | 0.4 | 0.2 | <0.1 |
| Exchangeable Magnesium | meq/100g | 0.1 | 0.4 | 0.4 | 0.4 | 0.2 |
| Exchangeable Potassium | meq/100g | 0.1 | <0.1 | 0.1 | <0.1 | <0.1 |
| Exchangeable Sodium | meq/100g | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Exchangeable Aluminium | meq/100g | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Exchangeable Sodium Percentage | % | 0.1 | n/a | n/a | n/a | n/a |
| Calcium/Magnesium Ratio | | 0.1 | 0.5 | 1 | 0.5 | n/a |
| **Total Metals by ICP-MS** | | | | | | |
| Arsenic | mg/kg | 0.1 | 6 | 14.9 | 5.7 | 0.8 |
| Cadmium | mg/kg | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Chromium | mg/kg | 0.1 | 5.1 | 12.3 | 6 | 1.9 |
| Copper | mg/kg | 0.1 | 2.5 | 5.2 | 2.9 | 0.9 |
| Nickel | mg/kg | 0.1 | 2.4 | 4.7 | 3 | 0.9 |
| Lead | mg/kg | 0.1 | 4.3 | 5.6 | 4.1 | 1.8 |
| Zinc | mg/kg | 0.5 | 3.9 | 11.7 | 6.5 | 1.7 |
| Lithium | mg/kg | 0.1 | 7.6 | 33.1 | 13.9 | 7 |
| Tin | mg/kg | 0.1 | 0.8 | 0.8 | 0.6 | 0.4 |
| Mercury | mg/kg | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **Nutrients** | | | | | | |
| Nitrite + Nitrate as N (Sol.) | mg/kg | 0.1 | 0.7 | <0.1 | <0.1 | 0.3 |
| Total Kjeldahl Nitrogen as N | mg/kg | 20 | 790 | 780 | 470 | 410 |
| Total Nitrogen as N | mg/kg | 20 | 790 | 780 | 470 | 410 |
| Bicarbonate Ext. P (Colwell) | mg/kg | 5 | <5 | <5 | <5 | <5 |
| Bicarbonate Extractable K (Colwell) | mg/kg | 100 | 129 | 135 | 341 | <100 |
| KCl Extractable Sulfur (23Ce) | % S | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| **Organic Matter** | | | | | | |
| Organic Matter | % | 0.5 | 2 | 1.3 | 1.3 | 1 |
| Total Organic Carbon | % | 0.5 | 1.1 | 0.8 | 0.7 | 0.6 |

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# Static Geochemical Testing of Mine Wastes & Ore

Finniss Lithium Project BP33 UG Mine

S1312 / J000662 / R1428

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DOCUMENT NUMBER: S1312 / J000662 / R1428

# Static Geochemical Testing of Mine Wastes & Ore

## FINNISS LITHIUM PROJECT BP33 UG MINE

| DOCUMENT STATUS AND REVIEW | | | | |
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| 0 | First Issue | RS | WAS | 05/07/2021 |
| 1 | Final Report | RS | WAS | 14/07/2021 |
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# LIST OF ABBREVIATIONS

## ABBREVIATIONS USED IN GEOCHEMICAL ASSESSMENT

| | |
|---|---|
| **ARD** | Acid Rock Drainage |
| **AMD** | Acid, Metalliferous and Saline Drainage |
| **NMD** | Neutral and Metalliferous Drainage |
| **ABA** | Acid Base Account |
| **$pH_{1:2}$** | pH of a sample slurry with a solid to water ratio of 1:2 (by weight) |
| **$EC_{1:2}$** | Electrical Conductivity of a sample slurry with a solid to water ratio of 1:2 (by weight) |
| **ESP** | Exchangeable Sodium Percentage |
| **ECEC** | Effective Cation Exchange Capacity |
| **S** | Sulphur |
| **CRS** | Chromium Reducible Sulphur |
| **KCl** | Potassium Chloride |
| **$H_2SO_4$** | Sulphuric Acid |
| **$SO_4$** | Sulphate |
| **$CaCO_3$** | Calcium Carbonate |
| **ANC** | Acid Neutralising Capacity in kg $H_2SO_4$/t |
| **$ANC_{ABCC}$** | Acid Neutralising Capacity in kg $H_2SO_4$/t estimated from ABCC testing |
| **CNV** | Carbonate Neutralising Value in kg $H_2SO_4$/t |
| **MPA** | Maximum Potential Acidity, calculated from total S in kg $H_2SO_4$/t |
| **NAPP** | Net Acid Producing Potential, calculated from ANC and total S (or MPA) in kg $H_2SO_4$/t. |
| **NAG** | Net Acid Generation (test) |
| **NAGpH** | pH of NAG solution before titration |
| **$NAG_{(pH4.5)}$** | NAG acidity titrated to pH 4.5 in kg $H_2SO_4$/t |
| **$NAG_{(pH7.0)}$** | NAG acidity titrated to pH 7.0 in kg $H_2SO_4$/t |
| **ABCC** | Acid Buffering Characteristic Curve |
| **GAI** | Geochemical Abundance Index based on multi-elements of solids |
| **PAF** | Potentially Acid Forming |
| **PAF-LC** | Potentially Acid Forming - Low Capacity |
| **NAF** | Non Acid Forming |
| **UC** | Uncertain |
| **AC** | Acid Consuming |

## UNITS OF MEASUREMENTS

| | |
|---|---|
| **%** | Percentage |
| **°C** | Degrees Celsius |
| **dS** | Deci Siemen |
| **µm** | Micrometre |
| **mm** | Millimetre |
| **m** | Metre |
| **mg** | Milligram |
| **g** | Gram |
| **kg** | Kilogram |
| **t** | Tonne |
| **L** | Litre |
| **ml** | Millilitre |

## OTHER ABBREVIATIONS

| | |
|---|---|
| **ALS** | Australian Laboratory Services |
| **EGi** | Environmental Geochemistry International Pty Ltd |
| **IRL** | International Resource Laboratories Pty Ltd |
| **Project** | Hunter Valley Operations Life-of-Mine Project |
| **ROM** | Run-of-Mine |

# EXECUTIVE SUMMARY

Previously, Environmental Geochemistry International Pty Ltd (EGi) were commissioned by EcOz Environmental Consultants to undertake data analysis, interpretation and reporting on physical and geochemical analysis results for drill core samples collected from the Core Lithium BP33 project. The results of this study were included in Core Lithium's submissions for mining approvals. The results from the initial test programme suggested that most waste rock, including oxide rock excavated during installation of a box cut portal, transitional and fresh rock excavated during construction of the mine decline and ore that will be mined during the project, will present little risk of acid or saline drainage. However, these investigations identified the potential for some potentially acid forming (PAF) waste, particularly in fresh phyllite rock. Results also suggested that both oxide and fresh rock may contain labile aluminium, arsenic and zinc which could be leached during surface storage.

In the NT EPA's response to the referral document, a Supplementary Environmental Report (SER) was requested. In relation to waste rock characterisation, their response requested that the additional studies should be undertaken and reported as a part of the SER. Consequently, EcOZ who are coordinating the SER on behalf of Core Lithium, requested EGi to undertake the following studies.

1. Complete ANC and NAG testing on selected samples from drill holes FRC166 – FRC171, focusing on, but not exclusively, samples with sulphur content >0.2 %S. Ideally all fresh and transitional waste rock from the 2018 drill holes should be included in the test program.
2. Kinetic testing (leach columns) of oxidised and fresh rock samples to confirm initial results of aluminium, arsenic and zinc leachability and to define the kinetics of this process. Kinetic leach column (KLC) testing conducted under oxidising conditions to simulate conditions during storage in the waste rock dumps (WRD) and in the unsaturated zones within the backfilled UG mine and box cut. Following a period of leaching under oxidising conditions, KLC tests will be conducted under saturated conditions to simulate the leaching properties of backfilled waste which will be placed below the water table upon rebound.

At the time of the current study, samples from the previous investigations were no longer available for further testing. Consequently, an alternate set of 69 samples were obtained from drilling programmes conducted during 2018 and 2019, from which 47 samples were selected for detailed static geochemical testing to meet the requirements of Task 1.

During December 2020 and January 2021, Core Lithium undertook further drilling at the BP33 project. This programme included three diamond drill holes, two of which intersected waste rock to a depth of around 70 m, which will be excavated during construction of the box cut. A third hole to a depth around 350 m, and intersecting waste rock and ore which will be mined during development of the decline and ore extraction, was also drilled as a part of this programme. Twenty-nine samples were obtained from these three drill holes to investigate the suitability of these materials for kinetic testing to meet the requirements of Task 2.

This report provides results for test work conducted for Task 1 above. From these results, criteria were developed to distinguish between non-acid forming (NAF), potentially acid forming – low capacity (PAF-LC) and PAF waste rock and ore. Using these criteria, and a database containing assay data and geological descriptions for over 2500 samples from the BP33 deposit, volumes of NAF, PAF-LC and PAF waste and ore were estimated.

The report also describes results from batch leaching tests under both oxidising and non-oxidising conditions to better define the likely quality of seepage from waste rock stockpiles. These tests can provide insight into elements of concern that may be potentially mobilised during surface storage, but they do not provide understanding of rates of reactivity and likely mobility of various metals and metalloids under field conditions. To obtain this information longer-term leach column testing is being conducted which provides insight into the rate of reactions under conditions

which are closer to field conditions than are provided in the short-term batch leach tests. Column leach tests have now commenced and are expected to be completed in around 12 months.

Preliminary testing was also undertaken on oxide, transition and fresh waste rock samples to define their geochemical properties and to ascertain the representativeness of these materials of waste rock which will be stockpiled in WRD and then backfilled in mine voids, and thereby their suitability for KLC testing (Task 2). Results for this preliminary testing are also reported.

Based on the results of geochemical testing of 144 samples from both the current and earlier test programmes, criteria were developed to identify NAF, PAF-LC and PAF waste rock and ore. These criteria are summarised in the table below. The criteria rely on oxidation and Total S content to classify mined materials according to their acid forming potential. While it is anticipated that there will be some overlap between the classifications, it is expected that the listed criteria can be used to provide a reasonable segregation of waste rock and ore according to their likelihood to produce acid as a consequence of exposure to air during surface storage.

The assay database was analysed to define the distribution of Total S among the various categories of materials including type (ore, waste), lithology and oxidation for waste rock samples. The results show that 99.8% of the sample interval represented by ore samples contain less than 0.2% Total S, supporting the acid rock drainage (ARD) classification criteria suggesting all ore can be classified as NAF. Similarly, 100% of the sample intervals representing oxide rock had a Total S content of below 0.2%, also supporting the classification of all oxide rock as NAF.

| **ARD Classification** | **Criteria** |
|---|---|
| NAF | Ore *OR*<br>Oxide waste rock *OR*<br>Transition and fresh waste rock with Total S <0.2% |
| PAF-LC | Transition and fresh waste rock with Total S ≥0.2% and <0.4% |
| PAF | Transition and fresh waste rock with Total S ≥0.4% |

Calculations used to estimate volumes of waste rock and ore indicated that the ARD properties of mined materials at the BP33 projects can be summarised as follows:

- Oxide rock excavated from the box cut and which will be placed in WRD1 is expected to be NAF;
- Ore that will be stored in the ROM pad while awaiting transport to the processing plant is expected to be NAF; and
- Estimates indicate that only around 15,000 tonnes of PAF-LC and PAF waste will be moved to WRD2 through the life of the mine out of a total of 229,000 tonnes of transition and fresh waste rock which will be mined, with most of the 15,000 tonnes likely to be classified as PAF-LC with limited acid producing potential.

These results suggest that all of the stockpiled mine materials (oxide waste in WRD1, transition and fresh waste in WRD2, ore in the ROM pad) will present little risk of producing acidic metalliferous drainage as a result of short-term surface storage during the mining operation.

The results of water extraction tests conducted on ore samples showed:

- Water extracts for the ore samples were slightly alkaline with low salinity;

- Except for Al and Fe, metal and metalloid concentrations were non-detectable in almost all of the water extracts of the ore samples;
- On average, concentrations of Al in ore water extracts were about an order of magnitude higher than the default ANZECC guideline values (DGV) for freshwater systems. Similarly, the concentrations of Al in ore water extracts were in the order of ten times those measured in both nearby surface water and shallow groundwater at the adjacent Grants project. These results suggest that Al in run-off from ore stockpiled in the ROM pad may present an environmental risk; and
- As the ore samples are all likely to be NAF and therefore unlikely to produce acidic drainage, stockpiled ore may not require any specific management to reduce potential impacts from run-off. However, since the results from water extractions indicate a potential risk from elevated Al concentrations in run-off, the likelihood of this risk should be evaluated at site, and it is recommended that any run-off from the ROM stockpile should be monitored and containment of run-off undertaken as required.

The results of water extraction tests conducted on waste rock samples showed:

- Oxide waste rock stored in WRD1, or transition and fresh waste rock stored in WRD2 would be unlikely to produce low pH saline seepage during short-term surface storage.
- The mobility of Al in all waste rock and As in fresh waste rock on contact with water, could potentially result in elevated concentrations of these elements in seepage from WRD1 (Al only) and WRD2 (Al and As) during short-term surface storage.
- Concentrations of As in water extracts of transition and fresh waste rock were of a similar magnitude to those measured in the groundwater collected from bores sampling the deeper aquifer within the Burrell Creek Formation (BCF) at the nearby Grants project. These results suggest that, on backfilling the mine with fresh waste rock that has not undergone extensive weathering, groundwater should not be significantly impacted in terms of mobilisation of As.

The results from kinetic leach column testing will help to confirm if leaching of Al and As from waste rock has the potential to provide any risk to the environment during surface storage in the WRD.

The results of peroxide extraction tests conducted on waste rock samples showed:

- Should substantial oxidation of fresh waste rock occur during surface storage, the concentrations of a number of metals/metalloids including Al, As, Co, Cr, Cu, U and Zn may by elevated in comparison to desirable environmental conditions, and seepage from the WRD could potentially represent a risk of contaminating the receiving environment.

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.

Comparison of the combined geochemical test results for the oxide, transition and fresh composite waste rock samples proposed for use in KLC testing with results for the corresponding waste types from all drill holes, suggests that these composite samples are representative of waste to be stored in the WRD at the BP33 project. Kinetic leach column tests using these samples should therefore deliver results which will provide a good indication of the quality of seepage that may result during surface storage of waste and the mobility of solutes in the waste following backfill and inundation by recovering groundwater.

The following recommendations follow from the results of this study:

- Kinetic leach column tests should be completed as proposed including operation under oxidising conditions to simulate conditions during storage in the WRD and in the unsaturated zones within the backfilled UG mine and box cut. Following a period of leaching under oxidising conditions, KLC tests should be continued under saturated conditions to simulate the leaching properties of backfilled waste which will be placed below the water table upon rebound.
- Groundwater monitoring t BP33 (both shallow alluvial and deeper BCF aquifers) should be on-going to provide baseline water quality data for comparison with column leachate data collected during leach column testing.
- Similarly, collection of surface water quality should continue to provide baseline water quality data for comparison with KLC test results.
- The results from static and kinetic geochemical testing should be used to conduct an ARD/Neutral Mine Drainage (NMD) risk assessment which can be applied in developing an ARD/NMD management plan for the operation.

# 1. INTRODUCTION

The BP33 deposit is a part of Core's Finniss Lithium Project, located in the Northern Territory on the Cox Peninsula, approximately 23 km southwest of Darwin or 90 km by road. The BP33 proposal involves excavation of a box cut portal to a depth of 60 m and construction of a 400 m long decline from the base of the box cut to access the spodumene deposit located beneath the historically worked open pit.

Two separate waste rock dumps (WRD) will be established for temporary storage of waste rock prior to it being used to backfill the underground mine and box-cut. WRD 1 with a design capacity of 2 million $m^3$ will accept oxide waste rock excavated from the box-cut. WRD 2 with a design capacity of 170,000 $m^3$ will accept transitional and fresh waste rock from the underground. Waste rock from WRD2 will be used to progressively backfill the underground mine as each production level is complete to maintain stability as the mine progresses. Ore mined at BP33 will be transported to the Grants processing facility approximately 7 km to the north-west. A ROM pad will be constructed for temporary storage of mined ore ready for transport to the Grants processing facility. Tailings will be deposited in the Tailings Storage Facility constructed as part of the Grants Project.

Previously, Environmental Geochemistry International Pty Ltd (EGi) were commissioned by EcOz Environmental Consultants to undertake data analysis, interpretation and reporting on physical and geochemical analysis results for drill core samples collected from the Core Lithium BP33 project. This work formed a part of an Environment Protection Act Referral submitted to the NT Environmental Protection Authority (NT EPA) in April 2020 for development of the BP33 Underground mine.

The results from the initial test programme suggested that most waste rock, including oxide and transitional rock excavated during installation of a box cut portal, transitional and fresh rock excavated during construction of the mine decline and ore that will be mined during the project, will present little risk of acid or saline drainage. However, these investigations identified the potential for some potentially acid forming (PAF) waste, particularly in fresh phyllite rock. Results also suggested that both oxide and fresh rock may contain labile aluminium, arsenic and zinc which could be leached during surface storage. As a result of these investigations, EGi recommended the following test work should be conducted to clarify potential environmental issues raised from the study:

- Complete ANC and NAG testing on selected samples from drill holes FRC166 – FRC171, focusing on, but not exclusively, samples with sulphur content >0.2 %S. Ideally all fresh and transitional waste rock from the 2018 drill holes should be included in the test program.
- Kinetic testing (leach columns) of oxidised and fresh rock samples to confirm initial results of aluminium, arsenic and zinc leachability and to define the kinetics of this process. Kinetic leach column (KLC) testing should be conducted under oxidising conditions to simulate conditions during storage in the WRD and in the unsaturated zones within the backfilled UG mine and box cut. Following a period of leaching under oxidising conditions, KLC tests should be conducted under saturated conditions to simulate the leaching properties of backfilled waste which will be placed below the water table upon rebound.

In the NT EPA's response to the referral document, a Supplementary Environmental Report (SER) was requested. In relation to waste rock characterisation, their response requested that the additional studies outlined above should be undertaken and reported as a part of the SER. Consequently, EcOZ who are coordinating the SER on behalf of Core Lithium, requested EGi to undertake the required studies as described in Attachment A, Section 8 Terrestrial environmental quality in the NT EPA referral response.

At the time of the current study, samples from the previous investigations were no longer available for further testing. Consequently, an alternate set of 69 samples were obtained from drilling programmes conducted during 2018 and 2019, from which 47 samples were selected for detailed static geochemical testing. Samples were selected from both waste and ore and covered a range of lithologies, including phyllite, pegmatite and sandstone, focusing on fresh rock with a sulphur content above 0.1%, which were under-represented in the initial geochemical tests and in accordance with the testing requirements of the NT EPA response.

During December 2020 and January 2021, Core Lithium undertook further drilling at the BP33 project. This programme was designed to provide samples for geotechnical testing, and included three diamond drill holes, two of which intersected waste rock to a depth of around 70 m, which will be excavated during construction of the box cut. A third hole to a depth around 350 m, and intersecting waste rock and ore which will be mined during development of the decline and ore extraction, was also drilled as a part of this programme. Twenty nine samples were obtained from these three drill holes to investigate the suitability of these materials for kinetic testing which requires crushed rock available from diamond drill core. Based on assay data, four oxide samples, four transition samples and five fresh samples were composited to produce oxide, transition and fresh rock samples, which subsequently underwent geochemical testing together with the 47 samples selected from earlier drill holes. The results from testing of the three composite samples were used to confirm these samples are likely to be representative of oxide, transition and fresh waste rock which will be temporarily surface stored in WRD prior to return to the underground mine and box cut. Kinetic testing is planned using oxide, transition and fresh rock in accordance with the testing requirements of the NT EPA referral response.

This report describes results of static geochemical testing conducted using fresh waste rock and ore samples, focusing on samples with a sulphur content above 0.1%. The results of this study were then combined with the results from geochemical tests conducted previously, in which most samples contained limited sulphur (<0.1%). Using the combined data set containing 144 samples, criteria were developed to allow identification of non-acid forming (NAF), potentially acid forming – low capacity (PAF-LC) and PAF materials, based around oxidation, type (waste, ore) and Total S content. Using these criteria and a database containing assay data and geological descriptions for around 2500 samples, volumes of NAF, PAF-LC and PAF waste rock and ore were estimated.

Ten samples of fresh higher S waste rock, including the three composite samples selected as potential candidates for kinetic testing, were subjected to batch leaching tests, using water to assess leachability of newly deposited waste, and peroxide to assess leaching from oxidised waste following surface exposure. The results from these leaching tests, which included NAF, PAF-LC and PAF wastes, where then combined with batch water leaching tests from the earlier test programme and which comprised almost exclusively NAF wastes and ore, to assess the leaching characteristics of waste rock and ore as a function of oxidation, lithology and ARD classification.

Finally, results from geochemical testing of the oxide, transition and fresh waste rock composite samples, including acid base accounting (ABA), net acid generation (NAG) testing, assay data and water and peroxide leaching experiments are described and compared with the results from the wider sample set, to evaluate how likely these composite materials are to represent materials which will be mined during the BP33 project and assess their suitability for kinetic testing.

# 2. STATIC GEOCHEMICAL TESTING

A number of pulp samples from previous drilling campaigns were available for the current test work. From this set of samples, a set of 47 samples were selected for detailed static geochemical testing. Samples were selected from both waste and ore and covered a range of lithologies, including phyllite, pegmatite and sandstone, focusing on fresh rock with a sulphur content above 0.1% (Table 1), which were under-represented in the initial geochemical tests. Figures 1 and 2 show plan and section views of the drill traces for the drill holes in relation to the ore body from which samples were selected.

*Table 1: Details of the samples used for current static geochemical test programme*

| EGi Code | Hole ID | Sample ID | Depth (m) | | Interval (m) | Lithology | Oxidation | Type |
|---|---|---|---|---|---|---|---|---|
| | | | From | To | | | | |
| 21086 | FDD008 | B1174 | 326 | 327 | 1.0 | Phyllite | Fresh | Waste |
| 21087 | FRC164 | A3428 | 139 | 140 | 1.0 | Pegmatite | Fresh | Waste |
| 21088 | FRC164 | A3429 | 140 | 141 | 1.0 | Pegmatite | Fresh | Waste |
| 21089 | FRC164 | A3430 | 141 | 142 | 1.0 | Pegmatite | Fresh | Ore |
| 21090 | FRC164 | A3435 | 145 | 148 | 3.0 | Phyllite | Fresh | Waste |
| 21091 | FRC166 | A3512 | 212 | 213 | 1.0 | Phyllite | Fresh | Waste |
| 21093 | FRC167 | A3515 | 124 | 125 | 1.0 | Pegmatite | Fresh | Waste |
| 21094 | FRC167 | A3516 | 125 | 126 | 1.0 | Pegmatite | Fresh | Waste |
| 21095 | FRC167 | A3517 | 126 | 129 | 3.0 | Phyllite | Fresh | Waste |
| 21097 | FRC168 | A3627 | 108 | 109 | 1.0 | Phyllite | Fresh | Waste |
| 21098 | FRC168 | A4408 | 109 | 110 | 1.0 | Phyllite | Fresh | Waste |
| 21099 | FRC168 | A4409 | 110 | 111 | 1.0 | Phyllite | Fresh | Waste |
| 21101 | FRC169 | A3629 | 66 | 69 | 3.0 | Phyllite | Fresh | Waste |
| 21102 | FRC169 | A3630 | 69 | 70 | 1.0 | Phyllite | Fresh | Waste |
| 21103 | FRC169 | A3632 | 70 | 71 | 1.0 | Phyllite | Fresh | Waste |
| 21106 | FRC172 | A3764 | 186 | 187 | 1.0 | Pegmatite | Fresh | Waste |
| 21107 | FRC172 | A3795 | 219 | 222 | 3.0 | Phyllite | Fresh | Waste |
| 21108 | FRC172 | A3796 | 222 | 223 | 1.0 | Phyllite | Fresh | Waste |
| 21109 | FRC172 | A3797 | 223 | 224 | 1.0 | Phyllite | Fresh | Waste |
| 21110 | FRC172 | A3798 | 224 | 225 | 1.0 | Pegmatite | Fresh | Waste |
| 21112 | FRC174 | A3972 | 190 | 191 | 1.0 | Phyllite | Fresh | Waste |
| 21114 | FRC203 | C3610 | 81 | 82 | 1.0 | Sandstone | Fresh | Waste |
| 21115 | FRC205 | C3617 | 138 | 141 | 3.0 | Sandstone | Fresh | Waste |
| 21116 | FRC205 | C3669 | 184 | 185 | 1.0 | Pegmatite | Fresh | Ore |
| 21118 | FRC205 | C3696 | 207 | 208 | 1.0 | Pegmatite | Fresh | Ore |
| 21119 | FRC205 | C3697 | 208 | 209 | 1.0 | Pegmatite | Fresh | Waste |
| 21122 | FRC205 | C3709 | 218 | 219 | 1.0 | Pegmatite | Fresh | Waste |
| 21123 | FRC206 | C3782 | 137 | 138 | 1.0 | Phyllite | Fresh | Waste |
| 21125 | FRC212 | A6714 | 88 | 89 | 1.0 | Phyllite | Fresh | Waste |
| 21126 | FRC213 | A6787 | 68 | 69 | 1.0 | Phyllite | Transition | Waste |
| 21129 | FRCD016 | B1053 | 276.2 | 277 | 0.8 | Phyllite | Fresh | Waste |
| 21130 | NRC057 | A4851 | 105 | 106 | 1.0 | Phyllite | Fresh | Waste |
| 21132 | NRC057 | A4854 | 108 | 109 | 1.0 | Phyllite | Fresh | Waste |
| 21134 | NRC057 | A4857 | 111 | 112 | 1.0 | Phyllite | Fresh | Waste |
| 21135 | NRC057 | A4858 | 112 | 113 | 1.0 | Pegmatite | Fresh | Waste |
| 21138 | NRC057 | A4869 | 122 | 123 | 1.0 | Sandstone | Fresh | Waste |
| 21140 | NRC057 | A4873 | 125 | 126 | 1.0 | Pegmatite | Fresh | Waste |
| 21141 | NRC057 | A4875 | 127 | 128 | 1.0 | Pegmatite | Fresh | Waste |
| 21143 | NRC129 | A6640 | 93 | 96 | 3.0 | Pegmatite | Fresh | Waste |
| 21144 | NRC148 | A6967 | 246 | 247 | 1.0 | Pegmatite | Fresh | Waste |
| 21145 | NRC148 | A6968 | 247 | 250 | 3.0 | Phyllite | Fresh | Waste |
| 21146 | NRC148 | A6969 | 250 | 253 | 3.0 | Phyllite | Fresh | Waste |
| 21148 | NRC148 | A6977 | 258 | 261 | 3.0 | Phyllite | Fresh | Waste |
| 21149 | NRC148 | A6983 | 274 | 275 | 1.0 | Pegmatite | Fresh | Waste |
| 21151 | NRC148 | A6985 | 276 | 277 | 1.0 | Pegmatite | Fresh | Waste |
| 21152 | NRC148 | A6992 | 281 | 282 | 1.0 | Pegmatite | Fresh | Waste |
| 21153 | NRC148 | A6993 | 282 | 283 | 1.0 | Pegmatite | Fresh | Waste |

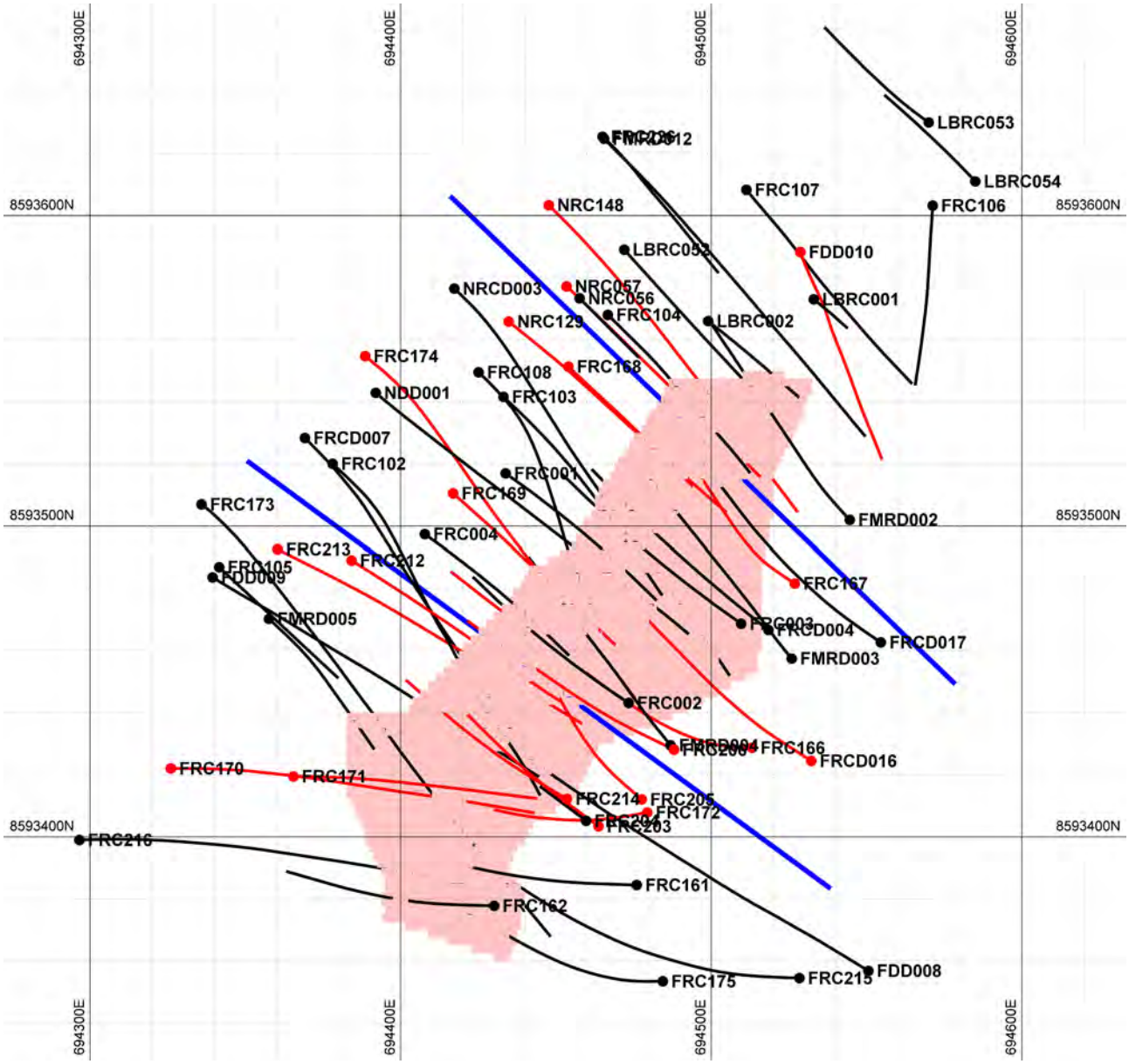


*Figure 1: Plan view showing drill hole traces for the BP33 project. Drill hole traces shown in red are for holes from which samples were collected for testing during the current study. The current resource block model is highlighted in pink. The two blue lines show the locations for sections shown in Figure 2 below.*

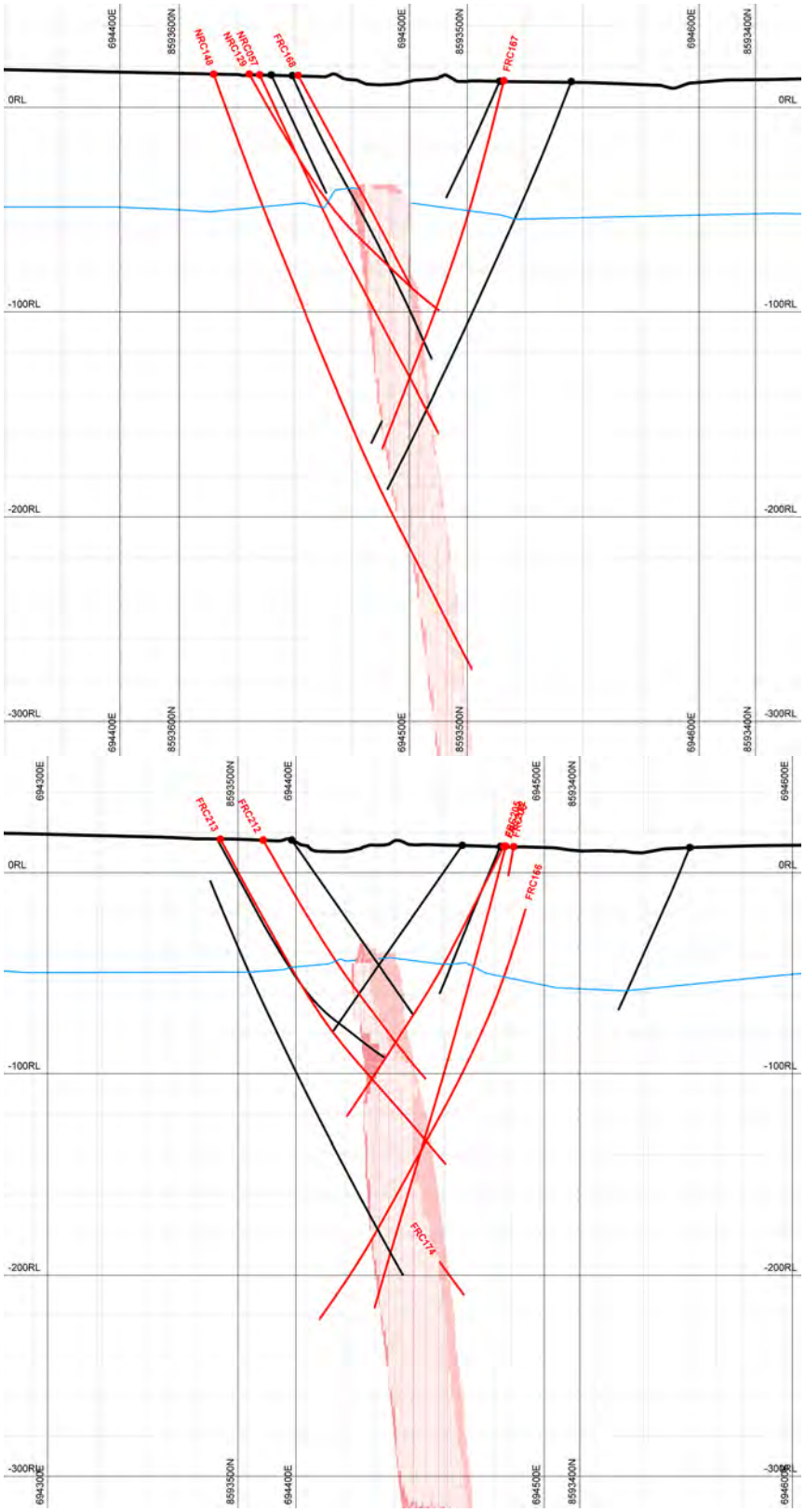


*Figure 2: Section views showing drill hole traces for the BP33 project. Traces shown in red are for holes from which samples were collected for testing during the current study. The current resource block model is highlighted in pink. The light blue line shows the top of the fresh rock profile.*

## 2.1. ABA and NAG testing: Current test samples

Geochemical testing conducted on 47 samples included Total S, carbon speciation (Total C, Organic C, Inorganic C), ANC and NAG tests. Additional testing including CRS which gives a measure of pyritic sulphur content and ABCC testing which provides a measure of readily available neutralising capacity was also conducted on 10 of the samples. The full set of results for these tests are provided in Appendix A (Table A1).

Total S values for the samples examined ranged from 0.1 to 1.1 % showing little variation between lithologies, with average Total S of 0.26, 0.31 and 0.18% for pegmatite, phyllite and sandstone respectively. However, samples with the highest sulphur content were all phyllites. The neutralising potential of these materials appears to be low to moderate with average ANC around 10 kg $H_2SO_4$/t, ranging from 4 to 27 kg $H_2SO_4$/t and with little variation between lithologies.

NAGpH ranged from 2.7 to 9.0, with most samples giving a pH between 3 and 4.5 after digestion with peroxide. Many of these samples gave a negative net acid producing potential (NAPP) value based on Total S and standard ANC measurements, which meant these materials plotted in the uncertain region of the ARD classification plot (Figure 3).

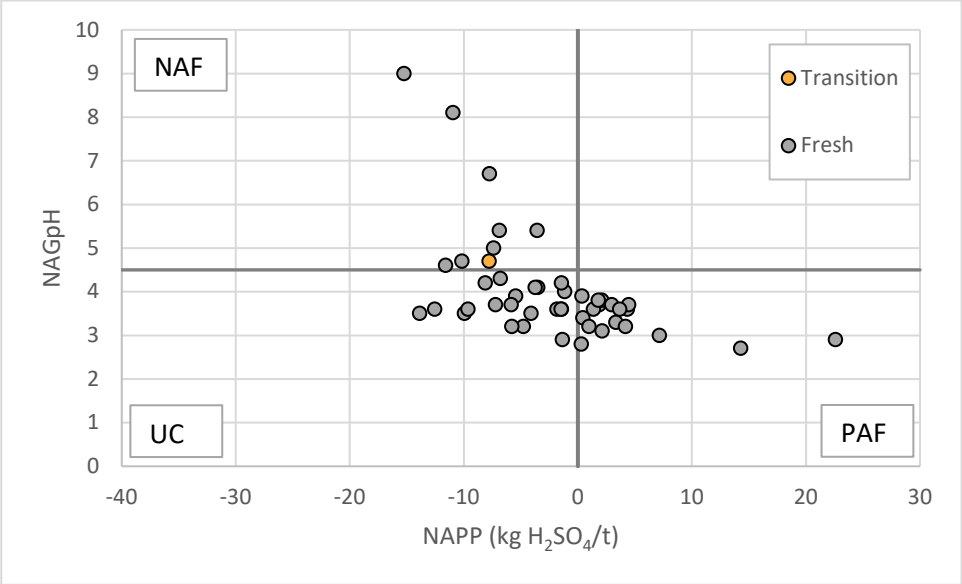


*Figure 3: ARD classification plot split by oxidation type.*

To further understand the reasons for the uncertain ARD classification of these samples, more detailed measurements were made to determine the nature of the neutralising phases present. Selected samples were subjected to acid buffering characteristic curve measurements (ABCC), which determines the amount of readily available neutralising capacity within the sample. The neutralising capacity of the samples was also calculated from their inorganic carbon (IC) content. Figure 4 shows a comparison between the neutralising capacity measured using the standard ANC method and neutralising capacity calculated from IC ($ANC_{IC}$) or by the ABCC method. The plot shows that with one exception the neutralising capacity of these materials measured using $ANC_{IC}$ or ABCC methods is significantly less than the standard ANC method, with the former methods measuring only around 20 -25% of the standard ANC on average. The results from ABCC testing (

Table 2 and Appendix B), indicate these samples contain very few reactive neutralising minerals, with effective ANC typically at or below 5 kg $H_2SO_4$/t. ABCC plots (Appendix B) suggest most of the carbonate is in the form of iron carbonates which provide limited neutralising capacity.

The presence of iron carbonates may have impacted inorganic carbon measurements, resulting in low $ANC_{IC}$ values for these samples. Figure 5 shows a comparison between neutralising capacity measured by $ANC_{IC}$ and ABCC, demonstrating that for all but one sample, ABCC was higher than $ANC_{IC}$. For samples containing iron carbonates, the opposite is often true. The measured values are very low for all of the samples where ABCC > $ANC_{IC}$, and the difference may just reflect uncertainties in the measurements at such low values. However, it is also possible that the presence of iron carbonates has resulted in an underestimation of the IC content of these materials, as precise measurement of IC can be difficult for iron carbonates.

Notwithstanding the issues described above, the results show that the fresh waste rock samples from the BP33 project represented by the materials tested here, have very limited acid neutralising capacities and consequently the presence of even minor sulphide sulphur will likely result in the potential for acid formation following oxidation. Use of $ANC_{IC}$ to generate the ARD classification plot suggests that many of these samples may be PAF (Figure 6), albeit with limited acid potential, with NAG values typically below 5 kg $H_2SO_4$/t (Table A1).

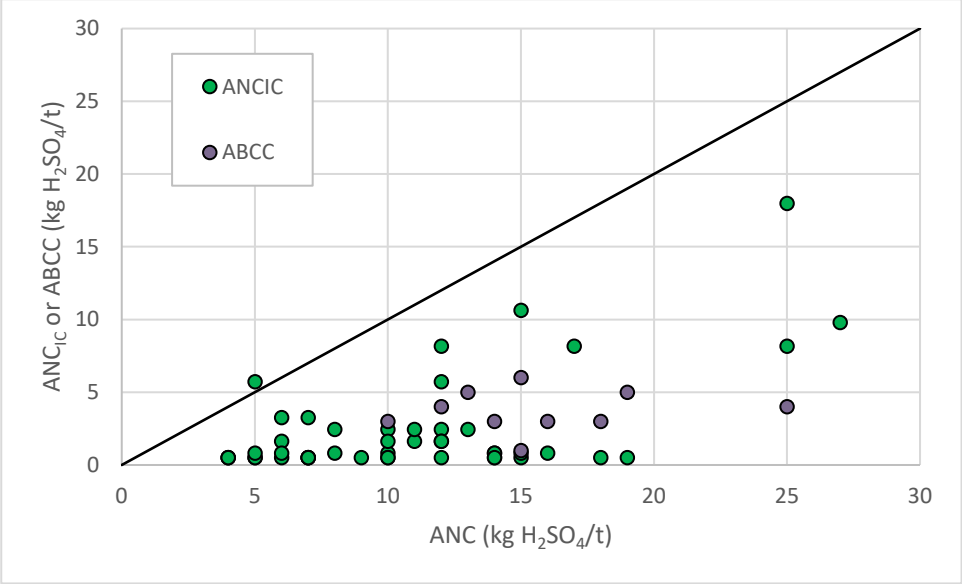


*Figure 4: Comparison between the neutralising capacity measured using the standard ANC method and carbonate ANC calculated from inorganic carbon assay ($ANC_{IC}$) and readily available ANC measured using the ABCC method. The black line represents agreement between the methods.*

*Table 2: ABCC test results*

| EGi Code | Sample ID | Figure Number (Appendix B) | Type of Carbonate Buffering | Effective ANC to pH 4 (kg $H_2SO_4$/t) | ANC (kg $H_2SO_4$/t) | Effective ANC as % of Measured ANC |
|---|---|---|---|---|---|---|
| 21091 | A3512 | B1 | Siderite | 3 | 10 | 32 |
| 21094 | A3516 | B2 | Ferroan Dolomite | 5 | 13 | 38 |
| 21103 | A3632 | B3 | Siderite | 4 | 25 | 16 |
| 21109 | A3797 | B4 | Siderite | 3 | 18 | 16 |
| 21110 | A3798 | B2 | Siderite/Ferroan Dolomite | 3 | 14 | 23 |
| 21130 | A4851 | B2 | Siderite | 1 | 15 | 10 |
| 21134 | A4857 | B2 | Siderite | 3 | 16 | 18 |
| 21135 | A4858 | B4 | Siderite | 5 | 19 | 26 |
| 21141 | A4875 | B2 | Ferroan Dolomite | 6 | 15 | 41 |
| 21144 | A6967 | B1 | Siderite | 4 | 12 | 31 |

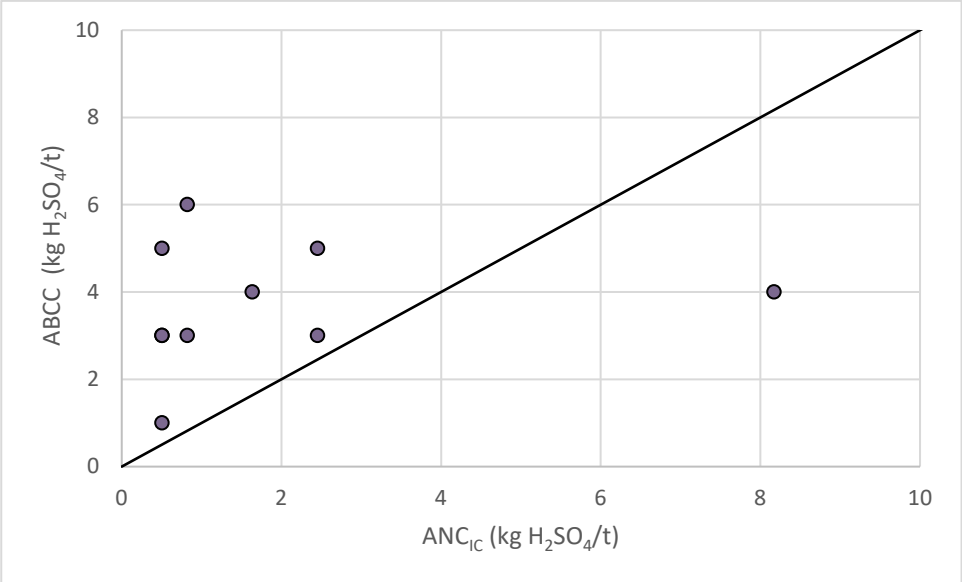


*Figure 5: Comparison between the neutralising capacity measured using carbonate ANC calculated from inorganic carbon assay ($ANC_{IC}$) and readily available ANC measured using the ABCC method. The black line represents agreement between the methods.*

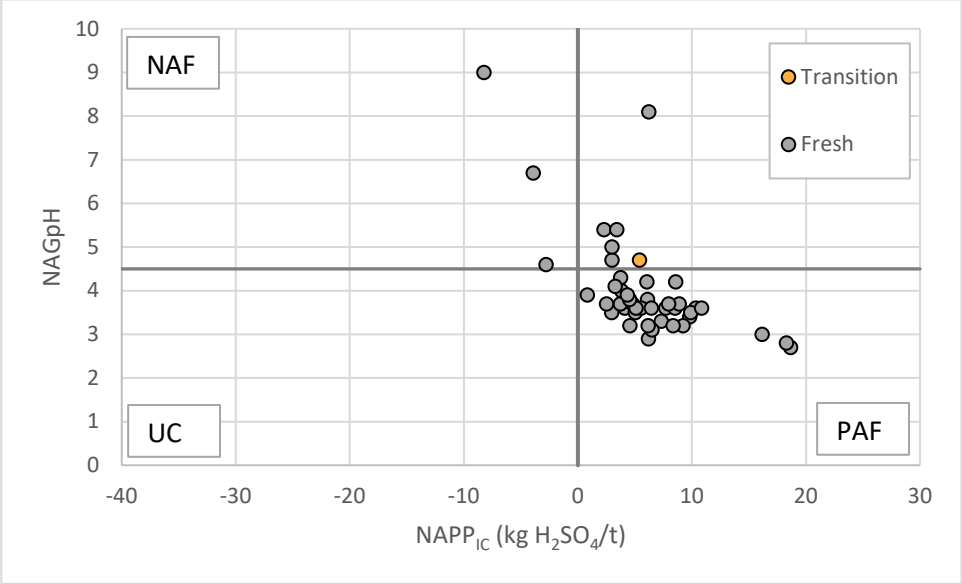


*Figure 6: ARD classification plot with NAPP calculated from $ANC_{IC}$.*

## 2.2. ABA and NAG testing: All samples

To provide a set of samples which would be more representative of waste and ore from the BP33 project, the results of ABA and NAG testing from the earlier study which investigated geochemical properties of waste rock[1] were combined with results from the current sample set. This provided a set of samples covering the major lithotypes (approximately two thirds phyllite, one third pegmatite, minor sandstone, laterite, soil), oxidation types (approximately 20% oxide and transition, 60% fresh), sample types (approximately 90% waste and 10% ore) and ARD classes (approximately 55% NAF, 40% PAF-LC and minor PAF) (Table 3). The total number of samples tested across the two test programmes was 144, but only 91 of these samples had sufficient results to provide ARD classification. Test results for the full sample set are presented in Appendix A (Table A2).

Figure 7 shows NAGpH and NAG (pH4.5) as a function of Total S for the full samples set (91 samples). The figure shows that where Total S is less than 0.2%, most samples gave a NAGpH above 4.5, although there were some samples were the NAGpH was between 3.5 to 4.5. However, the measured NAG(pH4.5) for these samples was less than 2 kg $H_2SO_4$/t, with uncertainty about the ARD classification assigned to these samples due to the very close balance between the acid generating and acid neutralising capacity.

Figure 7 also shows that for samples with Total S between 0.2 and 0.4% the NAG pH was below 4.5 for all but two samples, but the NAG(pH4.5) was below 5 kg $H_2SO_4$/t, suggesting these materials may have the potential to produce acid after oxidation, but that the amount of acidity generated is likely to be minor.

For samples where Total S was above 0.4%, the NAGpH was below 3.5 with one exception, and NAG(pH4.5) was above 5 kg $H_2SO_4$/t. Although there are a limited number of samples in this category, results suggest that materials with Total S above 0.4% may have the potential to be acid forming.

[1] Core Lithium BP33Project - Geochemical characterisation of waste rock and ore, March 2020, Document No. S1312/J000390/R1346.

*Table 3: Details of sample set used to define criteria for ARD classification of waste rock and ore*

| **Category** | **No. of Samples** | **Percentage of Samples** |
|---|---|---|
| *Lithology* | | |
| Py | 95 | 66% |
| Pg | 40 | 28% |
| Sst | 5 | 3% |
| Soil | 1 | 1% |
| Laterite | 3 | 2% |
| Total | 144 | |
| | | |
| *Oxidation* | | |
| Oxide | 27 | 19% |
| Transition | 29 | 20% |
| Fresh | 88 | 61% |
| Total | 144 | |
| | | |
| *Type* | | |
| Ore | 12 | 8% |
| Waste | 132 | 92% |
| Total | 144 | |
| | | |
| *ARD Classification* | | |
| NAF | 50 | 55% |
| PAF-LC | 35 | 38% |
| PAF | 6 | 7% |
| Total | 91 | |

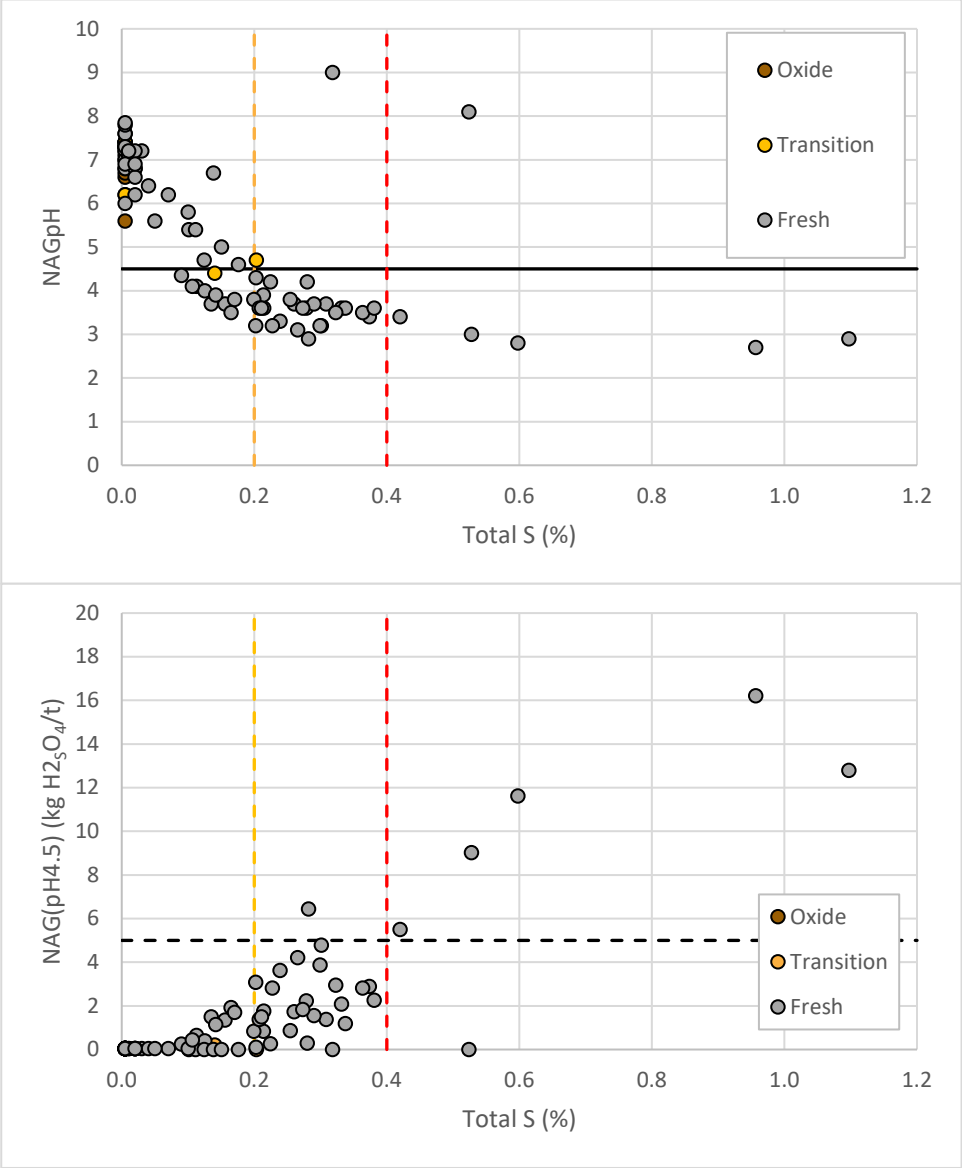


*Figure 7: NAGpH (top) and NAG(pH 4.5) (bottom) as a function of Total S for the full sample set.*

Figure 8 shows box plots displaying the distribution of Total S within set of samples examined in this and the earlier geochemical characterisation programmes. Total S distributions were split according to lithology/waste/ore, oxidation and ARD classification. Also shown in these figures are lines showing 0.2 and 0.4% Total S, which NAG test results suggest may form a basis for delineating NAF, PAF-LC and PAF materials.

This Figure shows that of the ore samples examined, a clear majority have a Total S content below 0.2%. These samples classified as NAF materials with a couple of exceptions, which while having a NAGpH below 4.5, produced very little acidity when treated with peroxide (NAG(pH4.5) <2 kg $H_2SO_4$/t). While around 75% of the phyllite samples examined had Total S of below 0.2%, it is likely that the sulphur content of some materials from this rock type may be higher, and consequently may potentially produce acid on oxidation. More than half of the waste pegmatite samples contained more than 0.2% Total S, suggesting that these materials may also have the potential to produce acid on oxidation.

All but one of the oxide samples contained Total S below the reporting limit of 0.01%, a clear indication that oxidised waste rock will likely classify as NAF. While many of the transition waste rock samples also gave a Total S assay below the reporting limit, the Total S content of these materials appears to be higher than highly oxidised rock, with sulphur content ranging up to 0.51%, but with around 95% of samples below 0.2% Total S. While the majority of fresh waste rock from within this sample set contained below 0.2% Total S, there is a significant proportion of the fresh rock samples with higher Total S content, indicating that fresh waste rock is likely to encompass a range of materials from NAF through to PAF rock.

Based on the results of geochemical testing of 144 samples from both the current and earlier test programmes as discussed above, criteria were developed to identify NAF, PAF-LC and PAF waste rock and ore. These criteria are summarised in Table 4 below. The criteria rely on oxidation and Total S content to classify mined materials according to their acid forming potential. Ore and oxidised waste rock are classified as NAF, with transitional and fresh waste rock with a Total S of below 0.2% also classified as NAF. For fresh and transitional waste rock with a Total S content above 0.2%, a Total S value of 0.4% is suggested for differentiating between PAF-LC and PAF materials. While there is likely to be some overlap between the classifications, it is expected that the listed criteria may be used to provide a reasonable segregation of waste rock and ore according to their likelihood to produce acid as a consequence of exposure to air during surface storage.

*Table 4: Criteria for ARD classification of waste rock and ore*

| **ARD Classification** | **Criteria** |
|---|---|
| NAF | Ore *OR*<br>Oxide waste rock *OR*<br>Transition and fresh waste rock with Total S <0.2% |
| PAF-LC | Transition and fresh waste rock with Total S ≥0.2% and <0.4% |
| PAF | Transition and fresh waste rock with Total S ≥0.4% |

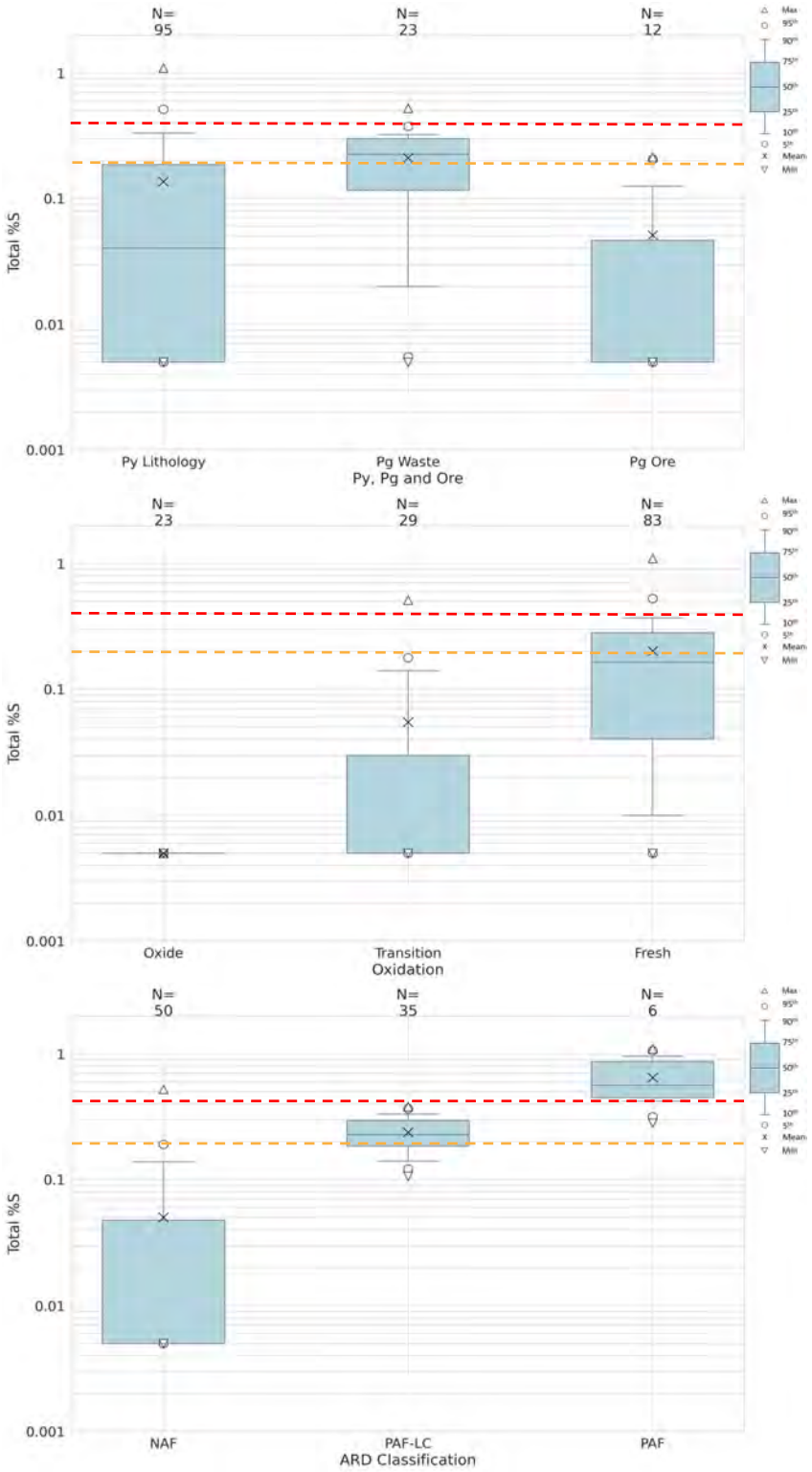


*Figure 8: Distributions of Total S as a function of lithology/waste/ore (top), oxidation (middle) and ARD classification (bottom) for the full sample set. The orange broken lines show 0.2% Total S and the red broken lines 0.4% Total S.*

## 2.3. Estimates of NAF, PAF-LC and PAF waste volumes

Core Lithium supplied a database containing assay data for around 2500 samples from 48 drill holes for the BP33 deposit (Figure 1). The database also contained a drill log which included details of sample colour, weathering, lithology and mineralogy. Samples were collected using RC, (36 holes), DD (3 holes), RC/DD (5 holes) and MR/DD (4 holes) drilling methods. Assays covered a standard set of 14 elements, including Li (value), As, Fe and Total S. Total S assay results provided in the database were employed to define ARD classification using criteria shown in Table 4 above.

Drilling programmes at BP33 have in the main been designed to provide resource definition data and consequently have been focused on fresh pegmatite which hosts the spodumene containing the value element (Li). Consequently, the sample set consists of nearly 90% fresh rock, with around 5% transition and oxide by sample interval length (Table 5). Pegmatite is the dominant lithology (63%) represented in the database, but a significant proportion of phyllite (36%) sample interval is present in the set. The split between ore and waste rock interval length is approximately even, with a slightly higher amount of waste sample interval (57%).

The assay database was analysed to define the distribution of Total S among the various categories of materials including type (ore, waste) and lithology and oxidation for waste rock samples. The results (Table 6) show that 99.8% of the sample interval represented by ore samples contain less than 0.2% Total S, supporting the ARD classification criteria suggesting all ore can be classified as NAF. Similarly, 100% of the sample intervals representing oxide rock had a Total S content of below 0.2%, also supporting the classification of all oxide rock as NAF. Around 90 to 95% of phyllite, pegmatite (waste) and sandstone samples contain a Total S content below 0.2%. Similarly, when waste rock is categorised according to oxidation, transitional and fresh waste rock display a similar sulphur distribution, suggesting that the majority of transitional and fresh waste rock, irrespective of the lithotype, will classify as NAF.

*Table 5: Details of samples from the BP33 deposit database used to estimated volumes of rock from each ARD class*

| **Category** | **Sample Interval Length (m)** | **Percentage of Total Interval Length** |
|---|---|---|
| *Lithology* | | |
| Pegmatite | 1989.55 | 63% |
| Phyllite | 1131.45 | 36% |
| Quartz (massive) | 2.25 | 0.1% |
| Quartz Vein | 9.4 | 0.3% |
| Soil | | 0% |
| Sandstone | 46.6 | 1.5% |
| Shale | 1 | 0.03% |
| Total | 3180.25 | |
| | | |
| *Oxidation* | | |
| Oxide | 179 | 5.6% |
| Transition | 178 | 5.6% |
| Fresh | 2823.25 | 88.8% |
| Total | 3180.25 | |
| | | |
| *Type* | | |
| Ore | 1371.6 | 43% |
| Waste | 1808.65 | 57% |
| Total | 3180.25 | |

*Table 6: Percentage interval length for drill hole samples as a function of Total S content*

| **Total S →** | **<0.2%** | **≥0.2 & <0.4%** | **≥0.4%** |
|---|---|---|---|
| **Category ↓** | **(NAF)** | **(PAF-LC)** | **(PAF)** |
| Ore | 99.8% | 0.2% | 0.0% |
| Waste | 94.3% | 5.1% | 0.6% |
| | | | |
| Pegmatite | 95.9% | 3.8% | 0.3% |
| Phyllite | 94.0% | 5.4% | 0.6% |
| Sandstone | 87.3% | 11.6% | 1.1% |
| | | | |
| Oxide | 100.0% | 0.0% | 0.0% |
| Transition | 90.1% | 9.9% | 0.0% |
| Fresh | 93.8% | 5.5% | 0.7% |
| | | | |
| All | 96.6% | 3.1% | 0.3% |

The amounts of waste rock and ore which will be mined during the BP33 operation are shown in Table 7. Amounts of waste rock are further divided according to oxidation, with the majority waste rock produced during construction of the box cut. This material is expected to be comprised of only oxide rock which will be placed in WRD1. All of this material is expected to be NAF, as is any ore that will be stored in the ROM pad while awaiting transport to the processing plant.

A much smaller volume of transition and fresh waste rock which will be mined to develop the underground operation, will be placed in WRD2. Assuming the sample set provided in the drill hole assay database is representative of mined waste rock, then around 90% of waste rock removed from the UG mine will be fresh rock with the remainder as transitional rock. Based on the same assumption, using the proportions of transitional and fresh waste as a function of ARD class shown in Table 6, the estimated volumes/tonnages of NAF, PAF-LC and PAF waste rock to be placed in WRD2 were calculated. The results of these estimates are shown in Figure 9 and Table 8.

These estimates indicate that only around 15,000 tonnes of PAF-LC and PAF waste will be moved to WRD2 through the life of the mine out of a total of 229,000 tonnes of transition and fresh waste rock which will be mined, with most of the 15,000 tonnes likely to be classified as PAF-LC with limited acid producing potential.

These results suggest that all of the stockpiled mine materials (oxide waste in WRD1, transition and fresh waste in WRD2, ore in the ROM pad) will present little risk of producing acidic metalliferous drainage as a result of surface storage during the mining operation.

*Table 7: Volumes and tonnages of waste rock and ore which will be moved to LOM*

| Material | Volume (BCM) | Volume (LCM)[1] | Tonnage (kt) |
|---|---|---|---|
| Oxide waste (box cut) | 1,000,000 | 1,500,000 | 2,000 |
| Transition/fresh waste (from underground) | 85,000 | 127,500 | 229 |
| Ore (production tonnes) | 776,000 | 1,164,000 | 2,095 |

1. Assumes a swell factor of 50%

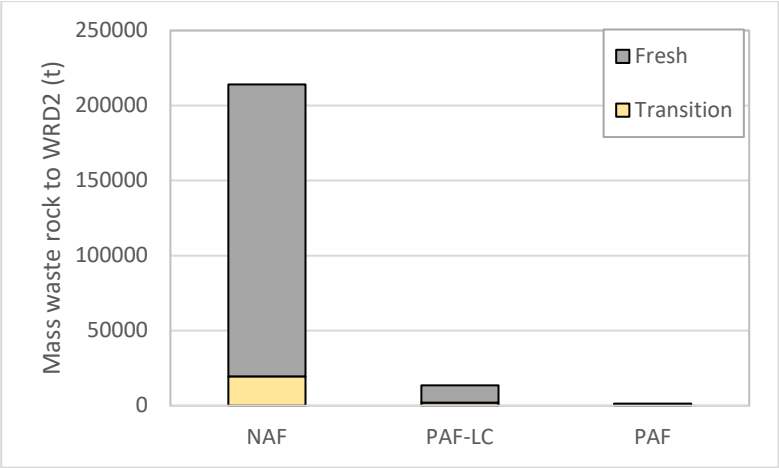


*Figure 9: Estimated mass of transition and fresh waste rock by ARD class to be placed in WRD2.*

*Table 8: Estimated volumes and tonnages of transition and fresh waste rock to be placed in WRD2*

| Rock Type | ARD Class | BCM | LCM | Tonnage (t) |
|---|---|---|---|---|
| Transition/fresh waste (from underground) | | 85000 | 127500 | 229000 |
| Transition rock in WRD2 | | 8036 | 12053 | 21649 |
| Fresh Rock in WRD2 | | 76964 | 115447 | 207351 |
| Transition Rock in WRD2 | NAF | 7239 | 10859 | 19503 |
| | PAF-LC | 796 | 1194 | 2145 |
| | PAF | 0 | 0 | 0 |
| Fresh Rock in WRD2 | NAF | 72223 | 108334 | 194576 |
| | PAF-LC | 4199 | 6298 | 11312 |
| | PAF | 543 | 814 | 1463 |
| Waste Rock in WRD2 | NAF | 79462 | 119193 | 214080 |
| | PAF-LC | 4995 | 7493 | 13457 |
| | PAF | 543 | 814 | 1463 |

# 3. LEACHING CHARACTERISTICS

Results from the previous study indicated that drainage from oxidised rock stored in the Box cut WRD may contain low concentrations of aluminium and zinc and some of the fresh rock stored on the UG WRD may contain water leachable arsenic and zinc. Consequently, as a part of the current study, the fresh rock samples examined here were subject to water extraction tests. Because these materials also contained higher than average sulphur content, NAG test liquors were also assayed to examine potential metal content of drainage from oxidised materials containing elevated sulphur.

The results of water extraction provide an indication of chemical mobility for a material that is freshly mined and exposed to atmospheric conditions, whereas the results of the peroxide extractions (NAG test) provide information on metal mobility for sulphidic materials that undergo oxidation. These two tests represent the two extremes of the leaching process. As waste rock at the BP33 project will only be stored on the surface for a short period of time, and residual ore remaining in stopes will only be exposed for a relatively short time prior to inundation, it is expected any sulphidic material will only undergo partial oxidation. Therefore, the potential for metals leaching will lie somewhere between the findings of the tests representing the two extremes.

Batch-leaching tests are short-term tests that can be used to provide an indication of the potential for environmental risk associated with leaching of metals from the ore and waste rock. However, these tests are also conducted at solid to liquid ratios far from what can be typically expected in waste rock or ore stockpiles, where precipitation reactions can be expected in addition to dissolution. Consequently, these tests can provide insight into elements of concern that may be potentially mobilised during surface storage, but they do not provide understanding of rates of reactivity and likely mobility of various metals and metalloids under field conditions. To obtain this information longer-term leach column testing is conducted which provides insight into the rate of reactions under conditions which are closer to field conditions than are provided by in the short-term batch leach tests. Column leach tests are currently being conducted and are expected to be completed in 12 months.

## 3.1. Multi-Element Assays

Multi-element assays were conducted on selected samples from the current sample set. The results are shown in Appendix C (Table C1). Using the results from the multi-element assays, geochemical abundance indices (GAI) were calculated to determine where there is significant enrichment of various elements in these samples. The calculated GAI are provided in Table 9. Where the GAI value is 3 or above this represents significant enrichment above the typical background level of each element. Note, where the GAI value is shown as "-", this indicates a calculated GAI of <0.5. The data provided in Table 9, show most samples have significant enrichment in As, Be, Cs, Li, Sn and Tl, with Bi, Ta and W displaying evidence of some enrichment.

While elevated concentrations in a rock sample may indicate the potential for higher concentrations in leachates, the mobility of any given element will depend on the mineral associations and environmental conditions including extent of oxidation, leachate pH etc. Nevertheless, the results suggest that elevated concentrations of typically mobile elements such as As (especially as arsenate), Li and Cs could result in elevated concentrations in leachates.

*Table 9: Geochemical Abundance Indices (GAI) for selected samples from the BP33 project*

| Element | Median Soil Abundance[2] | Sample ID | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **21095** | **21093** | **21291** | **21290** | **21138** | **21134** | **21109** | **21102** | **21086** | **21289** |
| Ag | 0.05 | - | - | - | - | - | 1 | 2 | 2 | 2 | **3** |
| Al | 7.1% | - | - | - | - | - | - | - | - | - | - |
| As | 6 | **8** | **9** | **3** | **3** | **7** | **9** | **10** | **5** | **5** | **3** |
| Ba | 500 | - | - | - | - | - | - | - | - | - | - |
| Be | 0.3 | **5** | **6** | 2 | **3** | **7** | **7** | **6** | **5** | **4** | **6** |
| Bi | 0.2 | 2 | **3** | - | 1 | 2 | **3** | **3** | **3** | 1 | 1 |
| Ca | 1.5% | - | - | - | - | - | - | - | - | - | - |
| Cd | 0.35 | - | - | - | - | - | 2 | 1 | - | 2 | - |
| Ce | 50 | - | - | - | - | - | - | - | - | - | - |
| Co | 8 | - | - | - | - | - | - | - | - | - | - |
| Cr | 70 | - | 1 | - | - | 2 | - | - | - | - | - |
| Cs | 4 | **>6** | **6** | **3** | **5** | **6** | **>6** | **5** | **>6** | **>6** | **4** |
| Cu | 30 | - | - | - | - | - | - | - | 1 | - | - |
| Fe | 4.0% | - | - | - | - | - | - | - | - | - | - |
| Ga | 20 | - | - | - | - | - | - | - | - | - | - |
| Ge | 1 | - | - | - | - | - | - | - | - | - | - |
| Hf | 6 | - | - | - | - | - | - | - | - | - | - |
| Hg | 0.06 | - | - | - | - | - | - | - | - | - | - |
| In | 1 | - | - | - | - | - | - | - | - | - | - |
| K | 1.4% | 1 | - | - | - | 1 | 1 | 1 | - | 1 | - |
| La | 40 | - | - | - | - | - | - | - | - | - | - |
| Li | 25 | **5** | **4** | 2 | 2 | **6** | **6** | **5** | **5** | **4** | 2 |
| Mg | 0.5% | - | - | - | - | - | - | - | - | - | - |
| Mn | 1000 | - | - | - | - | - | - | - | - | - | - |
| Mo | 1.2 | - | - | - | - | - | - | - | - | - | - |
| Na | 0.5% | - | - | - | - | - | - | - | - | - | 1 |
| Nb | 10 | - | 1 | - | - | 1 | 1 | 1 | - | - | 2 |
| Ni | 50 | - | - | - | - | - | - | - | - | - | - |
| P | 800 | - | 1 | - | - | 1 | 2 | 2 | 2 | - | - |
| Pb | 35 | - | - | - | - | - | - | - | - | **3** | - |
| Rb | 150 | 2 | 2 | - | - | 2 | **3** | 2 | 1 | 1 | - |
| S | 0.07% | - | 1 | - | - | - | 1 | **3** | **3** | 1 | - |
| Sb | 1 | - | - | - | - | - | - | - | - | - | - |
| Sc | 7 | - | - | - | - | - | - | - | - | - | - |
| Se | 0.4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Sn | 4 | **5** | **5** | - | - | **5** | **6** | **5** | **4** | **3** | 2 |
| Sr | 250 | - | - | - | - | - | - | - | - | - | - |
| Ta | 2 | 1 | **5** | - | - | **3** | **3** | 2 | 1 | - | **5** |
| Th | 9 | 2 | **3** | - | - | 1 | 1 | - | - | 1 | - |
| Ti | 0.50% | - | - | - | - | - | - | - | - | - | - |
| Tl | 0.2 | **5** | **4** | 2 | 2 | **5** | **6** | **5** | **4** | **4** | **3** |
| U | 2 | 1 | 1 | - | - | 1 | - | 1 | - | 1 | - |
| V | 90 | - | - | - | - | - | - | - | - | - | - |
| W | 1.5 | **3** | **3** | 2 | 1 | **3** | **3** | **3** | 2 | 2 | 2 |
| Zn | 90 | - | - | - | - | - | - | - | - | **3** | - |
| Zr | 400 | - | - | - | - | - | - | - | - | - | - |

[2] Bowen H.J.M.(1979) Environmental Chemistry of the Elements.

## 3.2. Water Extraction

Batch water extraction tests were conducted by extracting samples with deionised water at a solid to liquid ratio of 1:5 for 24 hours, which is generally sufficient for chemical equilibrium to be established. Extract pHs were recorded after the equilibration period, then the liquors were filtered and analysed for a suite of elements, the results of which are given in Appendix D (Table D1).

The results from the water extraction tests conducted as a part of the earlier study[3] were added to the water extraction results for the current sample set. The combined sample set provided samples that covered both ore (9 samples) and waste rock (45 samples). The properties of the waste rock samples used for water extraction tests are shown in Table 10. Samples covered oxide, transition and fresh rock types, with the majority of samples classified as NAF, showing the selected samples are reasonably representative of the waste rock which will be mined during the BP33 project. However, the number of PAF samples is likely to over-represent this ARD class in the waste rock stockpiles at the mine.

*Table 10: Details of samples used for water extraction tests*

| Category | No. Samples | Percentage of Total Samples |
|---|---|---|
| Oxide | 9 | 20% |
| Transition | 13 | 29% |
| Fresh | 23 | 51% |
| Total | 45 | |
| | | |
| NAF | 38 | 84% |
| PAF-LC | 4 | 9% |
| PAF | 3 | 7% |
| Total | 45 | |

Water extracts from the ore samples were slightly alkaline (average pH 9.2) with low salinity (average EC 105 µS/cm). Figure 10 shows the average concentration of metals in water extracts for the nine ore samples tested. For comparison, the average concentrations of metals in water extracts for the 45 waste rock samples tested are also shown in the figure. With the exception of Al and Fe, metal and metalloid concentrations were non-detectable in almost all of the water extracts of the ore samples. On average, concentrations of Al in ore water extracts were about an order of magnitude higher than the default ANZECC guideline values for freshwater systems. Analysis of surface water collected from ephemeral water courses at BP33 site, gave a median Al concentration also about an order of magnitude below that measured in water extracts of the ore samples. Similarly, water samples from bores within the oxidised rock profile at the nearby Grants project, indicated Al concentrations in the water contained in the shallow alluvial aquifer are also typically about an order of magnitude below those in water extracts of the BP33 ore. These results suggest that Al in run-off from ore stockpiled in the ROM pad may present an environmental risk. As all ore is likely to be NAF and therefore not produce acidic drainage, it would appear that stockpiled ore should not require any specific management to reduce potential impacts from run-off. However, since the results from water extractions indicate a potential risk from elevated Al concentrations in run-off, the likelihood of this risk should be evaluated at

[3] Core Lithium BP33Project - Geochemical characterisation of waste rock and ore, March 2020, Document No. S1312/J000390/R1346. Appendix B

site and it is recommended that any run-off from the ROM stockpile should be monitored and containment of run-off undertaken as required.

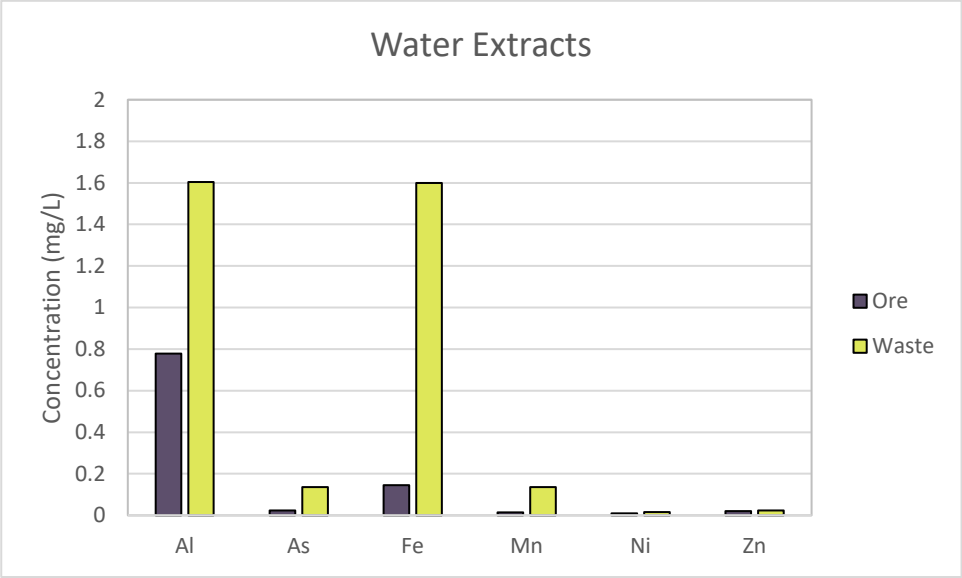


*Figure 10: Metal concentrations in water extracts for ore and waste rock.*

The results for water extraction tests conducted on waste rock samples are summarised in Figures 11 and 12. Results are grouped according to the oxidation state of the waste rock. Water extract pH for waste rock samples were slightly alkaline (average pH 8.2) with little difference between oxide, transition and fresh samples (Figure 11). Salinity in water extracts from oxide and transition waste rock samples were low (typically below 80 µS/cm), with fresh waste rock producing slightly higher salinity in water extracts (average 108 µS/cm). These results imply that oxide waste rock stored in WRD1, or transition and fresh waste rock stored in WRD2 are unlikely to produce low pH saline seepage during short-term surface storage.

Selected metal and metalloid concentrations in the water extracts for waste rock samples are summarised in Figure 12. For many metals, concentrations in water extracts were below the detection limit in all waste rock extracts, including Be, Sn and Tl which all showed significant enrichment in these materials. Mn, Ni and Zn concentrations in water extracts for waste rocks were all low and of a similar order of magnitude to the corresponding ANZECC DGV, with the exception of Mn where water extract concentrations were significantly below the DGV.

Similar to the ore samples, concentrations of Al in water extracts of waste rock were typically up to and order of magnitude or more higher than the ANZECC DGV and background surface and groundwater concentrations. Al concentrations were similar in water extracts for oxide, transition and fresh waste rock.

Arsenic concentrations in water extracts of fresh waste rock were significantly higher than in the water extracts of oxide and transition waste rock, and on average about an order of magnitude higher than the ANZECC DGV and background surface water concentrations. However, background concentrations of As in the aquifer hosted within the Burrell Creek Formation appear to be of a similar magnitude to those in water extracts, indicating elevated As concentrations in the deeper aquifer are in agreement with the apparent aqueous mobility of As within fresh rock.

There appears to be an inverse relationship between the amount of iron found in water extracts and As concentrations, with oxide and transition rock extracts having elevated concentrations of iron and lower As concentrations, while the reverse is true of the water extracts from the fresh waste rock. This may imply that iron is controlling As leachability to some extent, with higher iron concentrations in the leachate possibly associated with higher amounts of ferric oxyhydroxide precipitate which can attenuate As concentrations through adsorption.

These water extraction tests suggest that the mobility of Al in all waste rock and As in fresh waste rock on contact with water, could potentially result in elevated concentrations of these elements in seepage from WRD1 (Al only) and WRD2 (Al and As) during short-term surface storage. The results from kinetic leach column testing will help to confirm if leaching of Al and As from waste rock has the potential to provide any risk to the environment during surface storage in the WRD.

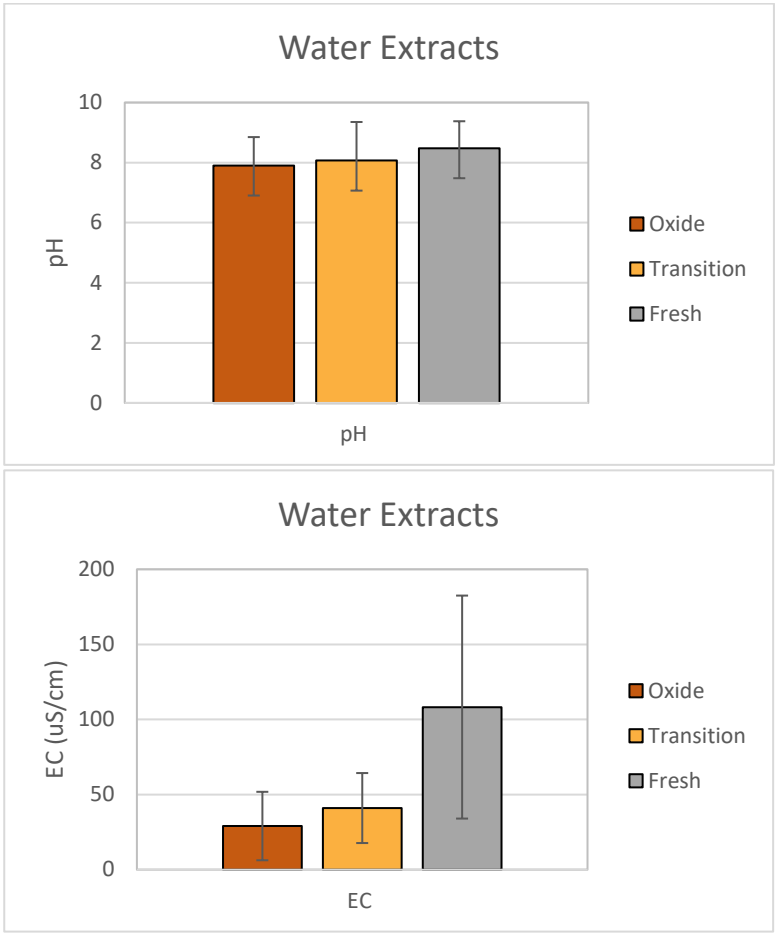


*Figure 11: Mean pH (top) and EC (bottom) in water extracts for waste rock samples. Error bars show plus/minus one standard deviation from the mean.*

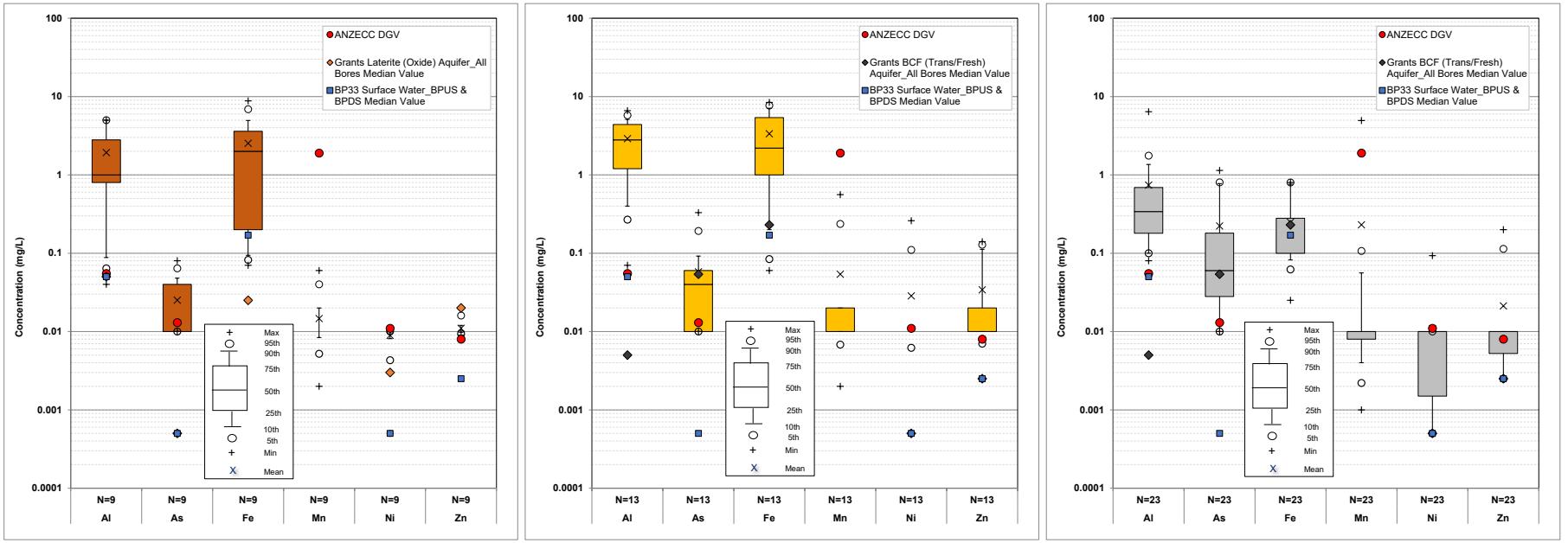


*Figure 12: Box plots for metal concentrations in water extracts for oxide(left), transition (middle) and fresh (right) waste rock samples. The water extracts were produced at a solid to liquid ratio of 1:5. Also shown for comparison are ANZECC DGV for fresh water at 95% protection level (red circles), median concentrations for groundwater from the Grants project shallow (oxide) aquifer (brown diamonds), median concentrations for groundwater from the Grants project deep BCF (trans/fresh)) aquifer (grey diamonds), and median concentrations for surface water from the BP33 project site (blue squares). Note, where median values were below the limit of reporting (LOR), 0.5 x LOR are shown. LOR are: Al – 0.01, As – 0.001, Ni – 0.001, Zn – 0.005 mg/L.*

## 3.3. Peroxide Extraction

A series of accelerated oxidation tests based on the NAG test procedure were also carried out to provide indicative data on metals and metalloids that are likely to occur in runoff from waste rock that is subject to oxidation processes following surface storage. The NAG test involves reaction of a sample with hydrogen peroxide to rapidly oxidise any sulphides that are present. Normally only the pH and acidity of the NAG solution are measured following the oxidation stage, but elemental analysis of the NAG liquor can also be carried out to provide data on the release of elements that may be of interest. Past experience has suggested NAG test concentrations typically need to be multiplied by between 3 to 10 times to provide a reasonable guide to what might be expected from column leach tests, so multiplication by a factor of five of metal concentrations in peroxide leachate was undertaken to give indicative metal/metalloid concentrations from column tests.

The full results for multi-element analysis of NAG liquors are provided in Appendix D (Table D2) and Figure 13 summarises the results. Analysis of NAG liquors was only carried out for fresh rock samples where peroxide treatment would result in sulphide oxidation. Comparison of the concentrations between water extracts (Figure 12) and peroxide extracts (Figure 13), considering the different solid to liquid ratios used in the two extraction tests, show that metal and metalloid concentrations were significantly higher in the peroxide extracts. Typically, Al and As concentrations were 1 to 2 orders of magnitude higher following oxidation with peroxide in comparison with water extracts, while Mn, Ni and Zn concentrations were 2 to 3 orders of magnitude higher in peroxide extracts in comparison with water extraction. A number of other metals, including Co, Cr, Cu, Mo, Pb and U were measurable following peroxide treatment, but non-detectable in the water extracts.

The pH of the peroxide extracts were substantially lower than the water extracts, with NAG liquor pH ranging from 2.7 to 6.2. This lower pH has undoubtedly led to increased solubility for a number of the metals after peroxide treatment. However, estimates of the volume of transition and fresh waste rock which will be temporarily stored in WRD2, and which will potentially be acid forming, are very low (Section 2.3) and widespread low pH conditions in pore water within the dump are unlikely. Consequently, even if significant oxidation were to occur during short-term storage of fresh waste rock in WRD2, mobilisation of many metals may be limited due to the likely near-neutral conditions within the WRD. This effect can be seen by comparing the concentration range of the various elements in peroxide extracts when all samples are included (pH range 2.7 – 6.2, average 4.6) shown in the top part of Figure 13, with the concentrations of the same elements in the peroxide extracts for NAF samples only (pH range 4.5 – 6.2, average 5.4) shown in the bottom part of Figure 13. For hydrolysable metals such as Al, Co, Cu, Ni and Zn, there is a significant increase in concentrations in peroxide extracts when PAF-LC samples are included in the sample set, but little change in the concentrations of metals which will be present as metal oxy anions (As, Cr, and Mo), where changes in pH will not influence hydrolysis and subsequent solubility. For the later metal types, oxidation during surface storage may result in mobility and elevated concentrations in seepage even if pH conditions remain circum-neutral.

ANZECC default guideline values for various metals in fresh water systems are also shown in Figure 13 for comparison with the concentrations in the NAG liquors. Also shown in the figure are the background concentrations of various metals in both surface water and the aquifer hosted within the Burrell Creek Formation (fresh rock) at the nearby Grants project. Comparisons with DGV and background surface and groundwater quality suggest that should substantial oxidation of fresh waste rock occur during surface storage, the concentrations of a number of metals/metalloids including Al, As, Co, Cr, Cu, U and Zn may by elevated in comparison to background water quality, and seepage from the WRD could potentially represent a risk of contaminating the receiving environment. The likelihood that significant oxidation and metal/metalloid release will occur during short-term surface storage will be further investigated using the kinetic leach column testing now in progress.

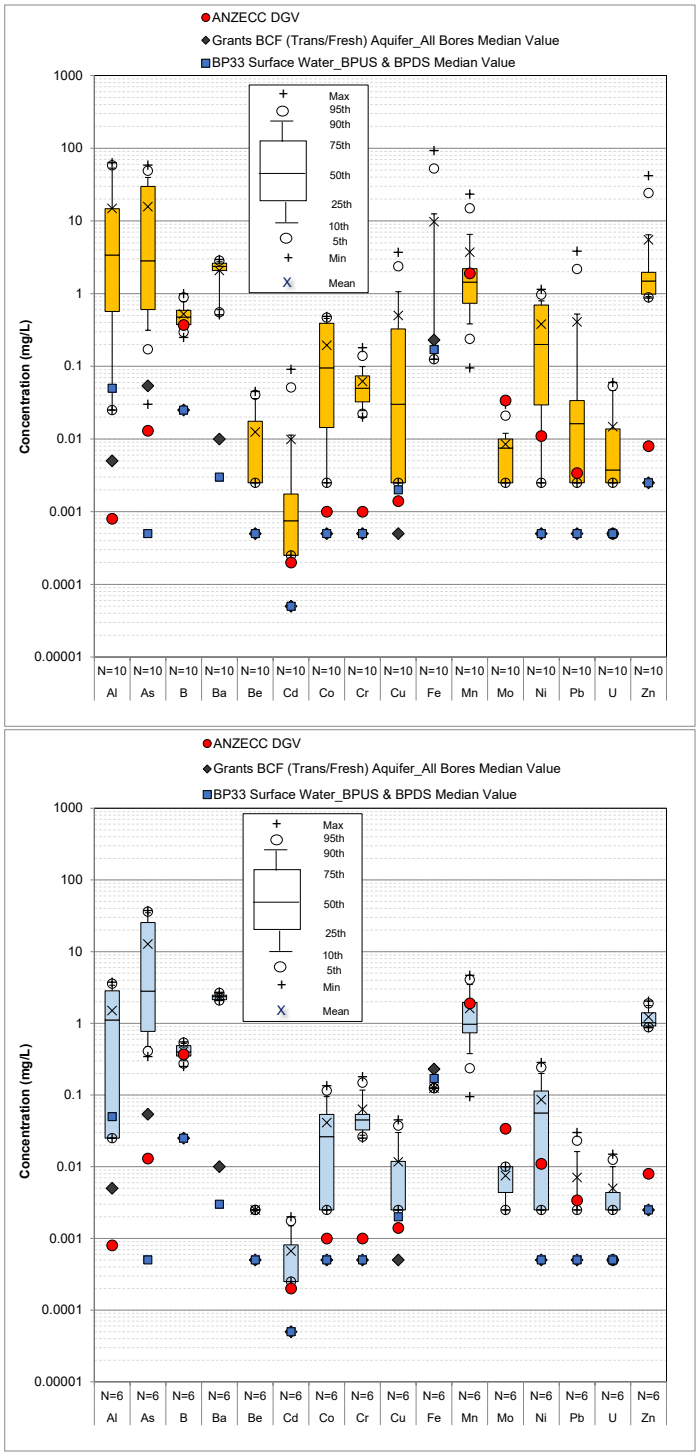


*Figure 13: Box plots for metal concentrations in peroxide extracts for all (top) and NAF only (bottom) waste rock samples. Note the concentrations shown here have been multiplied by a factor of five which provides and equivalent solid to liquid ratio of 1:20. Also shown for comparison are ANZECC DGV for fresh water at 95% protection level (red circles), median concentrations for groundwater from the Grants project deep BCF (trans/fresh)) aquifer (grey diamonds), and median concentrations for surface water from the BP33 project site (blue squares). Note, where median values were below the limit of reporting (LOR), 0.5 x LOR are shown. LOR are: Al – 0.01, As – 0.001, B – 0.05,Be – 0.001,Cd – 0.0001, Co – 0.001, Cr – 0.001, Cu – 0.001, Ni – 0.001, Pb – 0.001, U – 0.001, Zn – 0.005 mg/L.*

# 4. STATIC GEOCHEMICAL TESTING OF SAMPLES FOR KINETIC COLUMN TESTS

Twenty-nine samples obtained from the three DD holes drilled during December 2020 and January 2021 were tested to investigate the suitability of these materials for kinetic testing which requires crushed rock available from diamond drill core. Based on assay data (Appendix E), four oxide samples, four transition samples and five fresh samples were composited to produce oxide, transition and fresh rock samples, which subsequently underwent geochemical testing. The results from testing of the three composite samples have been compared with results for typical oxide, transition and fresh waste rock samples to ascertain if these samples can be used as representative of waste rock which will be temporarily surface stored in WRD prior to return to the underground mine and box cut. Kinetic testing is planned using oxide, transition and fresh rock in accordance with the testing requirements of the NT EPA referral response.

Results from ABA and NAG testing of the composite samples are given in Appendix A (Table A1). As is the case for most waste rock samples at the BP33 project, there is little neutralising capacity in the composite samples with ANC less than 10 kg $H_2SO_4$/t for the three samples. Despite the limited ANC, the very low concentrations of sulphur in these samples mean that all samples are NAPP negative. NAGpH for the three composite samples were between 5.7 and 6.3, confirming that the oxide, transition and fresh composite samples are classified as NAF. Since all oxide samples and the large majority of transition and fresh waste rock from the BP33 project are likely to be classified as NAF, the NAF classification of the three composite samples to be used for kinetic testing is in agreement with the acid forming characteristics expected for waste rock to be stored in the WRD during mining operations.

Figure 14 displays box plots which show the distributions of sulphur and arsenic in oxide, transition and fresh waste rock from the BP33 drill hole assay database. Overlaying the box plots are the sulphur and arsenic concentrations in the oxide, transition and fresh waste rock composite samples. The figure shows that sulphur and arsenic concentrations in the composite samples lie just either side of the corresponding median values for waste rock, except for the sulphur content of the oxide composite sample, which is significantly lower than the median sulphur value for oxide waste.

Figure 15 shows a similar comparison between the water leachability of various metals/metalloids in the three composite samples with the results from water leach tests conducted on 45 waste rock samples. In general, the concentrations of metals in water leachates of the composite samples were significantly lower than concentrations in leachates from the larger sample set. The exceptions are As and Al (fresh waste rock composite sample only), where concentrations in water extracts in the composite samples were close to median values for the larger sample set. These results suggest that these composite samples may not be entirely representative of the waste rock to be stored in the WRD at the BP33 project, with the possible exception of Al and As which are potentially the most significant elements in seepage from the WRD. However, the set of 45 samples used to compare with the three composite samples may not be entirely representative of waste rock in general, because for the fresh waste rock samples in particular, the sulphur content was significantly higher than the average value and this may have biased the results of water leachate tests towards higher concentrations.

Comparison of the combined geochemical test results for the oxide, transition and fresh composite waste rock samples with results for the corresponding waste types from all drill holes, suggests that these composite samples provide a representative set of waste rock types to be stored in the WRD at the BP33 project. Kinetic leach column tests using these samples should therefore provide results which will give a good indication of the nature of seepage that may result during surface storage of waste and leachability of solutes from the waste following backfill and inundation by recovering groundwater.

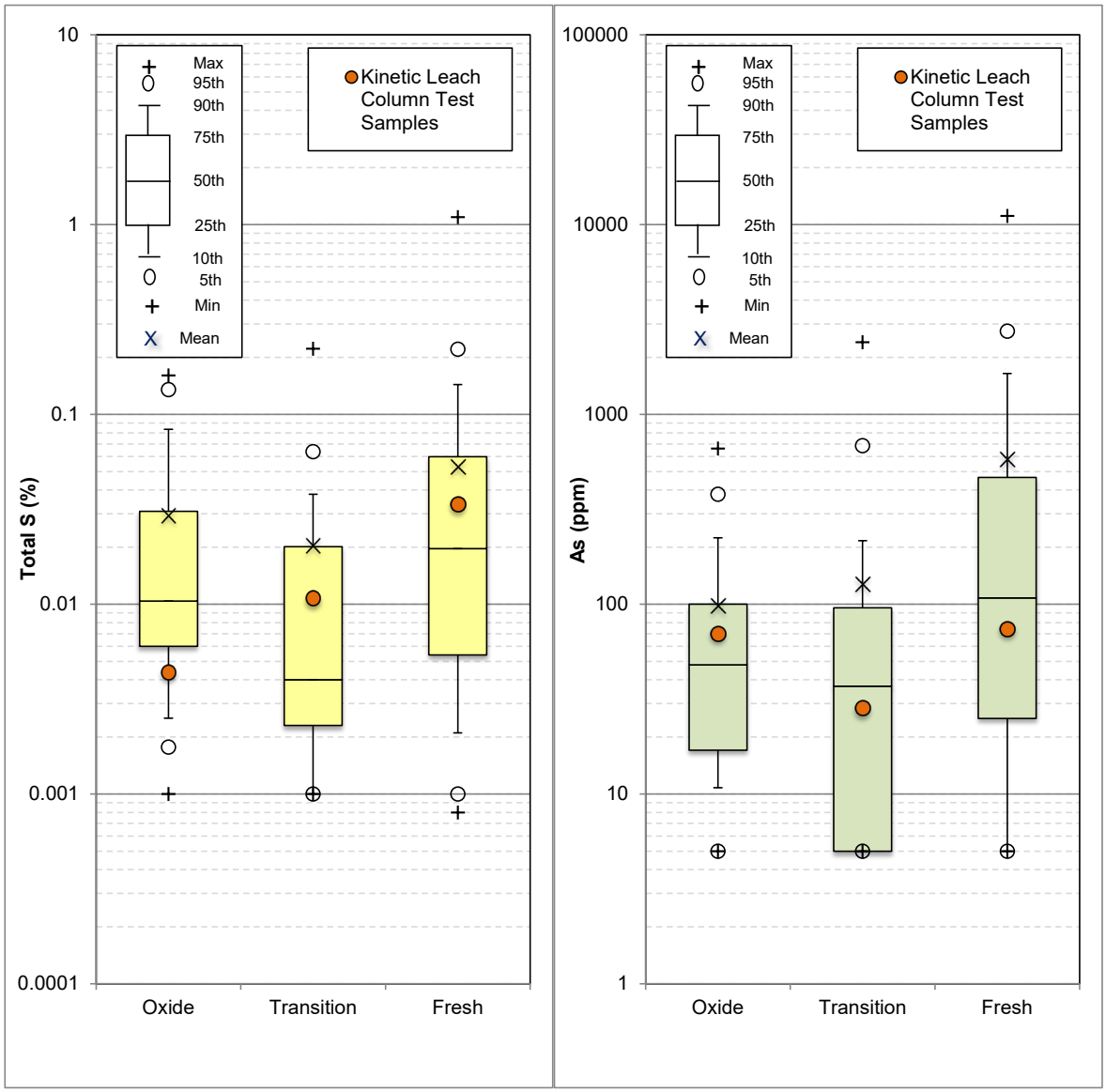


*Figure 14: Box plots for sulphur content (left) and arsenic content (right) for waste rock from the BP33 project. The brown circles show the concentrations of sulphur and arsenic for the composite oxide, transition and fresh rock samples.*

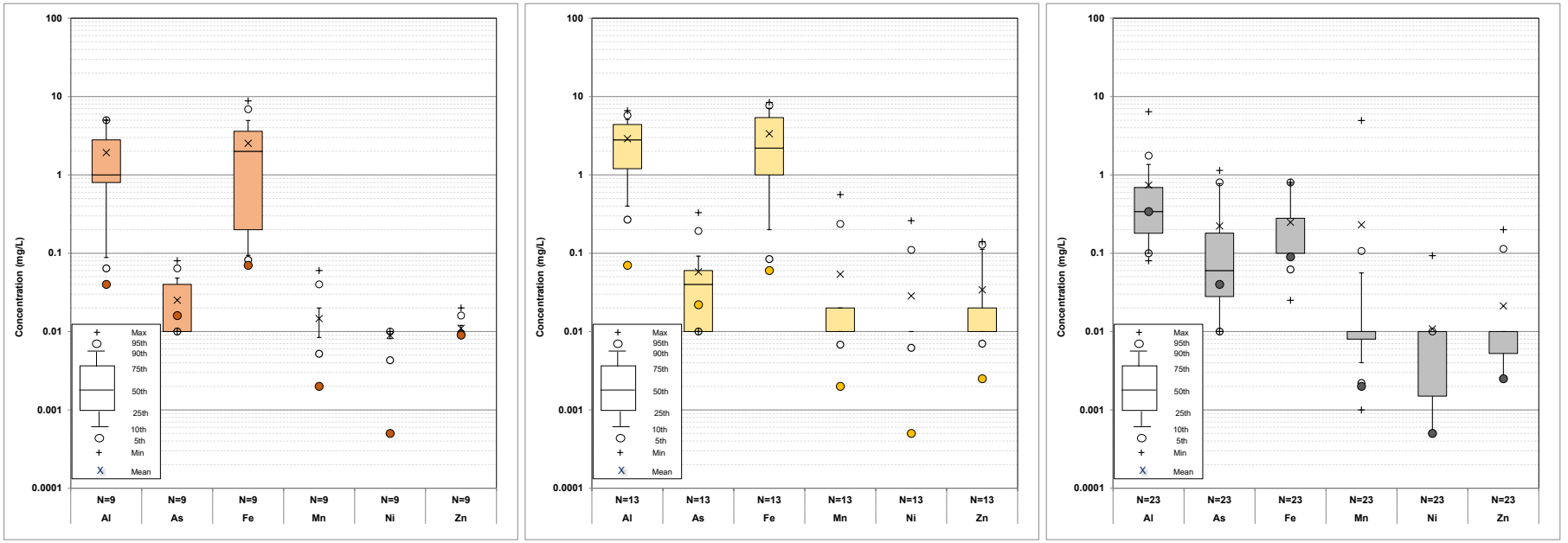


*Figure 15: Box plots for metal concentrations in water extracts for oxide(left), transition (middle) and fresh (right) waste rock samples. The brown, yellow and grey circles show the concentrations of metals in water extracts for the composite oxide, transition and fresh rock samples respectively.*

# 5. CONCLUSIONS AND RECOMMENDATIONS

## 5.1. Study Conclusions

Static geochemical testing conducted on samples covering the range of oxidation, lithologies and type (waste and ore) from the BP33 project showed that oxidation and sulphur content could be used to determine the ARD classification of materials which will be disturbed during mining of the BP33 deposit. Using the derived criteria, waste rock and ore were classified to categorise their acid forming potential. The results show:

- Oxide rock excavated from the box cut and which will be placed in WRD1 is expected to be NAF;
- Ore that will be stored in the ROM pad while awaiting transport to the processing plant is expected to be NAF; and
- Estimates indicate that only around 15,000 tonnes of PAF-LC and PAF waste will be moved to WRD2 through the life of the mine out of a total of 229,000 tonnes of transition and fresh waste rock which will be mined, with most of the 15,000 tonnes likely to be classified as PAF-LC with limited acid producing potential.

These results suggest that waste rock and ore stockpiled on the surface prior to backfill of the mine excavations or processing are unlikely to produce low pH metalliferous drainage during short-term storage.

Despite the unlikely occurrence of low pH drainage, water extraction tests suggest that Al in both waste rock and ore could be readily mobilised from freshly mined materials at neutral to slightly alkaline pH. Results also indicated that As may be mobilised from fresh waste rock on contact with water, even in the absence of significant oxidation. Consequently, the preponderance of NAF waste and likely limited oxidation of minor PAF-LC and PAF waste during short-term surface storage, does not ensure that seepage from stockpiled waste and ore will contain concentrations of Al and As near to or below local surface and shallow groundwater background concentrations.

Peroxide extraction of fresh wastes, especially PAF-LC and PAF wastes, showed that, should extensive oxidation of waste rock in WRD2 occur, the concentrations of a number of metals/metalloids including Al, As, Co, Cr, Cu, U and Zn may by elevated in comparison to background water quality, and seepage from the WRD could potentially represent a risk of contaminating the receiving environment. While PAF-LC and PAF waste volumes in this WRD are likely to represent only a very small volume of the total waste rock, testing has shown that these wastes contain very limited readily available neutralising capacity. Therefore, the possibility of poor-quality drainage from WRD2 cannot be discounted should waste be stored for an extended period, beyond what is currently anticipated under the current mine plan.

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. Geochemical test results for the oxide, transition and fresh composite waste rock samples suggest that these composite samples provide a representative set of waste rock types to be stored in the WRD at the BP33 project. Kinetic leach column tests using these samples should therefore provide results which will give a good indication of the nature of seepage that may result during surface storage of waste and leachability of solutes from the waste following backfill and inundation by recovering groundwater.

## 5.2. Recommendations

The results of this study have confirmed the requirement for kinetic testing to fully understand the geochemistry of waste rock from the BP33 project and the potential implications for environmental impacts as a result of mining. The following recommendations follow from the results of this study:

- Kinetic leach column tests should be completed as proposed including operation under oxidising conditions to simulate conditions during storage in the WRD and in the unsaturated zones within the backfilled UG mine and box cut. Following a period of leaching under oxidising conditions, KLC tests should be continued under saturated conditions to simulate the leaching properties of backfilled waste which will be placed below the water table upon rebound.
- Groundwater monitoring at BP33 (both shallow alluvial and deeper BCF aquifers) should be on-going to provide baseline water quality data for comparison with column leachate data collected during leach column testing.
- Similarly, collection of surface water quality should continue to provide baseline water quality data for comparison with KLC test results.
- The results from static and kinetic geochemical testing should be used to conduct an ARD/NMD risk assessment which can be applied in developing an ARD/NMD management plan for the operation.

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# APPENDIX A
# ABA and NAG Test Results

*Table A1: Acid forming characteristics of samples from Core Lithium BP33 Project – Current study samples set*

| EGi Code | Hole ID | Sample ID | Depth (m) | | Interval (m) | Lithology | Oxidation | Type | $pH_{1:5}$ | $EC_{1:5}$ | ACID-BASE ANALYSIS | | | | | | | | | | | | | NAG TEST | | | Reaction Comments | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | From | To | | | | | | | Total %S | CRS (%) | Total %C | Organic %C | Inorganic %C | MPA | ANC | $ANC_{TC}$ | ABCC | NAPP | $NAPP_{IC}$ | ANC/MPA | NAGpH | $NAG_{(pH4.5)}$ | $NAG_{(pH7.0)}$ | | |
| 21086 | FDD008 | B1174 | 326 | 327 | 1.0 | Py | Fr | Waste | 9.0 | 0.111 | 0.11 | | 0.02 | 0.03 | <0.01 | 3 | 7 | <1 | | -4 | 3 | 2.0 | 4.1 | 1 | 3 | | UC (PAF-LC) |
| 21087 | FRC164 | A3428 | 139 | 140 | 1.0 | Pg | Fr | Waste | 9.1 | 0.195 | 0.32 | | 0.27 | 0.05 | 0.22 | 10 | 25 | 18 | | -15 | -8 | 2.6 | 9.0 | 0 | 0 | | NAF |
| 21088 | FRC164 | A3429 | 140 | 141 | 1.0 | Pg | Fr | Waste | 8.9 | 0.272 | 0.52 | | 0.16 | 0.04 | 0.12 | 16 | 27 | 10 | | -11 | 6 | 1.7 | 8.1 | 0 | 0 | | NAF |
| 21089 | FRC164 | A3430 | 141 | 142 | 1.0 | Pg | Fr | Ore | 9.0 | 0.192 | 0.21 | | 0.08 | 0.05 | 0.03 | 7 | 8 | 2 | | -1 | 4 | 1.2 | 3.6 | 2 | 4 | | PAF-LC |
| 21090 | FRC164 | A3435 | 145 | 148 | 3.0 | Py | Fr | Waste | 9.1 | 0.159 | 0.21 | | 0.11 | 0.04 | 0.07 | 7 | 12 | 6 | | -5 | 1 | 1.8 | 3.9 | 1 | 3 | | UC (PAF-LC) |
| 21091 | FRC166 | A3512 | 212 | 213 | 1.0 | Py | Fr | Waste | 8.2 | 0.092 | 0.28 | 0.20 | 0.18 | 0.15 | 0.03 | 9 | 10 | 2 | 3 | -1 | 6 | 1.2 | 2.9 | 6 | 12 | | PAF |
| 21093 | FRC167 | A3515 | 124 | 125 | 1.0 | Pg | Fr | Waste | 9.3 | 0.121 | 0.18 | | 0.14 | 0.04 | 0.10 | 5 | 17 | 8 | | -12 | -3 | 3.2 | 4.6 | 0 | 3 | | NAF |
| 21094 | FRC167 | A3516 | 125 | 126 | 1.0 | Pg | Fr | Waste | 9.3 | 0.113 | 0.20 | <0.02 | 0.07 | 0.04 | 0.03 | 6 | 13 | 2 | 5 | -7 | 4 | 2.1 | 4.3 | 0 | 2 | | UC (PAF-LC) |
| 21095 | FRC167 | A3517 | 126 | 129 | 3.0 | Py | Fr | Waste | 9.4 | 0.126 | 0.10 | | 0.04 | 0.03 | 0.01 | 3 | 10 | 1 | | -7 | 2 | 3.2 | 5.4 | 0 | 3 | | NAF |
| 21097 | FRC168 | A3627 | 108 | 109 | 1.0 | Py | Fr | Waste | 8.8 | 0.099 | 0.16 | | 0.05 | 0.05 | <0.01 | 5 | 12 | <1 | | -7 | 5 | 2.5 | 3.7 | 1 | 6 | | PAF-LC |
| 21098 | FRC168 | A4408 | 109 | 110 | 1.0 | Py | Fr | Waste | 8.7 | 0.125 | 0.33 | | 0.07 | 0.04 | 0.03 | 10 | 12 | 2 | | -2 | 8 | 1.2 | 3.6 | 2 | 6 | | PAF-LC |
| 21099 | FRC168 | A4409 | 110 | 111 | 1.0 | Py | Fr | Waste | 8.4 | 0.162 | 0.37 | | 0.05 | 0.03 | 0.02 | 11 | 11 | 2 | | 0 | 10 | 1.0 | 3.4 | 3 | 8 | | PAF-LC |
| 21101 | FRC169 | A3629 | 66 | 69 | 3.0 | Py | Fr | Waste | 5.8 | 0.752 | 1.10 | | 0.08 | 0.05 | 0.03 | 34 | 11 | 2 | | 23 | 31 | 0.3 | 2.9 | 13 | 26 | *Reacted* | PAF |
| 21102 | FRC169 | A3630 | 69 | 70 | 1.0 | Py | Fr | Waste | 6.0 | 0.346 | 0.96 | | 0.16 | 0.03 | 0.13 | 29 | 15 | 11 | | 14 | 19 | 0.5 | 2.7 | 16 | 27 | *Reacted* | PAF |
| 21103 | FRC169 | A3632 | 70 | 71 | 1.0 | Py | Fr | Waste | 7.1 | 0.337 | 0.36 | 0.12 | 0.15 | 0.05 | 0.10 | 11 | 25 | 8 | 4 | -14 | 3 | 2.2 | 3.5 | 3 | 7 | | PAF-LC |
| 21106 | FRC172 | A3764 | 186 | 187 | 1.0 | Pg | Fr | Waste | 8.4 | 0.054 | 0.34 | | 0.02 | 0.03 | <0.01 | 10 | 6 | <1 | | 4 | 10 | 0.6 | 3.6 | 1 | 3 | | PAF-LC |
| 21107 | FRC172 | A3795 | 219 | 222 | 3.0 | Py | Fr | Waste | 8.2 | 0.143 | 0.28 | | 0.04 | 0.04 | <0.01 | 9 | 10 | <1 | | -1 | 9 | 1.2 | 3.6 | 2 | 6 | | PAF-LC |
| 21108 | FRC172 | A3796 | 222 | 223 | 1.0 | Py | Fr | Waste | 7.5 | 0.231 | 0.53 | | 0.02 | 0.03 | <0.01 | 16 | 9 | <1 | | 7 | 16 | 0.6 | 3.0 | 9 | 15 | | PAF |
| 21109 | FRC172 | A3797 | 223 | 224 | 1.0 | Py | Fr | Waste | 7.5 | 0.122 | 0.60 | 0.39 | 0.02 | 0.03 | <0.01 | 18 | 18 | <1 | 3 | 0 | 18 | 1.0 | 2.8 | 12 | 16 | | PAF |
| 21110 | FRC172 | A3798 | 224 | 225 | 1.0 | Pg | Fr | Waste | 8.5 | 0.096 | 0.30 | 0.13 | 0.03 | 0.04 | <0.01 | 9 | 14 | <1 | 3 | -5 | 9 | 1.5 | 3.2 | 5 | 8 | | PAF-LC |
| 21112 | FRC174 | A3972 | 190 | 191 | 1.0 | Py | Fr | Waste | 8.4 | 0.123 | 0.31 | | 0.14 | 0.07 | 0.07 | 9 | 5 | 6 | | 4 | 4 | 0.5 | 3.7 | 1 | 5 | | PAF-LC |
| 21114 | FRC203 | C3610 | 81 | 82 | 1.0 | Sst | Fr | Waste | 8.8 | 0.087 | 0.11 | | 0.03 | 0.05 | <0.01 | 3 | 7 | <1 | | -4 | 3 | 2.1 | 5.4 | 0 | 2 | | UC (NAF) |
| 21115 | FRC205 | C3617 | 138 | 141 | 3.0 | Sst | Fr | Waste | 8.5 | 0.137 | 0.29 | | 0.04 | 0.06 | <0.01 | 9 | 7 | <1 | | 2 | 9 | 0.8 | 3.7 | 2 | 5 | | PAF-LC |
| 21116 | FRC205 | C3669 | 184 | 185 | 1.0 | Pg | Fr | Ore | 9.7 | 0.275 | 0.20 | | 0.02 | 0.03 | <0.01 | 6 | 4 | <1 | | 2 | 6 | 0.7 | 3.8 | 1 | 3 | | PAF-LC |
| 21118 | FRC205 | C3696 | 207 | 208 | 1.0 | Pg | Fr | Ore | 9.5 | 0.302 | 0.13 | | 0.01 | 0.02 | <0.01 | 4 | 5 | <1 | | -1 | 4 | 1.3 | 4.0 | 0 | 3 | | UC (PAF-LC) |
| 21119 | FRC205 | C3697 | 208 | 209 | 1.0 | Pg | Fr | Waste | 8.8 | 0.365 | 0.24 | | 0.01 | 0.02 | <0.01 | 7 | 4 | <1 | | 3 | 7 | 0.5 | 3.3 | 4 | 7 | | PAF-LC |
| 21122 | FRC205 | C3709 | 218 | 219 | 1.0 | Pg | Fr | Waste | 7.9 | 0.279 | 0.26 | | 0.03 | 0.03 | <0.01 | 8 | 5 | <1 | | 3 | 8 | 0.6 | 3.7 | 2 | 6 | | PAF-LC |
| 21123 | FRC206 | C3782 | 137 | 138 | 1.0 | Py | Fr | Waste | 8.6 | 0.096 | 0.13 | | 0.06 | 0.04 | 0.02 | 4 | 10 | 2 | | -6 | 2 | 2.4 | 3.7 | 2 | 5 | | UC (PAF-LC) |
| 21125 | FRC212 | A6714 | 88 | 89 | 1.0 | Py | Fr | Waste | 9.0 | 0.111 | 0.12 | | 0.04 | 0.03 | 0.01 | 4 | 14 | 1 | | -10 | 3 | 3.7 | 4.7 | 0 | 3 | | UC (NAF) |
| 21126 | FRC213 | A6787 | 68 | 69 | 1.0 | Py | SW | Waste | 7.9 | 0.107 | 0.20 | | 0.07 | 0.06 | 0.01 | 6 | 14 | 1 | | -8 | 5 | 2.3 | 4.7 | 0 | 2 | | UC (NAF) |
| 21129 | FRCD016 | B1053 | 276.2 | 277 | 0.8 | Py | Fr | Waste | 9.3 | 0.133 | 0.14 | | 0.12 | 0.02 | 0.10 | 4 | 12 | 8 | | -8 | -4 | 2.8 | 6.7 | 0 | 0 | | NAF |
| 21130 | NRC057 | A4851 | 105 | 106 | 1.0 | Py | Fr | Waste | 8.5 | 0.059 | 0.16 | 0.03 | 0.04 | 0.04 | <0.01 | 5 | 15 | <1 | 1 | -10 | 5 | 3.0 | 3.5 | 2 | 5 | | PAF-LC |
| 21132 | NRC057 | A4854 | 108 | 109 | 1.0 | Py | Fr | Waste | 8.6 | 0.133 | 0.28 | | 0.05 | 0.05 | <0.01 | 9 | 10 | <1 | | -1 | 9 | 1.2 | 4.2 | 0 | 4 | | UC (PAF-LC) |
| 21134 | NRC057 | A4857 | 111 | 112 | 1.0 | Py | Fr | Waste | 8.3 | 0.096 | 0.21 | 0.02 | 0.04 | 0.03 | 0.01 | 6 | 16 | 1 | 3 | -10 | 6 | 2.5 | 3.6 | 1 | 5 | | PAF-LC |
| 21135 | NRC057 | A4858 | 112 | 113 | 1.0 | Pg | Fr | Waste | 8.1 | 0.140 | 0.21 | 0.08 | 0.13 | 0.13 | <0.01 | 6 | 19 | <1 | 5 | -13 | 6 | 3.0 | 3.6 | 1 | 5 | | PAF-LC |
| 21138 | NRC057 | A4869 | 122 | 123 | 1.0 | Sst | Fr | Waste | 8.4 | 0.091 | 0.15 | | 0.17 | 0.15 | 0.02 | 5 | 12 | 2 | | -7 | 3 | 2.6 | 5.0 | 0 | 2 | | UC (NAF) |
| 21140 | NRC057 | A4873 | 125 | 126 | 1.0 | Pg | Fr | Waste | 8.4 | 0.150 | 0.32 | | 0.02 | 0.03 | <0.01 | 10 | 14 | <1 | | -4 | 10 | 1.4 | 3.5 | 3 | 7 | | PAF-LC |
| 21141 | NRC057 | A4875 | 127 | 128 | 1.0 | Pg | Fr | Waste | 9.1 | 0.201 | 0.22 | 0.07 | 0.07 | 0.06 | 0.01 | 7 | 15 | 1 | 6 | -8 | 6 | 2.2 | 4.2 | 0 | 4 | | PAF-LC |
| 21143 | NRC129 | A6640 | 93 | 96 | 3.0 | Pg | Fr | Waste | 8.5 | 0.135 | 0.38 | | 0.09 | 0.08 | 0.01 | 12 | 8 | 1 | | 4 | 11 | 0.7 | 3.6 | 2 | 8 | | PAF-LC |
| 21144 | NRC148 | A6967 | 246 | 247 | 1.0 | Pg | Fr | Waste | 8.1 | 0.166 | 0.20 | 0.04 | 0.21 | 0.19 | 0.02 | 6 | 12 | 2 | 4 | -6 | 5 | 1.9 | 3.2 | 3 | 9 | | PAF-LC |
| 21145 | NRC148 | A6968 | 247 | 250 | 3.0 | Py | Fr | Waste | 8.2 | 0.116 | 0.27 | | 0.10 | 0.08 | 0.02 | 8 | 6 | 2 | | 2 | 6 | 0.7 | 3.1 | 4 | 10 | | PAF-LC |
| 21146 | NRC148 | A6969 | 250 | 253 | 3.0 | Py | Fr | Waste | 8.0 | 0.140 | 0.11 | | 0.55 | 0.58 | <0.01 | 3 | 7 | <1 | | -4 | 3 | 2.2 | 4.1 | 0 | 5 | | UC (PAF-LC) |
| 21148 | NRC148 | A6977 | 258 | 261 | 3.0 | Py | Fr | Waste | 7.4 | 0.245 | 0.23 | | 0.11 | 0.10 | 0.01 | 7 | 6 | 1 | | 1 | 6 | 0.9 | 3.2 | 3 | 11 | | PAF-LC |
| 21149 | NRC148 | A6983 | 274 | 275 | 1.0 | Pg | Fr | Waste | 8.5 | 0.164 | 0.30 | | 0.09 | 0.08 | 0.01 | 9 | 5 | 1 | | 4 | 8 | 0.5 | 3.2 | 4 | 8 | | PAF-LC |
| 21151 | NRC148 | A6985 | 276 | 277 | 1.0 | Pg | Fr | Waste | 8.2 | 0.170 | 0.27 | | 0.33 | 0.29 | 0.04 | 8 | 7 | 3 | | 1 | 5 | 0.8 | 3.6 | 2 | 6 | | PAF-LC |

| EGi Code | Hole ID | Sample ID | Depth (m) | | Interval (m) | Lithology | Oxidation | Type | $pH_{1:5}$ | $EC_{1:5}$ | ACID-BASE ANALYSIS | | | | | | | | | | | | NAG TEST | | | Reaction Comments | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | From | To | | | | | | | Total %S | CRS (%) | Total %C | Organic %C | Inorganic %C | MPA | ANC | $ANC_{TC}$ | ABCC | NAPP | $NAPP_{IC}$ | ANC/MPA | NAGpH | $NAG_{(pH4.5)}$ | $NAG_{(pH7.0)}$ | | |
| 21152 | NRC148 | A6992 | 281 | 282 | 1.0 | Pg | Fr | Waste | 8.9 | 0.134 | 0.25 | | 0.13 | 0.09 | 0.04 | 8 | 6 | 3 | | 2 | 5 | 0.8 | 3.8 | 1 | 6 | | PAF-LC |
| 21153 | NRC148 | A6993 | 282 | 283 | 1.0 | Pg | Fr | Waste | 5.9 | 0.613 | 0.14 | | 2.29 | 2.33 | <0.01 | 4 | 4 | <1 | | 0 | 4 | 0.9 | 3.9 | 1 | 6 | | UC (PAF-LC) |
| 21289 | - | - | - | - | - | Oxide Composite | | | 7.8 | 0.085 | 0.002 | | 0.03 | 0.04 | <0.01 | 0 | 1 | <1 | | -1 | 0 | 18.7 | 5.8 | 0 | 4 | | NAF |
| 21290 | - | - | - | - | - | Transition Composite | | | 7.9 | 0.083 | 0.011 | | 0.01 | 0.02 | <0.01 | 0 | 4 | <1 | | -4 | 0 | 12.2 | 5.7 | 0 | 3 | | NAF |
| 21291 | - | - | - | - | - | Fresh Composite | | | 9.5 | 0.076 | 0.034 | | 0.07 | 0.02 | 0.05 | 1 | 6 | 4 | | -5 | -3 | 5.8 | 6.3 | 0 | 1 | | NAF |

**KEY**

$pH_{1:2}$ = pH of 1:2 extract
$EC_{1:2}$ = Electrical Conductivity of 1:2 extract (dS/m)
MPA = Maximum Potential Acidity ($kgH_2SO_4/t$)
ANC = Acid Neutralising Capacity ($kgH_2SO_4/t$)
NAPP = Net Acid Producing Potential ($kgH_2SO_4/t$)

NAGpH = pH of NAG liquor
$NAG_{(pH4.5)}$ = Net Acid Generation capacity to pH 4.5 ($kgH_2SO_4/t$)
$NAG_{(pH7.0)}$ = Net Acid Generation capacity to pH 7.0 ($kgH_2SO_4/t$)

NAF = Non-Acid Forming
PAF = Potentially Acid Forming
PAF-LC = PAF - lower capacity
UC = Uncertain Classification
(expected classification in brackets)

*Table A2: Acid forming characteristics of samples from Core Lithium BP33 Project – Current and previous study sample sets*

| EGi Code | Hole ID | Sample ID | Depth (m) | | Depth (m) | Lithology | Weathering | Oxidation | Type | $pH_{1:2}$ | $EC_{1:2}$ | ACID-BASE ANALYSIS | | | | | | | | | | | | NAG TEST | | | Reaction Comments | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | From | To | | | | | | | | Total %S | CRS (%) | Total %C | Organic %C | Inorganic %C | MPA | ANC | $ANC_{TC}$ | ABCC | NAPP | $NAPP_{IC}$ | ANC/MPA | NAGpH | $NAG_{(pH4.5}$ | $NAG_{(pH7.0}$ | | |
| 21086 | FDD008 | B1174 | 326 | 327 | 327 | Py | FR | Fresh | Waste | 9.0 | 0.111 | 0.11 | | 0.02 | 0.03 | <0.01 | 3 | 7 | <1 | | -4 | 3 | 2.0 | 4.1 | 1 | 3 | | UC (PAF-LC) |
| 21087 | FRC164 | A3428 | 139 | 140 | 140 | Pg | FR | Fresh | Waste | 9.1 | 0.195 | 0.32 | | 0.27 | 0.05 | 0.22 | 10 | 25 | 18 | | -15 | -8 | 2.6 | 9.0 | 0 | 0 | | NAF |
| 21088 | FRC164 | A3429 | 140 | 141 | 141 | Pg | FR | Fresh | Waste | 8.9 | 0.272 | 0.52 | | 0.16 | 0.04 | 0.12 | 16 | 27 | 10 | | -11 | 6 | 1.7 | 8.1 | 0 | 0 | | NAF |
| 21089 | FRC164 | A3430 | 141 | 142 | 142 | Pg | FR | Fresh | Ore | 9.0 | 0.192 | 0.21 | | 0.08 | 0.05 | 0.03 | 7 | 8 | 2 | | -1 | 4 | 1.2 | 3.6 | 2 | 4 | | PAF-LC |
| 21090 | FRC164 | A3435 | 145 | 148 | 147 | Py | FR | Fresh | Waste | 9.1 | 0.159 | 0.21 | | 0.11 | 0.04 | 0.07 | 7 | 12 | 6 | | -5 | 1 | 1.8 | 3.9 | 1 | 3 | | UC (PAF-LC) |
| | FRC166 | FRC166_002 | | | 2 | Laterite | CW | Oxide | Waste | 5.5 | 0.003 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_008 | | | 8 | Py | CW | Oxide | Waste | 6.8 | 0.009 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_018 | | | 18 | Py | HW | Oxide | Waste | 7.0 | 0.008 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_032 | | | 32 | Py | HW | Oxide | Waste | 7.7 | 0.009 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_046 | | | 46 | Py | MW | Transition | Waste | 8.4 | 0.022 | 0.1 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_052 | | | 52 | Py | SW | Transition | Waste | 8.4 | 0.028 | 0.14 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_064 | | | 64 | Py | SW | Transition | Waste | 7.9 | 0.055 | 0.51 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_075 | | | 75 | Py | FR | Fresh | Waste | 8.5 | 0.032 | 0.29 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_088 | | | 88 | Py | FR | Fresh | Waste | 9.2 | 0.048 | 0.05 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_108 | | | 108 | Py | FR | Fresh | Waste | 9.2 | 0.037 | 0.09 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_144 | | | 144 | Py | FR | Fresh | Waste | 9.0 | 0.034 | 0.29 | | | | | | | | | | | | | | | | |
| | FRC166 | FRC166_152 | | | 152 | Py | FR | Fresh | Waste | 9.1 | 0.039 | 0.21 | | | | | | | | | | | | | | | | |
| 21091 | FRC166 | A3512 | 212 | 213 | 213 | Py | FR | Fresh | Waste | 8.2 | 0.092 | 0.28 | 0.20 | 0.18 | 0.15 | 0.03 | 9 | 10 | 2 | 3 | -1 | 6 | 1.2 | 2.9 | 6 | 12 | | PAF |
| | FRC166 | FRC166_226 | | | 226 | Py | FR | Fresh | Waste | 9.1 | 0.055 | 0.04 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_004 | | | 4 | Py | CW | Oxide | Waste | 7.2 | 0.008 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_013 | | | 13 | Py | HW | Oxide | Waste | 7.2 | 0.007 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_020 | | | 20 | Py | HW | Oxide | Waste | 6.9 | 0.009 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_031 | | | 31 | Py | HW | Oxide | Waste | 7.0 | 0.009 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_044 | | | 44 | Py | MW | Transition | Waste | 7.8 | 0.010 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_049 | | | 49 | Py | MW | Transition | Waste | 7.0 | 0.066 | 0.14 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_060 | | | 60 | Py | SW | Transition | Waste | 8.7 | 0.033 | 0.13 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_072 | | | 72 | Py | FR | Fresh | Waste | 7.8 | 0.050 | 0.23 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_076 | | | 76 | Py | FR | Fresh | Waste | 8.6 | 0.025 | 0.05 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_098 | | | 98 | Py | FR | Fresh | Waste | 9.4 | 0.087 | 0.02 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_117 | | | 117 | Py | FR | Fresh | Waste | 9.4 | 0.088 | 0.16 | | | | | | | | | | | | | | | | |
| 21093 | FRC167 | A3515 | 124 | 125 | 125 | Pg | FR | Fresh | Waste | 9.3 | 0.121 | 0.18 | | 0.14 | 0.04 | 0.10 | 5 | 17 | 8 | | -12 | -3 | 3.2 | 4.6 | 0 | 3 | | NAF |
| 21094 | FRC167 | A3516 | 125 | 126 | 126 | Pg | FR | Fresh | Waste | 9.3 | 0.113 | 0.20 | <0.02 | 0.07 | 0.04 | 0.03 | 6 | 13 | 2 | 5 | -7 | 4 | 2.1 | 4.3 | 0 | 2 | | UC (PAF-LC) |
| 21095 | FRC167 | A3517 | 126 | 129 | 128 | Py | FR | Fresh | Waste | 9.4 | 0.126 | 0.10 | | 0.04 | 0.03 | 0.01 | 3 | 10 | 1 | | -7 | 2 | 3.2 | 5.4 | 0 | 3 | | NAF |
| | FRC167 | FRC167_140 | | | 140 | Py | FR | Fresh | Waste | 9.0 | 0.032 | 0.10 | | | | | | | | | | | | | | | | |
| | FRC167 | FRC167_189 | | | 189 | Py | FR | Fresh | Waste | 9.2 | 0.052 | 0.04 | | | | | | | | | | | | | | | | |
| | FRC168 | FRC168_001 | | | 1 | Laterite | CW | Oxide | Waste | 6.0 | 0.005 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC168 | FRC168_005 | | | 5 | Py | CW | Oxide | Waste | 6.0 | 0.004 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC168 | FRC168_017 | | | 17 | Py | HW | Oxide | Waste | 6.1 | 0.004 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC168 | FRC168_042 | | | 42 | Py | MW | Transition | Waste | 7.8 | 0.012 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC168 | FRC168_045 | | | 45 | Py | MW | Transition | Waste | 7.9 | 0.012 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC168 | FRC168_052 | | | 52 | Py | SW | Transition | Waste | 8.2 | 0.012 | 0.02 | | | | | | | | | | | | | | | | |
| | FRC168 | FRC168_060 | | | 60 | Py | MW | Transition | Waste | 8.5 | 0.023 | 0.03 | | | | | | | | | | | | | | | | |
| 21097 | FRC168 | A3627 | 108 | 109 | 109 | Py | FR | Fresh | Waste | 8.8 | 0.099 | 0.16 | | 0.05 | 0.05 | 0.00 | 5 | 12 | 0 | | -7 | 5 | 2.5 | 3.7 | 1 | 6 | | PAF-LC |
| 21098 | FRC168 | A4408 | 109 | 110 | 110 | Py | FR | Fresh | Waste | 8.7 | 0.125 | 0.33 | | 0.07 | 0.04 | 0.03 | 10 | 12 | 2 | | -2 | 8 | 1.2 | 3.6 | 2 | 6 | | PAF-LC |
| 21099 | FRC168 | A4409 | 110 | 111 | 111 | Py | FR | Fresh | Waste | 8.4 | 0.162 | 0.37 | | 0.05 | 0.03 | 0.02 | 11 | 11 | 2 | | 0 | 10 | 1.0 | 3.4 | 3 | 8 | | PAF-LC |
| | FRC168 | FRC168_118 | | | 118 | Py | FR | Fresh | Waste | 8.7 | 0.076 | 0.37 | | | | | | | | | | | | | | | | |
| | FRC169 | FRC169_002 | | | 2 | Laterite | CW | Oxide | Waste | 7.3 | 0.010 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC169 | FRC169_004 | | | 4 | Py | CW | Oxide | Waste | 7.3 | 0.005 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC169 | FRC169_014 | | | 14 | Py | HW | Oxide | Waste | 7.1 | 0.007 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC169 | FRC169_026 | | | 26 | Py | HW | Oxide | Waste | 7.6 | 0.007 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC169 | FRC169_036 | | | 36 | Py | MW | Transition | Waste | 8.3 | 0.014 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC169 | FRC169_057 | | | 57 | Py | SW | Transition | Waste | 8.5 | 0.018 | 0.03 | | | | | | | | | | | | | | | | |
| | FRC169 | FRC169_065 | | | 65 | Py | FR | Fresh | Waste | 6.6 | 0.120 | 1.05 | | | | | | | | | | | | | | | | |
| 21101 | FRC169 | A3629 | 66 | 69 | 68 | Py | FR | Fresh | Waste | 5.8 | 0.752 | 1.10 | | 0.08 | 0.05 | 0.03 | 34 | 11 | 2 | | 23 | 31 | 0.3 | 2.9 | 13 | 26 | *Reacted* | PAF |

| EGi Code | Hole ID | Sample ID | Depth (m) | | Depth (m) | Lithology | Weathering | Oxidation | Type | $pH_{1:2}$ | $EC_{1:2}$ | ACID-BASE ANALYSIS | | | | | | | | | | | | NAG TEST | | | Reaction Comments | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | From | To | | | | | | | | Total %S | CRS (%) | Total %C | Organic %C | Inorganic %C | MPA | ANC | $ANC_{TC}$ | ABCC | NAPP | $NAPP_{tC}$ | ANC/MPA | NAGpH | $NAG_{(pH4.5}$ | $NAG_{(pH7.0}$ | | |
| 21102 | FRC169 | A3630 | 69 | 70 | 70 | Py | FR | Fresh | Waste | 6.0 | 0.346 | 0.96 | | 0.16 | 0.03 | 0.13 | 29 | 15 | 11 | | 14 | 19 | 0.5 | 2.7 | 16 | 27 | *Reacted* | PAF |
| 21103 | FRC169 | A3632 | 70 | 71 | 71 | Py | FR | Fresh | Waste | 7.1 | 0.337 | 0.36 | 0.12 | 0.15 | 0.05 | 0.10 | 11 | 25 | 8 | 4 | -14 | 3 | 2.2 | 3.5 | 3 | 7 | | PAF-LC |
| | FRC169 | FRC169_153 | | | 153 | Py | FR | Fresh | Waste | 9.0 | 0.033 | 0.07 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_004 | | | 4 | SOIL | CW | Oxide | Waste | 6.0 | 0.004 | 0.02 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_011 | | | 11 | Py | CW | Oxide | Waste | 6.7 | 0.004 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_023 | | | 23 | Py | HW | Oxide | Waste | 7.5 | 0.006 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_035 | | | 35 | Py | HW | Oxide | Waste | 7.6 | 0.009 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_044 | | | 44 | Py | MW | Transition | Waste | 8.0 | 0.007 | 0.02 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_056 | | | 56 | Py | SW | Transition | Waste | 8.5 | 0.016 | 0.02 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_064 | | | 64 | Py | FR | Fresh | Waste | 9.0 | 0.023 | 0.02 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_099 | | | 99 | Py | FR | Fresh | Waste | 9.2 | 0.076 | 0.02 | | | | | | | | | | | | | | | | |
| | FRC170 | FRC170_142 | | | 142 | Py | FR | Fresh | Waste | 9.4 | 0.041 | 0.03 | | | | | | | | | | | | | | | | |
| | FRC171 | FRC171_040 | | | 40 | Py | MW | Transition | Waste | 8.1 | 0.007 | <0.01 | | | | | | | | | | | | | | | | |
| | FRC171 | FRC171_065 | | | 65 | Py | SW | Transition | Waste | 6.2 | 0.002 | <0.01 | | | | | | | | | | | | | | | | |
| 21106 | FRC172 | A3764 | 186 | 187 | 187 | Pg | FR | Fresh | Waste | 8.4 | 0.054 | 0.34 | | 0.02 | 0.03 | <0.01 | 10 | 6 | <1 | | 4 | 10 | 0.6 | 3.6 | 1 | 3 | | PAF-LC |
| 21107 | FRC172 | A3795 | 219 | 222 | 221 | Py | FR | Fresh | Waste | 8.2 | 0.143 | 0.28 | | 0.04 | 0.04 | <0.01 | 9 | 10 | <1 | | -1 | 9 | 1.2 | 3.6 | 2 | 6 | | PAF-LC |
| 21108 | FRC172 | A3796 | 222 | 223 | 223 | Py | FR | Fresh | Waste | 7.5 | 0.231 | 0.53 | | 0.02 | 0.03 | <0.01 | 16 | 9 | <1 | | 7 | 16 | 0.6 | 3.0 | 9 | 15 | | PAF |
| 21109 | FRC172 | A3797 | 223 | 224 | 224 | Py | FR | Fresh | Waste | 7.5 | 0.122 | 0.60 | 0.39 | 0.02 | 0.03 | <0.01 | 18 | 18 | <1 | 3 | 0 | 18 | 1.0 | 2.8 | 12 | 16 | | PAF |
| 21110 | FRC172 | A3798 | 224 | 225 | 225 | Pg | FR | Fresh | Waste | 8.5 | 0.096 | 0.30 | 0.13 | 0.03 | 0.04 | <0.01 | 9 | 14 | <1 | 3 | -5 | 9 | 1.5 | 3.2 | 5 | 8 | | PAF-LC |
| 21112 | FRC174 | A3972 | 190 | 191 | 191 | Py | FR | Fresh | Waste | 8.4 | 0.123 | 0.31 | | 0.14 | 0.07 | 0.07 | 9 | 5 | 6 | | 4 | 4 | 0.5 | 3.7 | 1 | 5 | | PAF-LC |
| 21114 | FRC203 | C3610 | 81 | 82 | 82 | Sst | FR | Fresh | Waste | 8.8 | 0.087 | 0.11 | | 0.03 | 0.05 | <0.01 | 3 | 7 | <1 | | -4 | 3 | 2.1 | 5.4 | 0 | 2 | | UC (NAF) |
| 21115 | FRC205 | C3617 | 138 | 141 | 140 | Sst | FR | Fresh | Waste | 8.5 | 0.137 | 0.29 | | 0.04 | 0.06 | <0.01 | 9 | 7 | <1 | | 2 | 9 | 0.8 | 3.7 | 2 | 5 | | PAF-LC |
| 21116 | FRC205 | C3669 | 184 | 185 | 185 | Pg | FR | Fresh | Ore | 9.7 | 0.275 | 0.20 | | 0.02 | 0.03 | <0.01 | 6 | 4 | <1 | | 2 | 6 | 0.7 | 3.8 | 1 | 3 | | PAF-LC |
| 21118 | FRC205 | C3696 | 207 | 208 | 208 | Pg | FR | Fresh | Ore | 9.5 | 0.302 | 0.13 | | 0.01 | 0.02 | <0.01 | 4 | 5 | <1 | | -1 | 4 | 1.3 | 4.0 | 0 | 3 | | UC (PAF-LC) |
| 21119 | FRC205 | C3697 | 208 | 209 | 209 | Pg | FR | Fresh | Waste | 8.8 | 0.365 | 0.24 | | 0.01 | 0.02 | <0.01 | 7 | 4 | <1 | | 3 | 7 | 0.5 | 3.3 | 4 | 7 | | PAF-LC |
| 21122 | FRC205 | C3709 | 218 | 219 | 219 | Pg | FR | Fresh | Waste | 7.9 | 0.279 | 0.26 | | 0.03 | 0.03 | <0.01 | 8 | 5 | <1 | | 3 | 8 | 0.6 | 3.7 | 2 | 6 | | PAF-LC |
| 21123 | FRC206 | C3782 | 137 | 138 | 138 | Py | FR | Fresh | Waste | 8.6 | 0.096 | 0.13 | | 0.06 | 0.04 | 0.02 | 4 | 10 | 2 | | -6 | 2 | 2.4 | 3.7 | 2 | 5 | | UC (PAF-LC) |
| | FRC212 | FRC212 - 8 | | | 8 | Pg | HW | Oxide | Waste | 8.0 | 0.015 | <0.01 | | | | | <0.3 | 8 | | | -8 | | >25 | 6.6 | <0.1 | 1 | | NAF |
| | FRC212 | FRC212 - 15 | | | 15 | Py | MW | Transition | Waste | 7.9 | 0.017 | <0.01 | | | | | <0.3 | 12 | | | -12 | | >40 | 7.4 | <0.1 | <0.1 | | NAF |
| | FRC212 | FRC212 - 44 | | | 44 | Py | MW | Transition | Waste | 7.9 | 0.021 | <0.01 | | | | | <0.3 | 16 | | | -16 | | >54 | 7.3 | <0.1 | <0.1 | | NAF |
| | FRC212 | FRC212 - 53 | | | 53 | Pg | MW | Transition | Waste | 8.7 | 0.038 | <0.01 | | | | | <0.3 | 13 | | | -13 | | >42 | 7.0 | <0.1 | <0.1 | | NAF |
| | FRC212 | FRC212 - 66 | | | 66 | Py | SW | Transition | Waste | 8.9 | 0.042 | <0.01 | | | | | <0.3 | 14 | | | -14 | | >47 | 6.2 | <0.1 | 4 | | NAF |
| | FRC212 | FRC212 - 81 | | | 81 | Pg | FR | Fresh | Waste | 8.5 | 0.039 | <0.01 | | | | | <0.3 | 13 | | | -13 | | >44 | 6.8 | <0.1 | 1 | | NAF |
| | FRC212 | FRC212 - 88 | | | 88 | Py | FR | Fresh | Waste | 8.6 | 0.072 | 0.02 | | | | | 1 | 23 | | | -22 | | 37.6 | 6.2 | <0.1 | 2 | | NAF |
| 21125 | FRC212 | A6714 | 88 | 89 | 89 | Py | FR | Fresh | Waste | 9.0 | 0.111 | 0.12 | | 0.04 | 0.03 | 0.01 | 4 | 14 | 1 | | -10 | 3 | 3.7 | 4.7 | 0 | 3 | | UC (NAF) |
| | FRC212 | FRC212 - 92 | | | 92 | Pg | FR | Fresh | Waste | 9.3 | 0.050 | <0.01 | | | | | <0.3 | 12 | | | -12 | | >41 | 7.2 | <0.1 | <0.1 | | NAF |
| | FRC212 | FRC212 - 97 | | | 97 | Pg | FR | Fresh | Ore | 9.3 | 0.051 | <0.01 | | | | | <0.3 | 13 | | | -13 | | >42 | 6.0 | <0.1 | 4 | | NAF |
| | FRC212 | FRC212 - 109 | | | 109 | Pg | FR | Fresh | Ore | 9.4 | 0.129 | <0.01 | | | | | <0.3 | 16 | | | -16 | | >53 | 7.6 | <0.1 | <0.1 | | NAF |
| | FRC212 | FRC212 - 122 | | | 122 | Pg | FR | Fresh | Ore | 9.6 | 0.130 | <0.01 | | | | | <0.3 | 12 | | | -12 | | >41 | 7.0 | <0.1 | 1 | | NAF |
| | FRC212 | FRC212 - 131 | | | 131 | Pg | FR | Fresh | Waste | 9.3 | 0.077 | 0.01 | | | | | 0.3 | 36 | | | -35 | | 116.3 | 7.1 | <0.1 | <0.1 | | NAF |
| | FRC212 | FRC212 - 143 | | | 143 | Py | FR | Fresh | Waste | 9.4 | 0.076 | 0.07 | | | | | 2 | 21 | | | -19 | | 9.8 | 6.2 | <0.1 | 1 | | NAF |
| | FRC213 | FRC213 - 5 | | | 5 | Py | HW | Oxide | Waste | 8.1 | 0.012 | <0.01 | | | | | <0.3 | 11 | | | -11 | | >35 | 6.7 | <0.1 | 1 | | NAF |
| | FRC213 | FRC213 - 26 | | | 26 | Py | MW | Transition | Waste | 7.7 | 0.016 | <0.01 | | | | | <0.3 | 14 | | | -14 | | >45 | 7.4 | <0.1 | <0.1 | | NAF |
| | FRC213 | FRC213 - 37 | | | 37 | Pg | HW | Oxide | Waste | 8.1 | 0.032 | <0.01 | | | | | <0.3 | 16 | | | -16 | | >53 | 7.6 | <0.1 | <0.1 | | NAF |
| | FRC213 | FRC213 - 58 | | | 58 | Py | SW | Transition | Waste | 8.7 | 0.030 | <0.01 | | | | | <0.3 | 17 | | | -17 | | >56 | 6.2 | <0.1 | 3 | | NAF |
| | FRC213 | FRC213 - 62 | | | 62 | Pg | SW | Transition | Waste | 8.3 | 0.056 | <0.01 | | | | | <0.3 | 13 | | | -13 | | >43 | 6.8 | <0.1 | 1 | | NAF |
| | FRC213 | FRC213 - 67 | | | 67 | Pg | SW | Transition | Waste | 8.4 | 0.037 | 0.02 | | | | | 1 | 22 | | | -21 | | 35.1 | 6.8 | <0.1 | 1 | | NAF |
| 21126 | FRC213 | A6787 | 68 | 69 | 69 | Py | SW | Transition | Waste | 7.9 | 0.107 | 0.20 | | 0.07 | 0.06 | 0.01 | 6 | 14 | 1 | | -8 | 5 | 2.3 | 4.7 | 0 | 2 | | UC (NAF) |
| | FRC213 | FRC213 - 86 | | | 86 | Pg | FR | Fresh | Waste | 9.2 | 0.048 | 0.09 | | | | | 3 | 16 | | | -13 | | 5.7 | 4.4 | 0 | 2.4 | | UC (NAF) |
| | FRC213 | FRC213 - 107 | | | 107 | Sst | FR | Fresh | Waste | 9.4 | 0.082 | 0.02 | | | | | 1 | 22 | | | -21 | | 35.3 | 6.8 | <0.1 | 0.6 | | NAF |
| | FRC213 | FRC213 - 131 | | | 131 | Py | FR | Fresh | Waste | 9.5 | 0.089 | 0.03 | | | | | 1 | 15 | | | -14 | | 16.8 | 7.2 | <0.1 | <0.1 | | NAF |
| | FRC213 | FRC213 - 142 | | | 142 | Pg | FR | Fresh | Ore | 8.7 | 0.072 | 0.02 | | | | | 1 | 19 | | | -19 | | 31.5 | 7.2 | <0.1 | <0.1 | | NAF |
| | FRC213 | FRC213 - 148 | | | 148 | Pg | FR | Fresh | Ore | 9.4 | 0.128 | <0.01 | | | | | <0.3 | 10 | | | -10 | | >33 | 7.8 | <0.1 | <0.1 | | NAF |
| | FRC213 | FRC213 - 156 | | | 156 | Pg | FR | Fresh | Ore | 8.3 | 0.107 | 0.02 | | | | | 1 | 9 | | | -9 | | 15.4 | 6.6 | <0.1 | 0.8 | | NAF |
| | FRC213 | FRC213 - 170 | | | 170 | Pg | FR | Fresh | Ore | 9.5 | 0.143 | <0.01 | | | | | <0.3 | 10 | | | -10 | | >33 | 7.3 | <0.1 | <0.1 | | NAF |

| EGi Code | Hole ID | Sample ID | Depth (m) | | Depth (m) | Lithology | Weathering | Oxidation | Type | $pH_{1:2}$ | $EC_{1:2}$ | ACID-BASE ANALYSIS | | | | | | | | | | | | NAG TEST | | | Reaction Comments | ARD Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | From | To | | | | | | | | Total %S | CRS (%) | Total %C | Organic %C | Inorganic %C | MPA | ANC | $ANC_{TC}$ | ABCC | NAPP | $NAPP_{tC}$ | ANC/MPA | NAGpH | $NAG_{(pH4.5)}$ | $NAG_{(pH7.0)}$ | | |
| | FRC213 | FRC213 - 178 | | | 178 | Pg | FR | Fresh | Ore | 9.4 | 0.138 | <0.01 | | | | | <0.3 | 13 | | | -13 | | >44 | 7.9 | <0.1 | <0.1 | | NAF |
| | FRC213 | FRC213 - 187 | | | 187 | Py | FR | Fresh | Waste | 9.1 | 0.089 | 0.10 | | | | | 3 | 19 | | | -16 | | 6.1 | 5.8 | <0.1 | 0.9 | | NAF |
| | FRC214 | FRC214 - 6 | | | 6 | Py | CW | Oxide | Waste | 7.9 | 0.032 | <0.01 | | | | | <0.3 | 10 | | | -10 | | >32 | 7.4 | <0.1 | <0.1 | | NAF |
| | FRC214 | FRC214 - 13 | | | 13 | Py | HW | Oxide | Waste | 7.3 | 0.018 | <0.01 | | | | | <0.3 | 8 | | | -8 | | >27 | 7.1 | <0.1 | <0.1 | | NAF |
| | FRC214 | FRC214 - 20 | | | 20 | Py | CW | Oxide | Waste | 7.7 | 0.030 | <0.01 | | | | | <0.3 | 10 | | | -10 | | >32 | 7.2 | <0.1 | <0.1 | | NAF |
| | FRC214 | FRC214 - 34 | | | 34 | Py | HW | Oxide | Waste | 8.5 | 0.034 | <0.01 | | | | | <0.3 | 14 | | | -14 | | >46 | 7.4 | <0.1 | <0.1 | | NAF |
| | FRC214 | FRC214 - 45 | | | 45 | Py | MW | Transition | Waste | 8.6 | 0.034 | <0.01 | | | | | <0.3 | 14 | | | -14 | | >47 | 7.3 | <0.1 | <0.1 | | NAF |
| | FRC214 | FRC214 - 50 | | | 50 | Py | SW | Transition | Waste | 8.9 | 0.040 | <0.01 | | | | | <0.3 | 14 | | | -14 | | >46 | 7.3 | <0.1 | <0.1 | | NAF |
| | FRC214 | FRC214 - 74 | | | 74 | Py | FR | Fresh | Waste | 9.0 | 0.048 | 0.01 | | | | | 0 | 14 | | | -14 | | 45.8 | 7.2 | <0.1 | <0.1 | | NAF |
| | FRC214 | FRC214 - 102 | | | 102 | Pg | FR | Fresh | Ore | 9.2 | 0.115 | <0.01 | | | | | <0.3 | 11 | | | -11 | | >38 | 6.9 | <0.1 | 0.5 | | NAF |
| | FRC214 | FRC214 - 116 | | | 116 | Pg | FR | Fresh | Waste | 9.1 | 0.056 | 0.04 | | | | | 1 | 13 | | | -12 | | 10.5 | 6.4 | <0.1 | 0.4 | | NAF |
| 21129 | FRCD016 | B1053 | 276.2 | 277 | 277 | Py | FR | Fresh | Waste | 9.3 | 0.133 | 0.14 | | 0.12 | 0.02 | 0.10 | 4 | 12 | 8 | | -8 | -4 | 2.8 | 6.7 | 0 | 0 | | NAF |
| 21130 | NRC057 | A4851 | 105 | 106 | 106 | Py | FR | Fresh | Waste | 8.5 | 0.059 | 0.16 | 0.03 | 0.04 | 0.04 | <0.01 | 5 | 15 | <1 | 1 | -10 | 5 | 3.0 | 3.5 | 2 | 5 | | PAF-LC |
| 21132 | NRC057 | A4854 | 108 | 109 | 109 | Py | FR | Fresh | Waste | 8.6 | 0.133 | 0.28 | | 0.05 | 0.05 | <0.01 | 9 | 10 | <1 | | -1 | 9 | 1.2 | 4.2 | 0 | 4 | | UC (PAF-LC) |
| 21134 | NRC057 | A4857 | 111 | 112 | 112 | Py | FR | Fresh | Waste | 8.3 | 0.096 | 0.21 | 0.02 | 0.04 | 0.03 | 0.01 | 6 | 16 | 1 | 3 | -10 | 6 | 2.5 | 3.6 | 1 | 5 | | PAF-LC |
| 21135 | NRC057 | A4858 | 112 | 113 | 113 | Pg | FR | Fresh | Waste | 8.1 | 0.140 | 0.21 | 0.08 | 0.13 | 0.13 | <0.01 | 6 | 19 | <1 | 5 | -13 | 6 | 3.0 | 3.6 | 1 | 5 | | PAF-LC |
| 21138 | NRC057 | A4869 | 122 | 123 | 123 | Sst | FR | Fresh | Waste | 8.4 | 0.091 | 0.15 | | 0.17 | 0.15 | 0.02 | 5 | 12 | 2 | | -7 | 3 | 2.6 | 5.0 | 0 | 2 | | UC (NAF) |
| 21140 | NRC057 | A4873 | 125 | 126 | 126 | Pg | FR | Fresh | Waste | 8.4 | 0.150 | 0.32 | | 0.02 | 0.03 | <0.01 | 10 | 14 | <1 | | -4 | 10 | 1.4 | 3.5 | 3 | 7 | | PAF-LC |
| 21141 | NRC057 | A4875 | 127 | 128 | 128 | Pg | FR | Fresh | Waste | 9.1 | 0.201 | 0.22 | 0.07 | 0.07 | 0.06 | 0.01 | 7 | 15 | 1 | 6 | -8 | 6 | 2.2 | 4.2 | 0 | 4 | | PAF-LC |
| | NRC129 | NRC129 - 4 | | | 4 | Py | EW | Oxide | Waste | 5.6 | 0.007 | <0.01 | | | | | <0.3 | 8 | | | -8 | | >27 | 5.6 | <0.1 | 1 | | NAF |
| | NRC129 | NRC129 - 20 | | | 20 | Py | MW | Transition | Waste | 7.0 | 0.015 | <0.01 | | | | | <0.3 | 12 | | | -12 | | >41 | 7.3 | <0.1 | <0.1 | | NAF |
| | NRC129 | NRC129 - 55 | | | 55 | Py | SW | Transition | Waste | 8.3 | 0.082 | 0.14 | | | | | 4 | 19 | | | -15 | | 4.4 | 4.4 | 0.2 | 3 | | UC (PAF-LC) |
| | NRC129 | NRC129 - 68 | | | 68 | Sst | FR | Fresh | Waste | 9.0 | 0.052 | 0.05 | | | | | 2 | 15 | | | -14 | | 9.9 | 5.6 | <0.1 | 3 | | NAF |
| | NRC129 | NRC129 - 89 | | | 89 | Py | FR | Fresh | Waste | 8.8 | 0.062 | 0.17 | | | | | 5 | 18 | | | -12 | | 3.4 | 3.8 | 2 | 7 | | UC (PAF-LC) |
| 21143 | NRC129 | A6640 | 93 | 96 | 95 | Pg | FR | Fresh | Waste | 8.5 | 0.135 | 0.38 | | 0.09 | 0.08 | 0.01 | 12 | 8 | 1 | | 4 | 11 | 0.7 | 3.6 | 2 | 8 | | PAF-LC |
| | NRC129 | NRC129 - 98 | | | 98 | Pg | FR | Fresh | Waste | 9.0 | 0.069 | 0.02 | | | | | 1 | 13 | | | -13 | | 21.9 | 6.9 | <0.1 | 0.4 | | NAF |
| | NRC129 | NRC129 - 134 | | | 134 | Py | FR | Fresh | Waste | 9.3 | 0.095 | 0.42 | | | | | 13 | 17 | | | -4 | | 1.3 | 3.4 | 6 | 8 | | UC (PAF) |
| 21144 | NRC148 | A6967 | 246 | 247 | 247 | Pg | FR | Fresh | Waste | 8.1 | 0.166 | 0.20 | 0.04 | 0.21 | 0.19 | 0.02 | 6 | 12 | 2 | 4 | -6 | 5 | 1.9 | 3.2 | 3 | 9 | | PAF-LC |
| 21145 | NRC148 | A6968 | 247 | 250 | 249 | Py | FR | Fresh | Waste | 8.2 | 0.116 | 0.27 | | 0.10 | 0.08 | 0.02 | 8 | 6 | 2 | | 2 | 6 | 0.7 | 3.1 | 4 | 10 | | PAF-LC |
| 21146 | NRC148 | A6969 | 250 | 253 | 252 | Py | FR | Fresh | Waste | 8.0 | 0.140 | 0.11 | | 0.55 | 0.58 | <0.01 | 3 | 7 | <1 | | -4 | 3 | 2.2 | 4.1 | 0 | 5 | | UC (PAF-LC) |
| 21148 | NRC148 | A6977 | 258 | 261 | 260 | Py | FR | Fresh | Waste | 7.4 | 0.245 | 0.23 | | 0.11 | 0.10 | 0.01 | 7 | 6 | 1 | | 1 | 6 | 0.9 | 3.2 | 3 | 11 | | PAF-LC |
| 21149 | NRC148 | A6983 | 274 | 275 | 275 | Pg | FR | Fresh | Waste | 8.5 | 0.164 | 0.30 | | 0.09 | 0.08 | 0.01 | 9 | 5 | 1 | | 4 | 8 | 0.5 | 3.2 | 4 | 8 | | PAF-LC |
| 21151 | NRC148 | A6985 | 276 | 277 | 277 | Pg | FR | Fresh | Waste | 8.2 | 0.170 | 0.27 | | 0.33 | 0.29 | 0.04 | 8 | 7 | 3 | | 1 | 5 | 0.8 | 3.6 | 2 | 6 | | PAF-LC |
| 21152 | NRC148 | A6992 | 281 | 282 | 282 | Pg | FR | Fresh | Waste | 8.9 | 0.134 | 0.25 | | 0.13 | 0.09 | 0.04 | 8 | 6 | 3 | | 2 | 5 | 0.8 | 3.8 | 1 | 6 | | PAF-LC |
| 21153 | NRC148 | A6993 | 282 | 283 | 283 | Pg | FR | Fresh | Waste | 5.9 | 0.613 | 0.14 | | 2.29 | 2.33 | <0.01 | 4 | 4 | <1 | | 0 | 4 | 0.9 | 3.9 | 1 | 6 | | UC (PAF-LC) |

**KEY**

$pH_{1:2}$ = pH of 1:2 extract
$EC_{1:2}$ = Electrical Conductivity of 1:2 extract (dS/m)
MPA = Maximum Potential Acidity ($kgH_2SO_4/t$)
ANC = Acid Neutralising Capacity ($kgH_2SO_4/t$)
NAPP = Net Acid Producing Potential ($kgH_2SO_4/t$)

NAGpH = pH of NAG liquor
$NAG_{(pH4.5)}$ = Net Acid Generation capacity to pH 4.5 ($kgH_2SO_4/t$)
$NAG_{(pH7.0)}$ = Net Acid Generation capacity to pH 7.0 ($kgH_2SO_4/t$)

NAF = Non-Acid Forming
PAF = Potentially Acid Forming
PAF-LC = PAF - lower capacity
UC = Uncertain Classification
(expected classification in brackets

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# APPENDIX B
# ABCC Test Results

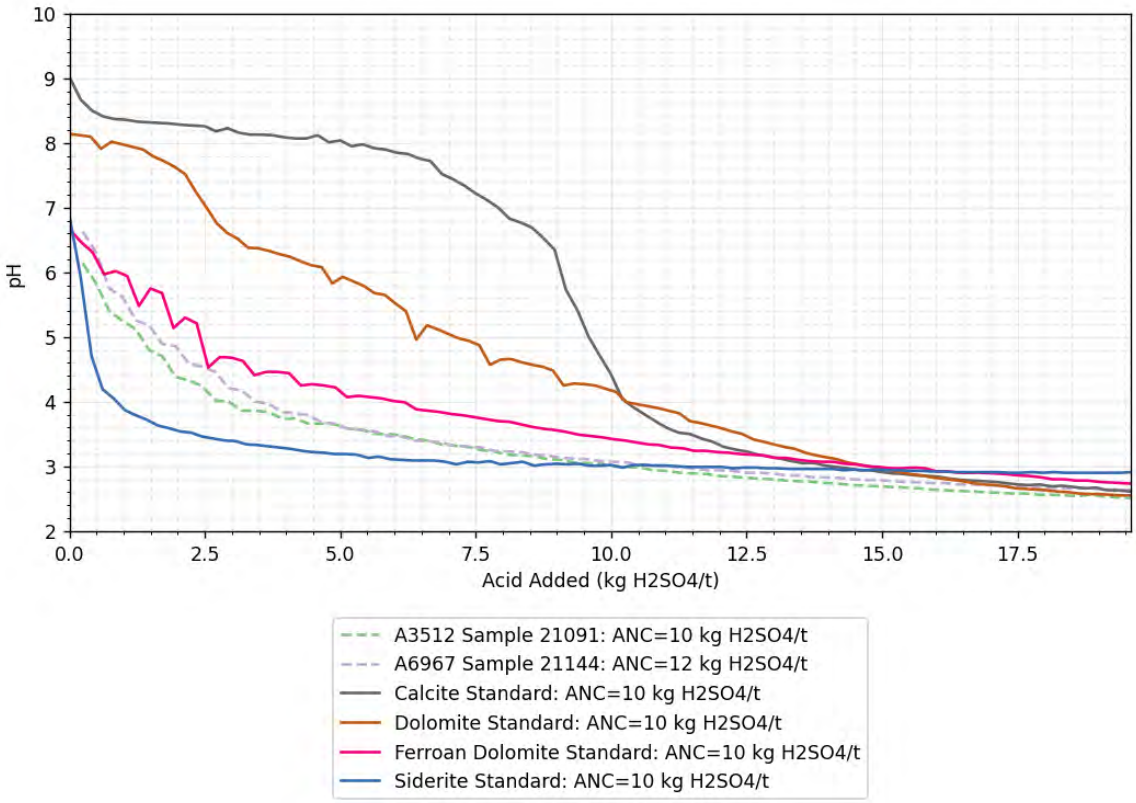


*Figure B16: ABCC profile for samples 21091, 21144 with an ANC value close to 10 kg H2SO4/t. Carbonate standard curves are included for reference. Note sample IDs used here are the EGi Codes. Sample details for each EGi Code can be found in Table A1 (Appendix A).*

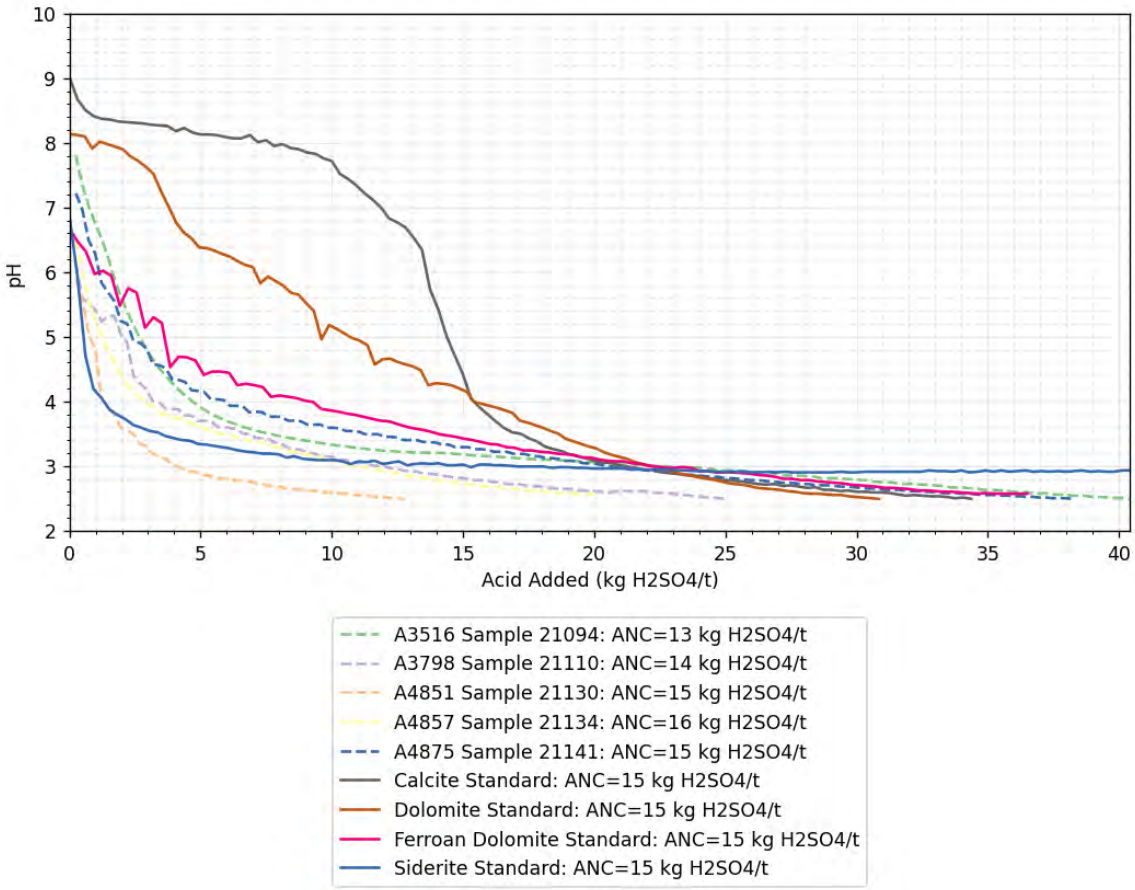


*Figure B17: ABCC profile for samples 21094, 21110, 21130, 21134, 21141 with an ANC value close to 15 kg H2SO4/t. Carbonate standard curves are included for reference. Note sample IDs used here are the EGi Codes. Sample details for each EGi Code can be found in Table A1 (Appendix A).*

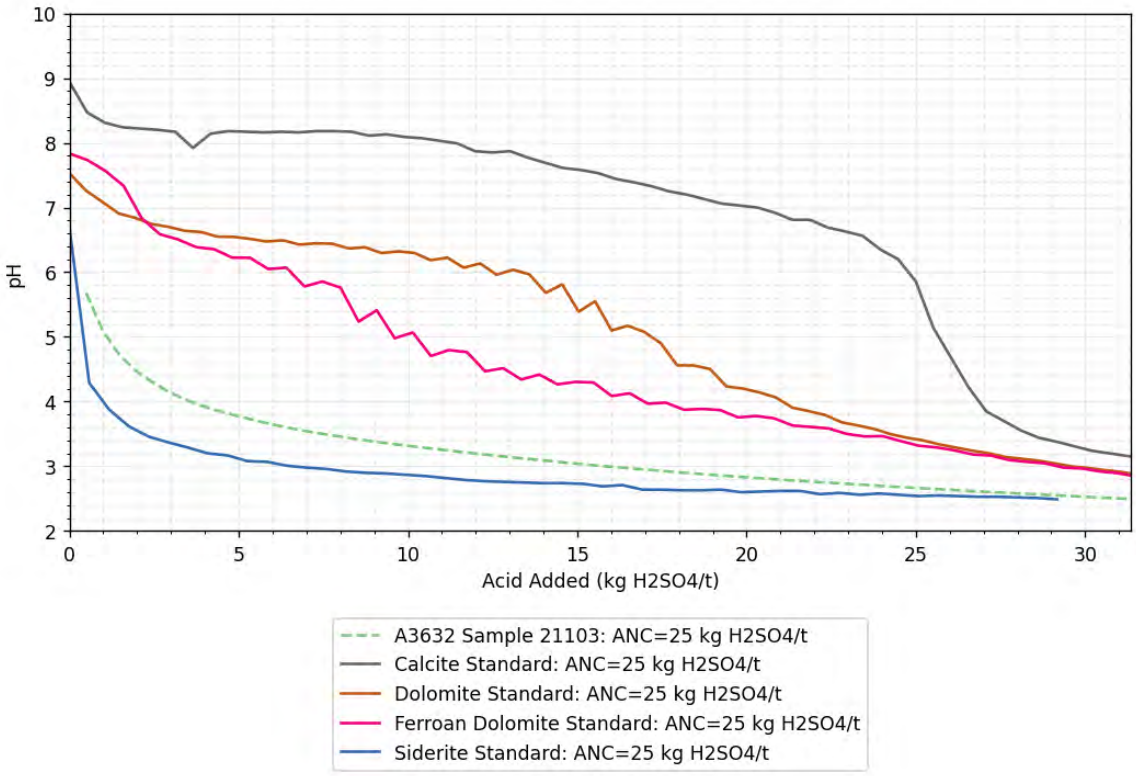


*Figure B18: ABCC profile for sample 21103 with an ANC value close to 25 kg H2SO4/t. Carbonate standard curves are included for reference. Note sample IDs used here are the EGi Codes. Sample details for each EGi Code can be found in Table A1 (Appendix A).*

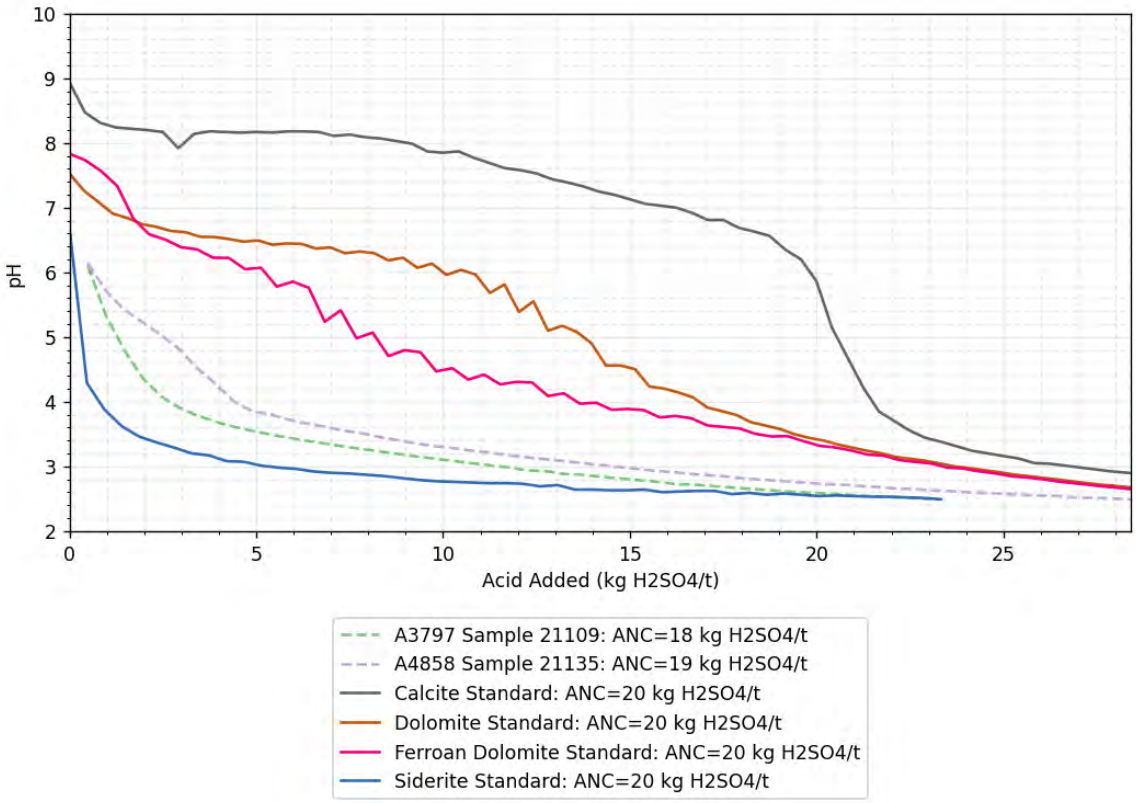


*Figure B19: ABCC profile for samples 21109, 21135 with an ANC value close to 20 kg H2SO4/t. Carbonate standard curves are included for reference. Note sample IDs used here are the EGi Codes. Sample details for each EGi Code can be found in Table A1 (Appendix A).*

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# APPENDIX C
# Bulk Assay Results

*Table C1: Multi-element assay results for selected samples from Core Lithium BP33 Project. All results are ppm except where indicated. Note sample IDs used here are the EGi Codes. Sample details for each EGi Code can be found in Table A1 (Appendix A).*

| | | Sample ID | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Element | Detection Limit | 21095 | 21093 | 21291 | 21290 | 21138 | 21134 | 21109 | 21102 | 21086 | 21289 |
| Ag | 0.01 | 0.01 | 0.03 | 0.04 | 0.05 | 0.08 | 0.11 | 0.22 | 0.26 | 0.28 | 0.59 |
| Al | 0.01% | 6.72% | 5.95% | 6.20% | 5.79% | 6.82% | 7.45% | 8.39% | 6.07% | 6.54% | 6.63% |
| As | 0.2 | 2710 | 5370 | 70.7 | 65.1 | 1100 | 6180 | 11350 | 380 | 397 | 87.1 |
| Ba | 10 | 570 | 360 | 550 | 570 | 400 | 490 | 450 | 580 | 590 | 370 |
| Be | 0.05 | 18.9 | 36 | 2.17 | 2.88 | 59.1 | 56.2 | 38.3 | 16 | 9.12 | 40 |
| Bi | 0.01 | 1.02 | 1.93 | 0.28 | 0.52 | 0.87 | 2.8 | 2.45 | 1.82 | 0.65 | 0.79 |
| Ca | 0.01% | 0.37% | 0.68% | 0.28% | 0.24% | 0.52% | 0.85% | 1.14% | 0.84% | 0.20% | 0.04% |
| Cd | 0.02 | 0.66 | 0.55 | 0.02 | 0.03 | 0.67 | 1.58 | 0.86 | 0.39 | 1.9 | 0.06 |
| Ce | 0.01 | 77.5 | 50.5 | 79.7 | 80.7 | 56.9 | 17.15 | 26.3 | 90.1 | 63.2 | 59 |
| Co | 0.1 | 8.2 | 6 | 7.4 | 9.1 | 7.1 | 12.4 | 9.9 | 9.3 | 11.5 | 6.1 |
| Cr | 1 | 129 | 149 | 71 | 76 | 357 | 112 | 69 | 105 | 76 | 99 |
| Cs | 0.05 | 500 | 321 | 47.6 | 159.5 | 452 | >500 | 225 | >500 | >500 | 99 |
| Cu | 0.2 | 3.8 | 4 | 16.7 | 14.9 | 16.2 | 3.9 | 8.5 | 69.8 | 29 | 16.2 |
| Fe | 0.01% | 2.65% | 2.19% | 2.96% | 2.58% | 2.35% | 3.22% | 2.23% | 5.86% | 4.11% | 2.46% |
| Ga | 0.05 | 19.55 | 24.4 | 17.6 | 15.65 | 18.95 | 22.1 | 27.7 | 18.55 | 20.2 | 19.75 |
| Ge | 0.05 | 0.16 | 0.14 | 0.19 | 0.15 | 0.15 | 0.12 | 0.13 | 0.17 | 0.15 | 0.16 |
| Hf | 0.01 | 5.2 | 4.4 | 5.3 | 5.8 | 4.3 | 6.5 | 4 | 3.8 | 4.5 | 5.1 |
| Hg | 0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.007 | <0.005 | 0.008 |
| In | 0.005 | 0.155 | 0.153 | 0.049 | 0.046 | 0.14 | 0.319 | 0.185 | 0.113 | 0.125 | 0.042 |
| K | 0.01% | 3.23% | 2.76% | 2.72% | 2.38% | 3.05% | 3.80% | 4.01% | 2.38% | 3.14% | 2.09% |
| La | 0.5 | 38.5 | 24.9 | 39.9 | 41.8 | 29.7 | 7.1 | 12.3 | 46.4 | 32 | 31.6 |
| Li | 0.2 | 1490 | 820 | 153 | 200 | 2340 | 2560 | 1380 | 900 | 840 | 113 |
| Mg | 0.01% | 0.55% | 0.36% | 0.66% | 0.53% | 0.45% | 0.63% | 0.42% | 0.64% | 0.79% | 0.25% |
| Mn | 5 | 328 | 486 | 329 | 196 | 299 | 211 | 335 | 2000 | 526 | 243 |
| Mo | 0.05 | 1.09 | 1.3 | 0.24 | 0.2 | 2 | 0.57 | 0.44 | 0.88 | 0.91 | 0.52 |
| Na | 0.01% | 0.23% | 0.62% | 0.68% | 0.60% | 0.68% | 0.12% | 0.88% | 0.27% | 0.36% | 1.16% |
| Nb | 0.1 | 14.5 | 31.3 | 11.4 | 11 | 31.2 | 23.6 | 23.3 | 16.3 | 11.7 | 54.6 |
| Ni | 0.2 | 18.6 | 14.5 | 15.5 | 16.5 | 21.4 | 21.3 | 14.3 | 25 | 20 | 12.5 |
| P | 10 | 1450 | 2530 | 300 | 290 | 2460 | 4010 | 5560 | 3710 | 560 | 280 |
| Pb | 0.5 | 10.8 | 12.6 | 12.9 | 14.6 | 10.6 | 7.3 | 11.2 | 10.8 | 309 | 22.4 |
| Rb | 0.1 | 1150 | 667 | 169.5 | 206 | 1160 | 2360 | 1060 | 508 | 602 | 307 |
| Re | 0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| S | 0.01% | 0.12% | 0.22% | 0.05% | 0.02% | 0.12% | 0.20% | 0.73% | 1.09% | 0.21% | 0.01% |
| Sb | 0.05 | 0.38 | 0.55 | 0.05 | 0.05 | 0.43 | 1.15 | 0.87 | 0.08 | 0.17 | 0.09 |
| Sc | 0.1 | 9.7 | 6.7 | 9.2 | 8.6 | 7.7 | 10 | 8.2 | 11 | 11.9 | 6.2 |
| Se | 1 | <1 | <1 | <1 | <1 | <1 | <1 | 1 | 1 | <1 | <1 |
| Sn | 0.2 | 147.5 | 183.5 | 5.8 | 6.1 | 141.5 | 363 | 210 | 91.5 | 35.8 | 22.9 |
| Sr | 0.2 | 44.8 | 66.8 | 47.4 | 53.4 | 126 | 369 | 400 | 64.3 | 43.9 | 24.2 |
| Ta | 0.05 | 7.02 | 77.2 | 1.01 | 1.04 | 18.75 | 19.05 | 12.65 | 4.59 | 1.06 | 87.8 |
| Te | 0.05 | 0.06 | 0.1 | <0.05 | <0.05 | 0.05 | 0.17 | 0.1 | 0.11 | <0.05 | <0.05 |
| Th | 0.2 | 50.5 | 111 | 16.25 | 15.75 | 22 | 36.4 | 8.84 | 17.4 | 19.85 | 13.3 |
| Ti | 0.005% | 0.23% | 0.17% | 0.26% | 0.26% | 0.18% | 0.22% | 0.15% | 0.20% | 0.25% | 0.17% |
| Tl | 0.02 | 11.6 | 5.89 | 0.88 | 1.16 | 11.6 | 24.8 | 8.85 | 5.12 | 5.97 | 2.54 |
| U | 0.1 | 6.3 | 6 | 3.7 | 4 | 5.8 | 3.3 | 5.6 | 3.9 | 6.9 | 4.1 |
| V | 1 | 43 | 29 | 40 | 38 | 36 | 46 | 31 | 40 | 51 | 28 |
| W | 0.1 | 18 | 16.1 | 7.6 | 4.6 | 12.8 | 17.9 | 21.8 | 7.2 | 11.5 | 10.6 |
| Y | 0.1 | 17.5 | 16.2 | 10.9 | 11.5 | 12 | 17.6 | 10.6 | 24.2 | 10.5 | 10.8 |
| Zn | 2 | 55 | 62 | 44 | 45 | 110 | 87 | 55 | 81 | 928 | 56 |
| Zr | 0.5 | 145 | 105.5 | 152 | 168.5 | 109 | 119 | 103.5 | 103 | 122 | 126 |

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# APPENDIX D
# Water and Peroxide Extraction Results

*Table D1: Multi-element assay results for water extracts of selected samples from Core Lithium BP33 Project. Note sample IDs used here are the EGi Codes. Sample details for each EGi Code can be found in Table A1 (Appendix A).*

| Element | Units | Detection Limit | Sample ID | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 21086 | 21093 | 21095 | 21102 | 21109 | 21134 | 21138 | 21289 | 21290 | 21291 |
| pH | | 0.1 | 9.0 | 9.3 | 9.4 | 6.0 | 7.5 | 8.3 | 8.4 | 7.8 | 7.9 | 9.5 |
| EC | dS/m | 0.001 | 0.111 | 0.121 | 0.126 | 0.346 | 0.122 | 0.096 | 0.091 | 0.085 | 0.083 | 0.076 |
| Acidity | mg/l | 1 | | | | 21 | | | | | | |
| Alkalinity | mg/l | 1 | 34 | 86 | 49 | | 16 | 23 | 25 | 14 | 49 | 41 |
| Ag | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Al | mg/l | 0.01 | 0.08 | 0.26 | 0.58 | 0.18 | 0.19 | 0.23 | 0.18 | 0.04 | 0.07 | 0.34 |
| As | mg/l | 0.001 | 0.016 | 0.578 | 0.739 | 0.014 | 0.805 | 0.785 | 0.161 | 0.016 | 0.022 | 0.04 |
| B | mg/l | 0.05 | <0.05 | <0.05 | <0.05 | 0.17 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Ba | mg/l | 0.001 | 0.193 | 0.088 | 0.072 | 0.114 | 0.022 | 0.005 | 0.007 | 0.021 | 0.015 | 0.13 |
| Be | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Ca | mg/l | 1 | 4 | 3 | 2 | 20 | <1 | <1 | <1 | <1 | <1 | 2 |
| Cd | mg/l | 0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0002 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Cl | mg/l | 1 | <1 | 1 | 1 | <1 | 2 | 1 | 2 | 2 | <1 | <1 |
| Co | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | 0.024 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Cr | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Cu | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | 0.012 | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 | <0.001 |
| F | mg/l | 0.1 | 1.2 | 2.1 | 3.2 | 0.4 | 2 | 3 | 2.2 | 0.6 | 0.5 | 0.4 |
| Fe | mg/l | 0.05 | <0.05 | 0.08 | 0.21 | 0.35 | 0.06 | 0.1 | 0.1 | 0.07 | 0.06 | 0.09 |
| Hg | mg/l | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| K | mg/l | 1 | 20 | 24 | 30 | 29 | 24 | 15 | 15 | 1 | 2 | 15 |
| Mg | mg/l | 1 | <1 | <1 | <1 | 17 | <1 | <1 | <1 | <1 | <1 | <1 |
| Mn | mg/l | 0.001 | 0.004 | 0.006 | 0.004 | 4.94 | 0.112 | 0.001 | 0.006 | 0.002 | 0.002 | 0.002 |
| Mo | mg/l | 0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 |
| Na | mg/l | 1 | 6 | 6 | 4 | 8 | 6 | 2 | 6 | 5 | 4 | 4 |
| Ni | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | 0.093 | 0.002 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 |
| P | mg/l | 1 | <1 | <1 | <1 | <1 | <1 | <1 | 1 | <1 | <1 | <1 |
| Pb | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Sb | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Se | mg/l | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Si | mg/l | 0.1 | 0.6 | 1.7 | 2.0 | 0.5 | 0.8 | 0.7 | 0.9 | 1.1 | 1.5 | 1.6 |
| Sn | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| SO4 | mg/l | 1 | 18 | 6 | 4 | 160 | 24 | 5 | 9 | <1 | <1 | 1 |
| Sr | mg/l | 0.001 | 0.009 | 0.007 | 0.004 | 0.074 | 0.006 | 0.001 | 0.001 | <0.001 | 0.001 | 0.006 |
| Th | mg/l | 0.001 | <0.001 | 0.004 | 0.004 | <0.001 | <0.001 | 0.005 | <0.001 | <0.001 | <0.001 | <0.001 |
| Tl | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| U | mg/l | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Zn | mg/l | 0.005 | <0.005 | <0.005 | <0.005 | 0.125 | 0.008 | <0.005 | <0.005 | 0.009 | <0.005 | <0.005 |

*Table D2: Multi-element assay results for peroxide extracts of selected samples from Core Lithium BP33 Project. Measured extract concentrations have been multiplied by five to provide an estimate of likely leachate concentrations from column leach tests. Note sample IDs used here are the EGi Codes. Sample details for each EGi Code can be found in Table A1 (Appendix A).*

| Element | Units | Detection Limit | Sample ID | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 21086 | 21093 | 21095 | 21102 | 21109 | 21134 | 21138 | 21289 | 21290 | 21291 |
| Ag | mg/l | 0.001 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Al | mg/l | 0.01 | 6.2 | 3.75 | 2.2 | 52.35 | 63.35 | 17.55 | 3.05 | <0.05 | <0.05 | <0.05 |
| As | mg/l | 0.001 | 0.03 | 37.45 | 32.45 | 0.605 | 58.45 | 21.95 | 4.37 | 0.345 | 0.605 | 1.27 |
| B | mg/l | 0.05 | 0.45 | 0.5 | 0.55 | 1 | 0.75 | 0.6 | 0.45 | 0.25 | 0.35 | 0.35 |
| Ba | mg/l | 0.001 | 2.66 | 2.085 | 2.415 | 0.51 | 0.61 | 2.95 | 2.72 | 2.09 | 2.31 | 2.495 |
| Be | mg/l | 0.001 | 0.01 | <0.005 | <0.005 | 0.045 | 0.035 | 0.02 | <0.005 | <0.005 | <0.005 | <0.005 |
| Ca | mg/l | 1 | 20 | 85 | 30 | 55 | 85 | 15 | 10 | <5 | <5 | 30 |
| Cd | mg/l | 0.0001 | 0.091 | 0.002 | <0.0005 | 0.003 | 0.001 | 5E-04 | 0.001 | <0.0005 | <0.0005 | <0.0005 |
| Cl | mg/l | 1 | <5 | <5 | 5 | <5 | <5 | <5 | <5 | 15 | 15 | <5 |
| Co | mg/l | 0.001 | 0.4 | 0.135 | 0.055 | 0.36 | 0.485 | 0.45 | 0.05 | <0.005 | <0.005 | <0.005 |
| Cr | mg/l | 0.001 | 0.02 | 0.055 | 0.04 | 0.09 | 0.08 | 0.05 | 0.18 | 0.05 | 0.03 | 0.025 |
| Cu | mg/l | 0.001 | 0.765 | 0.045 | <0.005 | 3.705 | 0.415 | 0.06 | 0.015 | <0.005 | <0.005 | <0.005 |
| F | mg/l | 0.1 | 2.5 | 4 | 4 | 6.5 | 8 | 5.5 | 3 | 1 | 0.5 | 0.5 |
| Fe | mg/l | 0.05 | <0.25 | <0.25 | <0.25 | 93 | 3.6 | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Hg | mg/l | 0.0001 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| K | mg/l | 1 | 40 | 50 | 70 | 65 | 80 | 80 | 80 | 15 | 20 | 35 |
| Mg | mg/l | 1 | 15 | 5 | 5 | 20 | 10 | 10 | 10 | <5 | <5 | 5 |
| Mn | mg/l | 0.001 | 1.895 | 4.675 | 0.97 | 23.34 | 1.955 | 0.415 | 2.285 | 0.98 | 0.095 | 0.66 |
| Mo | mg/l | 0.001 | 0.03 | 0.01 | 0.01 | <0.005 | 0.005 | <0.005 | 0.01 | <0.005 | <0.005 | 0.01 |
| Na | mg/l | 1 | 40 | 30 | 40 | 45 | 45 | 45 | 50 | 40 | 40 | 50 |
| Ni | mg/l | 0.001 | 0.755 | 0.285 | 0.11 | 1.145 | 0.675 | 0.705 | 0.115 | <0.005 | <0.005 | <0.005 |
| P | mg/l | 1 | <5 | <5 | <5 | <5 | 15 | <5 | <5 | <5 | <5 | <5 |
| Pb | mg/l | 0.001 | 3.83 | 0.03 | <0.005 | 0.155 | 0.03 | 0.035 | <0.005 | <0.005 | <0.005 | <0.005 |
| Sb | mg/l | 0.001 | <0.005 | 0.01 | 0.01 | <0.005 | <0.005 | 0.015 | 0.005 | <0.005 | <0.005 | <0.005 |
| Se | mg/l | 0.01 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Si | mg/l | 0.1 | 31.65 | 49.7 | 42.3 | 62 | 68 | 49.95 | 60 | 23.2 | 27.3 | 25 |
| Sn | mg/l | 0.001 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| SO4 | mg/l | 1 | 285 | 365 | 160 | 1570 | 1230 | 335 | 185 | 5 | 30 | 95 |
| Sr | mg/l | 0.001 | 0.09 | 0.135 | 0.065 | 0.19 | 2.585 | 0.41 | 0.18 | 0.04 | 0.06 | 0.07 |
| Th | mg/l | 0.001 | <0.005 | <0.005 | <0.005 | 0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Tl | mg/l | 0.001 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.01 | <0.005 | <0.005 | <0.005 | <0.005 |
| U | mg/l | 0.001 | <0.005 | 0.015 | 0.005 | 0.06 | 0.045 | 0.01 | <0.005 | <0.005 | <0.005 | <0.005 |
| Zn | mg/l | 0.005 | 41.925 | 2.04 | 1.1 | 2.505 | 1.71 | 1.475 | 1.505 | 0.87 | 0.945 | 0.915 |

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# APPENDIX E

# Assay Results for DD Drill Core Samples for use in Kinetic Column Testing

*Table E1: Multi-element assay results for oxide DD drill core samples from BP33 deposit. Samples highlighted in brown were composited to produce an oxide sample for use in kinetic leach column testing.*

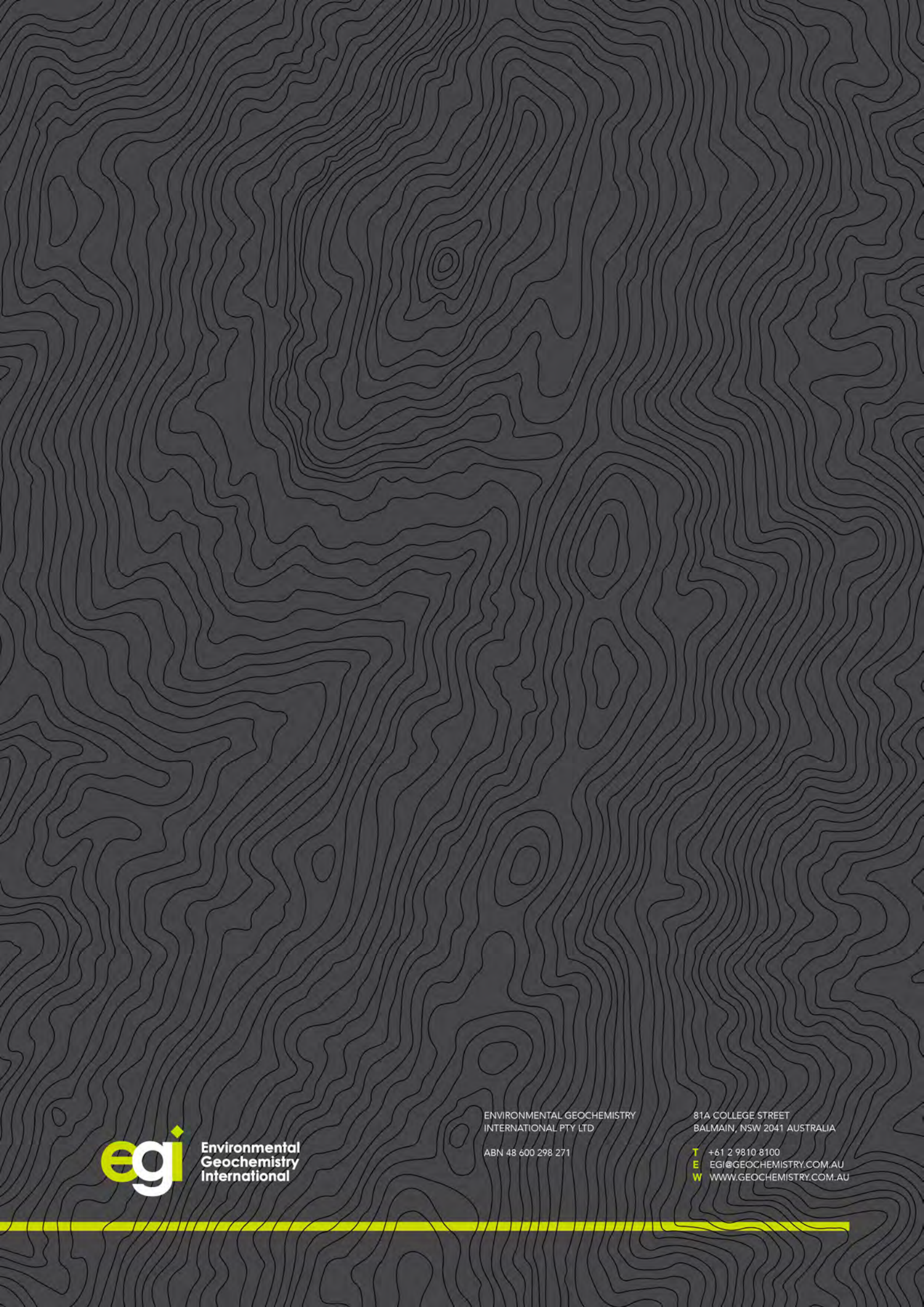
| Hole ID | Easting | Northing | Lithology 1 | Lithology 2 | Weathering | Description | Depth_from | Depth_to | Mean Depth | Sample ID | Type_Method | Date | Cs_ppm | Sr_ppm | Nb_ppm | Sn_ppm | Ta_ppm | U_ppm | Sb_ppm | Li_ppm | Rb_ppm | As_ppm | K_ppm | P_ppm | Fe_ppm | S_ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FDD010 | 694530 | 8593587 | Py | | EW to MW | Saprolite/saprock (phyllite) in weathered/oxidised zone. Variable colour inc pale to dark brown, pale yellow, tan, pale to mid green. | 0 | 40 | 20 | FDD010_WC01 | Composite of corefragments from each metre | 12/12/2020 | 250.64 | 34.07 | 12.96 | 33.25 | 11.03 | 3.14 | 0.16 | 343 | 505 | 193 | 26213 | 103 | 49410 | <20 |
| FDD011 | 694282 | 8593699 | Py | Sst | EW to MW | Saprolite/saprock (phyllite) in weathered/oxidised zone. Variable colour inc pale to mid brown, pale yellow, tan. | 0 | 25 | 12.5 | FDD011_WC01 | Composite of corefragments from each metre | 17/01/2021 | 113.91 | 6.69 | 7.16 | 2.12 | 0.83 | 2.3 | <0.05 | 197 | 533 | 77 | 21208 | L | 39870 | 33 |
| FDD011 | 694282 | 8593699 | Pg | | HW | Clay-weathered pegmatite, often crumbly and broken up into fine powder. Bright white. | 37 | 38 | 37.5 | FDD011_WC03 | Half PQ core split | 17/01/2021 | 34.23 | 1.8 | 110.8 | 21.39 | 180.2 | 0.51 | <0.05 | 48 | 751 | <10 | 20064 | 235 | 818 | <20 |
| FDD012 | 694257 | 8593850 | Py | Sst | EW to MW | Saprolite/saprock (phyllite and sandstone) in weathered/oxidised zone. Variable colour inc pale to dark brown and red-brown, pale yellow, tan, pale to mid green. However, pale dominates. | 0 | 28 | 14 | FDD012_WC01 | Composite of corefragments from each metre | 22/01/2021 | 18.33 | 9.07 | 6.72 | 2.31 | 0.62 | 2.36 | 0.09 | 48 | 275 | 33 | 13457 | 85 | 39465 | 44 |
| FDD012 | 694257 | 8593850 | Sst | Py | HW to MW | Sandstone and lesser phyllite interlayered. Minor (<2%) quartz veins and joints. Mixed loose and coherent core. Some unconsolidated "flowing" sand. More highly weathered than 28-38m interval. Pale grey and yellow. | 38 | 48 | 43 | FDD012_WC03 | Composite of corefragments from each metre | 22/01/2021 | 16.27 | 15.86 | 6.33 | 3.8 | 0.58 | 2.62 | 0.1 | 52 | 238 | 49 | 15961 | 170 | 33420 | <20 |

*Table E2: Multi-element assay results for transition DD drill core samples from BP33 deposit. Samples highlighted in brown were composited to produce a transition sample for use in kinetic leach column testing.*

| Hole ID | Easting | Northing | Lithology 1 | Lithology 2 | Weathering | Description | Depth_from | Depth_to | Mean Depth | Sample ID | Type_Method | Date | Cs_ppm | Sr_ppm | Nb_ppm | Sn_ppm | Ta_ppm | U_ppm | Sb_ppm | Li_ppm | Rb_ppm | As_ppm | K_ppm | P_ppm | Fe_ppm | S_ppm | S_% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FDD010 | 694530 | 8593587 | Py | | SW | Phyllite with fractures at high angle to core axis and minor (<2%) quartz veins in transitional zone. Pale grey. | 46.3 | 47.3 | 46.8 | FDD010_WC02 | Half PQ coresplit | 12/12/2020 | 172.87 | 25.91 | 8.22 | 5.36 | 0.88 | 3.03 | 0.06 | 218 | 292 | 80 | 19404 | 383 | 27630 | 400 | 0.04 |
| FDD011 | 694282 | 8593699 | Py | | MW | Phyllite moderately weathered zone. Coherent core. Pale yellow-brown. | 28 | 29 | 28.5 | FDD011_WC02 | Half PQ core cut | 17/01/2021 | 98.39 | 9.52 | 7.37 | 3.42 | 0.89 | 2.03 | <0.05 | 294 | 602 | 104 | 25251 | 78 | 31320 | <20 | <0.002 |
| FDD011 | 694282 | 8593699 | Sst | | MW | Sandstone, finely laminated/foliated in transitional zone. Minor (<2%) quartz veins. Pale grey. | 53 | 54 | 53.5 | FDD011_WC05 | Half PQ core cut | 17/01/2021 | 183.4 | 58.4 | 10.27 | 4.43 | 0.95 | 3.52 | <0.05 | 383 | 340 | <10 | 22446 | 249 | 32513 | <20 | <0.002 |
| FDD011 | 694282 | 8593699 | Sst | | SW | Sandstone, finely laminated/foliated in transitional zone. Minor joints. Pale grey. | 60 | 61 | 60.5 | FDD011_WC06 | Half PQ core cut | 17/01/2021 | 40.72 | 37.89 | 7.11 | 1.44 | 0.74 | 2.61 | <0.05 | 238 | 226 | <10 | 18095 | 312 | 24503 | <20 | <0.002 |
| FDD012 | 694257 | 8593850 | Sst | Py | MW | Sandstone and lesser phyllite interlayered. Minor (<2%)quartz veins and joints. Mostly coherent core. Pale green, brown and yellow. | 28 | 38 | 33 | FDD012_WC02 | Composite of core fragments from each metre | 22/01/2021 | 21.2 | 21.97 | 8.31 | 3.46 | 0.78 | 2.39 | 1.45 | 92 | 360 | 17 | 26571 | 90 | 39473 | 50 | 0.01 |
| FDD012 | 694257 | 8593850 | Sst | | MW | Sandstone, fine grained banded. Minor (<1%) quartz veins and joints. Coherent core. Pale to mid green-grey,with yellow and red staining pervading along joints. | 50 | 51 | 50.5 | FDD012_WC04 | Half PQ core cut | 26/01/2021 | 33.35 | 32.33 | 7.71 | 3.76 | 0.66 | 2.6 | 0.07 | 104 | 261 | 23 | 21236 | 338 | 32618 | <20 | <0.002 |
| FDD012 | 694257 | 8593850 | Sst | | SW | Sandstone, fine grained banded. Coherent core. Pale to mid green-grey. | 67 | 68 | 67.5 | FDD012_WC06 | Half PQ core cut | 26/01/2021 | 126.33 | 30.73 | 8.78 | 3.92 | 0.64 | 2.77 | <0.05 | 176 | 353 | <10 | 20433 | 192 | 31658 | <20 | <0.002 |
| FDD012 | 694257 | 8593850 | Sst | | MW | Sandstone, fine grained banded. Jointed fractured core.Pale to mid green-grey, with yellow and red staining pervading along joints. More weathered than above. | 73 | 74 | 73.5 | FDD012_WC08 | Half PQ coresplit | 26/01/2021 | 43.13 | 11.44 | 8.32 | 4.97 | 0.66 | 2.02 | <0.05 | 195 | 295 | <10 | 18981 | 351 | 35273 | <20 | <0.002 |

*Table E3: Multi-element assay results for fresh DD drill core samples from BP33 deposit. Samples highlighted in brown were composited to produce a fresh sample for use in kinetic leach column testing.*

| Hole ID | Eastin g | Northing | Litholog y 1 | Litholog y 2 | Weatheri ng | Description | Depth_fr o m | Depth_to | Mean Depth | Sample ID | Type_Me t hod | Photo info | Date | SAMPLE_Lab | Cs_ppm | Sr_ppm | Nb_pp m | Sn_ppm | Ta_ppm | U_ppm | Sb_ppm | Li_ppm | Rb_ppm | As_ppm | K_ppm | P_ppm | Fe_ppm | S_ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FDD010 | 694530 | 8593587 | Py | | FR | Phyllite - soild core with no imperfections. Dark grey. | 91 | 92 | 91.5 | FDD010 _WC04 | Half HQ core cut | Refer to core tray photos | 15/12/2020 | FDD010_WC0 4 | 200 | 18.8 | 10.77 | 5.86 | 1.03 | 3.39 | 0.05 | 337 | 329 | 154 | 32802 | 226 | 42158 | 1074 |
| FDD010 | 694530 | 8593587 | Sst | | FR | Sandstone, highly fractured (partly drilling related but atleast some natural) with no alteration. Dark grey. | 149 | 150 | 149.5 | FDD010 _WC06 | Half HQ core split | Refer to core tray photos | 15/12/2020 | FDD010_WC0 6 | 24.19 | 45.25 | 8.96 | 3.07 | 0.88 | 3.31 | <0.05 | 164 | 206 | 28 | 22022 | 311 | 24203 | 40 |
| FDD010 | 694530 | 8593587 | Py | | FR | Phyllite, foliated and jointed throughout. Dark grey. | 185 | 186 | 185.5 | FDD010 _WC07 | Half HQ core cut | Refer to core tray photos | 19/12/2020 | FDD010_WC0 7 | 23.02 | 21.56 | 9.86 | 4.36 | 0.91 | 2.72 | 0.07 | 178 | 374 | 25 | 38407 | 124 | 44723 | 610 |
| FDD010 | 694530 | 8593587 | Py | | FR | Phyllite, jointed throughout. Dark grey. | 235 | 236 | 235.5 | FDD010 _WC09 | Half HQ core cut | Refer to core tray photos | 19/12/2020 | FDD010_WC0 9 | 17.47 | 27.42 | 9.97 | 4.12 | 0.69 | 3.23 | <0.05 | 120 | 269 | 38 | 29271 | 430 | 28118 | 103 |
| FDD010 | 694530 | 8593587 | Py | Sst | FR | Phyllite with lesser interbands of fine sandstone. Soild core with no imperfections. Dark grey. | 258 | 259 | 258.5 | FDD010 _WC10 | Half HQ core cut | Refer to core tray photos | 19/12/2020 | FDD010_WC1 0 | 18.04 | 37.14 | 5 | 1.79 | 0.44 | 1.83 | <0.05 | 104 | 263 | 50 | 20856 | 310 | 36525 | 37 |
| FDD010 | 694530 | 8593587 | Py | Sst | FR | Phyllite with lesser interbands of fine sandstone. Soild core with no imperfections. Dark grey. | 322 | 323 | 322.5 | FDD010 _WC11 | Half HQ core cut | Refer to core tray photos | 21/12/2020 | FDD010_WC1 1 | 27.01 | 14.46 | 10.03 | 6.6 | 0.95 | 2.94 | <0.05 | 131 | 300 | 78 | 23414 | 440 | 39480 | 82 |
| FDD010 | 694530 | 8593587 | Py | Sst | FR | Phyllite with lesser interbands of fine sandstone. Jointed throughout. Dark grey. | 352 | 353 | 352.5 | FDD010 _WC12 | Half HQ core cut | Refer to core tray photos | 21/12/2020 | FDD010_WC1 2 | 51.39 | 11.39 | 8.06 | 5.85 | 0.74 | 1.67 | 0.06 | 133 | 297 | 264 | 28347 | 445 | 47033 | 937 |
| FDD011 | 694282 | 8593699 | Sst | | FR | Sandstone, finely laminated/foliated in fresh zone. Minor (<2%) quartz veins. Mid grey. | 71 | 72 | 71.5 | FDD011 _WC09 | Half PQ core cut | Refer to core tray photos | 17/01/2021 | FDD011_WC0 9 | 23.35 | 12.82 | 5.84 | 1.67 | 0.6 | 1.35 | <0.05 | 250 | 295 | <10 | 20647 | 372 | 29453 | 51 |



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# Kinetic Geochemical Testing of Waste Rock

Finniss Lithium Project BP33 UG Mine

S1312 / J000662 / R1525

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## FINNISS LITHIUM PROJECT BP33 UG MINE

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# LIST OF ABBREVIATIONS

## ABBREVIATIONS USED IN GEOCHEMICAL ASSESSMENT

| | |
|---|---|
| **ABA** | Acid Base Account |
| **ABCC** | Acid Buffering Characteristic Curve |
| **AC** | Acid Consuming |
| **AMD** | Acid Metalliferous Drainage |
| **ANC** | Acid Neutralising Capacity in kg $H_2SO_4$/t |
| **$ANC_{ABCC}$** | Acid Neutralising Capacity in kg $H_2SO_4$/t estimated from ABCC testing |
| **$ANC_{TC}$** | Carbonate Neutralising Value based on Total C in kg $H_2SO_4$/t |
| **ARD** | Acid Rock Drainage |
| **$CaCO_3$** | Calcium Carbonate |
| **CNV** | Carbonate Neutralising Value in kg $H_2SO_4$/t |
| **CRS** | Chromium Reducible Sulphur |
| **$EC_{1:2}$** | Electrical Conductivity of a sample slurry with a solid to water ratio of 1:2 (by weight) |
| **ECEC** | Effective Cation Exchange Capacity |
| **ESP** | Exchangeable Sodium Percentage |
| **GAI** | Geochemical Abundance Index based on multi-elements of solids |
| **$H_2SO_4$** | Sulphuric Acid |
| **KCl** | Potassium Chloride |
| **MPA** | Maximum Potential Acidity, calculated from total S in kg $H_2SO_4$/t |
| **NAF** | Non-Acid Forming |
| **NAG** | Net Acid Generation (test) |
| **$NAG_{(pH4.5)}$** | NAG acidity titrated to pH 4.5 in kg $H_2SO_4$/t |
| **$NAG_{(pH7.0)}$** | NAG acidity titrated to pH 7.0 in kg $H_2SO_4$/t |
| **NAGpH** | pH of NAG solution before titration |
| **NAPP** | Net Acid Producing Potential, calculated from ANC and total S (or MPA) in kg $H_2SO_4$/t. |
| **NMD** | Neutral Metalliferous Drainage |
| **PAF** | Potentially Acid Forming |
| **PAF-LC** | Potentially Acid Forming - Low Capacity |
| **$pH_{1:2}$** | pH of a sample slurry with a solid to water ratio of 1:2 (by weight) |
| **S** | Sulphur |
| **SD** | Saline Drainage |
| **$SO_4$** | Sulphate |
| **UC** | Uncertain |

## UNITS OF MEASUREMENTS

| | |
|---|---|
| **%** | Percentage |
| **°C** | Degrees Celsius |
| **dS** | Deci Siemen |
| **µm** | Micrometre |
| **mm** | Millimetre |
| **m** | Metre |
| **mg** | Milligram |
| **g** | Gram |
| **kg** | Kilogram |
| **t** | Tonne |
| **L** | Litre |
| **ml** | Millilitre |

## OTHER ABBREVIATIONS

| | |
|---|---|
| **ALS** | Australian Laboratory Services |
| **EGi** | Environmental Geochemistry International Pty Ltd |
| **Project** | Finniss Lithium Project - BP33 Underground Mine |
| **LOM** | Life of Mine |
| **ROM** | Run-of-Mine |

# EXECUTIVE SUMMARY

The Finniss Lithium Project - BP33 Underground Mine will include two separate waste rock dumps (WRD) which will be used for temporary (LOM) storage of waste rock prior to it being used to backfill the underground (UG) mine and box cut. The Box Cut WRD, with a design capacity of 2 million $m^3$, will accept oxide waste rock excavated from the box cut. The UG WRD, with a design capacity of 170,000 $m^3$, will accept transitional and fresh waste rock from the underground. Waste rock from the WRDs will be used to backfill the underground mine and box cut at closure.

Results from an earlier test programme suggested that most waste rock, including oxide and transitional rock excavated during installation of a box cut portal, transitional and fresh rock excavated during construction of the mine decline and ore that will be mined during the project, will present little risk of acid or saline drainage. However, results also suggested that both oxide and fresh rock may contain labile aluminium, arsenic and zinc which could be leached during surface storage.

As a consequence of the findings from these previous investigations, EGi established three kinetic leach column tests which included:

- Oxide waste rock that will be stored in the Box Cut WRD,
- Fresh waste rock that will be stored in the UG WRD, and
- Transition waste rock that will likely be placed in both WRDs.

The kinetic tests progressed through two stages. Stage 1 involved leaching of samples under free draining, oxidising conditions designed to simulate conditions during initial surface storage of waste materials throughout the operational stage. The second stage involved leaching under saturated conditions to simulate leaching of materials that are subsequently placed as backfill within the underground or the box cut and below the depth of rebound of the water table.

In addition to leach column testing, extensive characterisation of the materials used in the leach column tests was undertaken, including acid rock drainage (ARD) testing. Acid Base Accounting and net acid generation (NAG) testing indicated that the acid neutralising capacity of these samples exceeded their acid generating capacity. Kinetic leach column testing confirmed the non-acid forming (NAF) classification of the Oxide, Transition and Fresh waste rock samples tested during this study, demonstrating that this excess alkalinity can be delivered at a rate to match or exceed the rate of acid generation, ensuring neutral pH conditions will be maintained under both oxidising and saturated conditions. This indicates that, if the Oxide sample used in this study reasonably represents oxide waste stored in the Box Cut WRD and subsequently backfilled into the box cut, seepage from the WRD and recharged groundwater in the backfilled box cut will maintain neutral pH together with low sulphate concentrations. Similarly, if the Transition and Fresh samples used in this study reasonably represent transition and fresh waste rock stored in UG WRD and subsequently backfilled into the UG mine, seepage from the WRD and groundwater in the UG mine will maintain neutral pH together with low sulphate concentrations.

The results of leachate analysis for leach column tests were compared with baseline surface and groundwater quality for the BP33 project. This was done to evaluate where leachate chemistry from waste rock varied significantly from background surface and groundwater quality and may therefore represent a potential source for adverse impact on local water bodies and associated ecosystems.

Possible contaminating metal sources and potential receptors are summarised in Table ES1 below. Also listed in the table are the average factor by which leach column leachate concentrations exceed the baseline water quality value for each metal and water type. The concentrations of solutes in leachates from leach column tests are unlikely to be directly relatable to concentrations in seepage/runoff from the WRDs or from backfilled mine wastes. Rather they can provide a qualitative indication of which metals in waste rock leachate may be present at elevated concentrations in comparison with baseline water quality values. Thus, the exceedance factors shown in the table below are not designed to represent a risk factor for adverse impact of particular metals on surface or groundwater quality. Further

studies are required to provide a more quantitative framework for risk evaluation of metal/metalloid contamination of local surface and groundwaters.

*Table ES1: Potential sources and possible receptors for various metals and comparison of column test leachate concentrations with baseline water quality for the corresponding metals.*

| Metal | Source | Receptor | Average Exceedance Factor of Baseline Water Quality[1] |
|---|---|---|---|
| Al[2] | Box Cut WRD | Surface water<br>Shallow ground water<br>Deeper ground water | 15<br>76<br>5 |
| | UG WRD | Surface water<br>Shallow ground water | 6<br>32 |
| As | UG WRD | Surface water<br>Shallow ground water | 39<br>101 |
| Cu | Box Cut WRD | Surface water<br>Shallow ground water | 20<br>14 |
| | Backfilled box cut | Shallow ground water<br>Deeper ground water | 25<br>49 |
| | UG WRD | Surface water<br>Shallow ground water | 16<br>11 |
| Pb | Backfilled mine voids | Deeper ground water | 12 |
| Zn | Backfilled box cut | Shallow ground water<br>Deeper ground water | 18<br>57 |
| | Backfilled mine voids | Deeper ground water | 50 |

1. Calculated as the average leachate concentration from leach column testing under either unsaturated or saturated leaching conditions divided by the corresponding baseline water quality value
2. Concentrations of aluminium measured in leach column testing may include significant amounts of colloidal material, and consequently actual solution concentrations and the calculated corresponding exceedance factors could be much lower.

Results from leach column testing suggest that while acidic drainage from wastes stored in WRD at the BP33 project or following backfilling of mine voids is unlikely, there is potential for water in contact with these materials to contain elevated concentrations of a number of metals/metalloids (arsenic, copper, lead and zinc, and possibly aluminium ) relative to local surface and groundwaters. It is therefore recommended that:

- Run-off from WRDs is contained within run-off/seepage ponds and water quality monitored especially in relation to arsenic, copper and aluminium concentrations and, if required, stored (e.g., mine site dam) for later discharge at times of high flow or treated before discharge if required.
- WRD leachate quality/quantity data be used to calibrate leach column and validate/calibrate modelling results (see below) and the updated/ validated models used to better evaluate any potential impacts on groundwater quality from backfilled mine wastes.
- Mine waste management plans be updated during the operational phase, especially in relation to closure, based on the results of the above monitoring and modelling updates as required, with a view to minimising risk to groundwater quality and potential impacts on associated ecosystems.

While the results from kinetic leach testing provide qualitative evaluation of leachate chemistry in relation to WRD or backfilled waste seepages/leachates, they can also provide quantitative data (dissolution rates and solute loads) as

inputs for solute transport modelling. It is therefore recommended that a useful next step would be to undertake a more quantitative evaluation of the potential for impact on surface and groundwater quality from WRD seepage and leaching from backfilled materials. This could be done using the existing groundwater model combined with development of a conceptual hydrogeological model for the WRDs, using the leaching rates and loads from the leach column tests as inputs. Specifically, this could include:

- Qualitatively assess the risk of migration of leachable metal contaminants from the site by development of a (schematic) hydrogeological conceptual model of the waste rock dumps and underground mining to assess the potential pathways by which leachable metals may migrate into the water environment.
- Quantitatively assess the same by implementation of components of the hydrogeological conceptual model in 2-dimensional finite element models (using Seep/W and CTran/W) to quantify the migration of soluble metal contaminants from temporary surface WRDs and from permanent underground void backfill, including dilution in groundwater due to advection and dispersion, and removal or capture from groundwater due to adsorption, reaction or decay.

This process would add significant value to the column leach tests and provide further evidence for evaluation of environmental risks associated with the Finniss Lithium Project - BP33 UG Mine and can form a basis for updated mine waste and water management plans if required.

# 1. INTRODUCTION

The BP33 deposit is a part of Lithium Developments (Grants NT) Pty Ltd Finniss Lithium Project, located in the Northern Territory on the Cox Peninsula, approximately 23 km southwest of Darwin or 90 km by road. The BP33 proposal involves excavation of a box cut portal to a depth of 60 m and construction of a 400 m long decline from the base of the box cut to access the spodumene deposit located beneath the historically worked open pit.

Two separate waste rock dumps (WRD) will be established for temporary storage of waste rock prior to it being used to backfill the underground (UG) mine and box cut. The Box Cut WRD, with a design capacity of 2 million $m^3$, will accept oxide waste rock excavated from the box cut. The UG WRD, with a design capacity of 170,000 $m^3$, will accept transitional and fresh waste rock from the underground. Waste rock from the WRDs will be used to backfill the underground mine and box cut at closure. Ore mined at BP33 will be transported to the Grants processing facility approximately 7 km to the north-west. A ROM pad will be constructed for temporary storage of mined ore ready for transport to the Grants processing facility. Tailings will be deposited in the Tailings Storage Facility constructed as part of the Grants Project.

Previously, Environmental Geochemistry International Pty Ltd (EGi) were commissioned by EcOz Environmental Consultants to undertake data analysis, interpretation and reporting on physical and geochemical analysis results for drill core samples collected from the BP33 project[1]. This work formed a part of an Environment Protection Act Referral submitted to the NT Environmental Protection Authority (NT EPA) in April 2020 for development of the BP33 Underground mine.

The results from the initial test programme suggested that most waste rock, including oxide and transitional rock excavated during installation of a box cut portal, transitional and fresh rock excavated during construction of the mine decline and ore that will be mined during the project, will present little risk of acid or saline drainage. However, these investigations identified the potential for some potentially acid forming (PAF) waste, particularly in fresh phyllite rock. Results also suggested that both oxide and fresh rock may contain labile aluminium, arsenic and zinc which could be leached during surface storage. As a result of these investigations, EGi recommended the following test work should be conducted to clarify potential environmental issues raised from the study:

- Complete ANC and NAG testing on selected samples, focusing on, but not exclusively, samples with sulphur content >0.2 %S.
- Kinetic testing (leach columns) of oxidised and fresh rock samples to confirm initial results of aluminium, arsenic and zinc leachability and to define the kinetics of this process. Kinetic leach column (KLC) testing should be conducted under oxidising conditions to simulate conditions during storage in the WRD and in the unsaturated zones within the backfilled UG mine and box cut. Following a period of leaching under oxidising conditions, KLC tests should be conducted under saturated conditions to simulate the leaching properties of backfilled waste which will be placed below the water table upon rebound.

In the NT EPA's response to the referral document, a Supplementary Environmental Report (SER) was requested. In relation to waste rock characterisation, their response requested that the additional studies outlined above should be undertaken and reported as a part of the SER. Consequently, EcOz who coordinated the SER on behalf of Lithium Developments (Grants NT) Pty Ltd, requested EGi to undertake the required studies as described in Attachment A, Section 8 Terrestrial environmental quality in the NT EPA referral response[2].

During December 2020 and January 2021, Core Lithium undertook further drilling at the BP33 project. This programme was designed to provide samples for geotechnical testing, and included three diamond drill holes, two of

[1] Environmental Geochemistry International 2020, Geochemical Characterisation of waste rock and ore, Core Lithium BP33 Project, Document Ref 1312/1346, 12 March 2020.
[2] NT EPA 2020. Direction to provide additional information, Finniss Lithium Project BP33 Underground Mine, EP2020/001, NT EPA, 16 October 2020.

which intersected waste rock to a depth of around 70 m, which will be the excavation depth during construction of the box cut. A third hole to a depth around 350 m, which intersected waste rock and ore that will be mined during development of the decline and ore extraction, was also drilled as a part of this programme. Twenty-nine samples were obtained from these three drill holes to investigate the suitability of these materials for kinetic testing, which requires crushed rock available from diamond drill core. Based on assay data, three oxide samples, four transition samples and five fresh samples were composited to produce oxide, transition and fresh rock samples, which subsequently underwent geochemical testing together with 47 samples selected from earlier drill holes.

The results of this study[3] were then combined with the results from geochemical tests conducted previously. Using the combined data set containing 144 samples, criteria were developed to allow identification of non-acid forming (NAF), potentially acid forming – low capacity (PAF-LC) and PAF materials, based around oxidation, type (waste, ore) and Total S content. Using these criteria and a database containing assay data and geological descriptions for around 2500 samples, volumes of NAF, PAF-LC and PAF waste rock and ore were estimated. The results of this analysis showed that:

- Oxide rock excavated from the box cut and which will be placed in the Box Cut WRD is expected to be NAF.
- Ore that will be stored in the ROM pad while awaiting transport to the processing plant is expected to be NAF; and
- Estimates indicate that only around 15,000 tonnes (≈7%) of PAF-LC and PAF waste rock will be moved to the UG WRD through the life of the mine out of a total of 229,000 tonnes of transition and fresh waste rock to be mined, with most of the 15,000 tonnes likely to be classified as PAF-LC with limited acid producing potential.

Preliminary water and hydrogen peroxide extraction testing showed:

- Oxide waste rock stored in the Box Cut WRD, or transition and fresh waste rock stored in the UG WRD would be unlikely to produce low pH saline seepage during short-term surface storage.
- The mobility of Al in all waste rock and As in fresh waste rock on contact with water, could potentially result in elevated concentrations of these elements in seepage during short-term surface storage.
- Should substantial oxidation of fresh waste rock occur during surface storage, the concentrations of a number of metals/metalloids including Al, As, Co, Cr, Cu, U and Zn may by elevated in comparison to desirable environmental conditions, and seepage from the UG WRD could potentially represent a risk of contaminating the receiving environment.

Lastly, comparison of the combined geochemical test results for the oxide, transition and fresh composite waste rock samples proposed for use in KLC testing with results for the corresponding waste types from all drill holes, indicated that these composite samples are representative of waste to be stored in the WRDs at the BP33 project. Kinetic leach column tests using these samples should therefore deliver results which will provide a good indication of the quality of seepage that may result during surface storage of waste and the mobility of solutes in the waste following backfill and inundation by recovering groundwater.

Subsequently EGi established three kinetic leach column tests which included:

- Oxide waste rock that will be stored in the Box Cut WRD,
- Fresh waste rock that will be stored in the UG WRD, and
- Transition waste rock that will likely be placed in both WRDs.

The kinetic tests progressed through two stages. Stage 1 involved leaching of samples under free draining, oxidising conditions designed to simulate conditions during initial surface storage of waste materials throughout the operational stage. The second stage involved leaching under saturated conditions to simulate leaching of materials that are subsequently placed as backfill within the underground or the box cut and below the depth of rebound of the water table.

[3] Environmental Geochemistry International 2021, Static Geochemical Testing of Mine Wastes and Ore Finniss Lithium Project BP33 UG Mine, Document Ref S1312/J000662/R1428, 14 July 2021.

The kinetic test program commenced on 30 July 2021 and ran for a period of 12 months. This report presents results for both stages of column testing.

# 2. SAMPLE SELECTION AND PREPARATION

A total of 29 core intervals from the three diamond drill holes drilled during December 2020 and January 2021 were initially assayed to investigate their suitability for kinetic testing[3]. Based on assay data, three oxide samples, four transition samples and five fresh samples were composited to produce oxide, transition, and fresh rock samples (Table 1). Each composite comprised either 2.5 or 3.0 kg of drill core. Following inspection of the samples they were despatched to Indicum Laboratories for sample preparation, which involved crushing to minus 4 mm size for use in the column leach tests. A sub-sample of crushed sample was also pulverised for initial geochemical characterisation analyses using static test methods.

# 3. LEACH COLUMN TEST PROCEDURES

## 3.1. Free draining (Unsaturated) Leach Column Method

EGi's standard free-draining column leach method was used for the first stage of the kinetic program, as described in the AMIRA ARD Test Handbook[4]. The columns were set-up and maintained at EGi's specialised geochemical laboratory in Sydney. Each column comprises approximately 2.0 kg (dry weight) of crushed solids housed within a plastic Buchner funnel measuring 160 mm ID and 100 mm in height (Figure 1). The funnel configuration provides a free-draining condition and a relatively high exposure area per unit mass of sample, thereby providing conditions amenable to sulphide oxidation should it occur.

Leach column testing of the three samples commenced on 30 July 2021. Immediately following setup, the samples were flushed with 800 mL of deionised water and first-flush leachates were collected for analysis on 2 August 2021. Thereafter, samples were subjected to cyclic wetting and drying on a weekly basis over a four-week leach cycle. During the first three weeks of each cycle the samples were moistened by a once weekly addition of water at a rate of 100 mL/kg. On the fourth week the samples were flushed by addition of 400 mL/kg (solid to liquid ratio (SLR) of 2.5), with the leachates collected in plastic containers positioned immediately beneath the funnel spouts. Typically, 450 to 500 mL of leachate were collected from a column per cycle.

Leachates from the columns were assayed for pH, EC, alkalinity/acidity, and a suite of elements that included Ag, Al, As, B, Ba, Be, Ca, Cd, Cl, Co, Cr, Cu, Cs, F, Fe, Hg, Li, K, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Si, Sn, SO4, Sr, Th, Tl, U and Zn.

The unsaturated leaching phase extended for 16 weeks which, in addition to the initial flush, included four 4-week leach cycles.

[4] **AMIRA. 2002**. ARD Test Handbook. Project P387A. Prediction and Kinetic Control of Acid Mine Drainage, AMIRA International Limited, Melbourne, Australia.

*Table 1: Details of the samples used for kinetic leach column tests*

| | Hole ID | Easting | Northing | Depth from | Depth to | Sample ID | Lithology | Weathering | Description | Type_Method | S (%) | As(ppm) | Mass in Composite Sample (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OXIDE COMPOSITE | FDD010 | 694530 | 8593587 | 0 | 40 | FDD010_ WC01 | Py | EW to MW | Saprolite/saprock (phyllite) in weathered/oxidised zone. Variable colour inc pale to dark brown, pale yellow, tan, pale to mid green. | Composite of core fragments from metre | 0.001 | 193 | 1200 |
| | FDD011 | 694282 | 8593699 | 37 | 38 | FDD011_WC03 | Pg | HW | Clay-weathered pegmatite, often crumbly and broken up into fine powder. Bright white. | Half PQ core split | 0.001 | 5 | 500 |
| | FDD012 | 694257 | 8593850 | 38 | 48 | FDD012_ WC03 | Sst | HW to MW | Sandstone and lesser phyllite interlayered. Minor (<2%) quartz veins and joints. Mixed loose and coherent core. Some unconsolidated "flowing" sand. More highly weathered than 28-38m interval. Pale grey and yellow. | Composite of core fragments from each metre | 0.001 | 49 | 800 |
| TRANSITION COMPOSITE | FDD010 | 694530 | 8593587 | 46.3 | 47.3 | FDD010_ WC02 | Py | SW | Phyllite with fractures at high angle to core axis and minor (<2%) quartz veins in transitional zone. Pale grey. | Half PQ core split | 0.04 | 80 | 750 |
| | FDD011 | 694282 | 8593699 | 53 | 54 | FDD011_ WC05 | Sst | MW | Sandstone, finely laminated/foliated in transitional zone. Minor (<2%) quartz veins. Pale grey. | Half PQ core cut | 0.001 | 5 | 750 |
| | FDD012 | 694257 | 8593850 | 50 | 51 | FDD012_ WC04 | Sst | MW | Sandstone, fine grained banded. Minor (<1%) quartz veins and joints. Coherent core. Pale to mid green-grey, with yellow and red staining pervading along joints. | Half PQ core cut | 0.001 | 23 | 750 |
| | FDD012 | 694257 | 8593850 | 67 | 68 | FDD012_WC06 | Sst | SW | Sandstone, fine grained banded. Coherent core. Pale to mid green-grey. | Half PQ core cut | 0.001 | 5 | 750 |
| FRESH COMPOSITE | FDD010 | 694530 | 8593587 | 149 | 150 | FDD010_ WC06 | Sst | FR | Sandstone, highly fractured (partly drilling related but at least some natural) with no alteration. Dark grey. | Half HQ core split | 0.004 | 28 | 600 |
| | FDD010 | 694530 | 8593587 | 185 | 186 | FDD010_ WC07 | Py | FR | Phyllite, foliated and jointed throughout. Dark grey. | Half HQ core cut | 0.06 | 25 | 600 |
| | FDD010 | 694530 | 8593587 | 258 | 259 | FDD010_ WC10 | Py | FR | Phyllite with lesser interbands of fine sandstone. Soild core with no imperfections. Dark grey. | Half HQ core cut | 0.004 | 50 | 600 |
| | FDD010 | 694530 | 8593587 | 352 | 353 | FDD010_ WC12 | Py | FR | Phyllite with lesser interbands of fine sandstone. Jointed throughout. Dark grey. | Half HQ core cut | 0.09 | 264 | 600 |
| | FDD011 | 694282 | 8593699 | 71 | 72 | FDD011_ WC09 | Sst | FR | Sandstone, finely laminated/foliated in fresh zone. Minor (<2%) quartz veins. Mid grey. | Half PQ core cut | 0.01 | 5 | 600 |

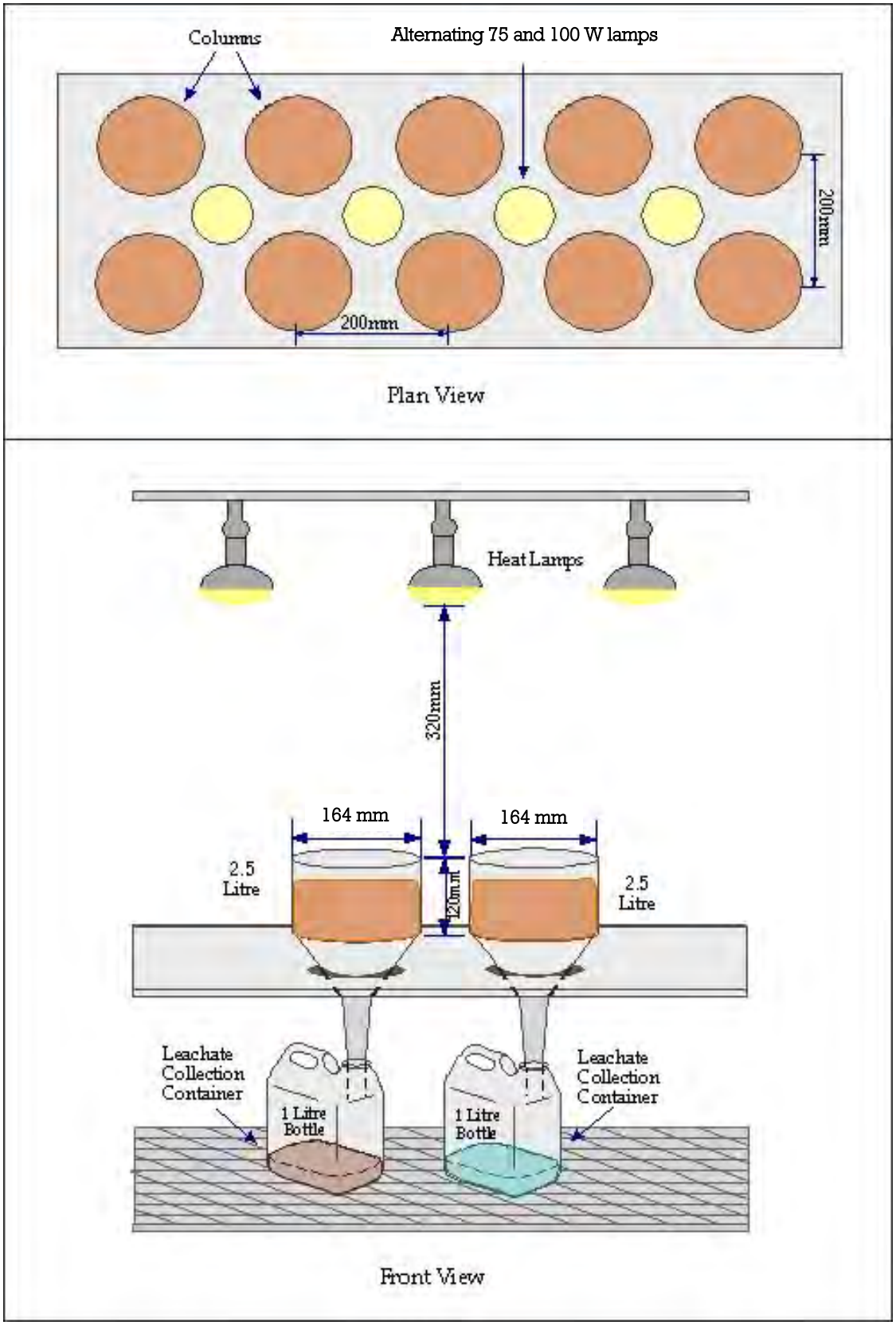


*Figure 1: Schematic diagram of a typical free draining leach column set-up using conventional Buchner funnels.*

## 3.2. Saturated Leach Column Method

The saturated column test is used to investigate the leaching characteristics of waste rock and tailings that are fully submerged or flooded. Columns can be prepared to simulate a period of exposure of waste rock to oxidation conditions followed by inundation in a tailings storage facility (TSF) or being flooded. The results from this column type can be used to provide a guide to the run down in accumulated oxidation products and longer-term solubility-controlled metal/metalloid loadings once waste rock has been inundated. The columns would be initially operated as free draining for a period, before being fully submerged underwater.

The experimental setup used for the saturated phase of the leach column tests is shown in Figure 2. A head of water was maintained throughout the leaching period, which included eight collections conducted over a 32-week period following the free draining leaching period. Approximately one pore volume of water was drained from each column during each collection. The pore volume (Table 2) in each column was calculated using an average particle density estimated from the results of QXRD analysis (see Table 5, Section 4). If it is assumed that there was no mixing of the pore water with the water cover during the 4-week leaching period, then the SLR for the oxide, transition and fresh leach column tests were 3.0, 3.3 and 4.3 respectively. If it is assumed that there is complete mixing of pore water with the water cover, then the SLR for the oxide, transition and fresh leach column tests ranged from 0.84 to 0.86. In practice, it is likely that limited mixing of pore water and the water cover occurred during the leaching period (no active mixing was applied) and the SLR was probably somewhere between these two extremes, possibly similar to the SLR of 2.5 for the unsaturated leach column tests.

Leachates were collected by attaching a sample bag to the column drain via a plastic tube (Figure 2). The bag was lowered to allow water to flow into the bag while maintaining exclusion of oxygen. When one pore volume of water had been collected, the bag was raised above the height of the column and leachate collected from the bag via a tap in the collection bag. Fresh DI water was then added to the top of the column to maintain the same head of water (90 mm) and the cap replaced on the top of the column until the next collection. Collections during the saturated period occurred once every 4 weeks, with leachates being analysed for pH, EC, alkalinity/acidity, and a suite of elements that included Ag, Al, As, B, Ba, Be, Ca, Cd, Cl, Co, Cr, Cu, Cs, F, Fe, Hg, Li, K, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Si, Sn, SO4, Sr, Th, Tl, U and Zn.

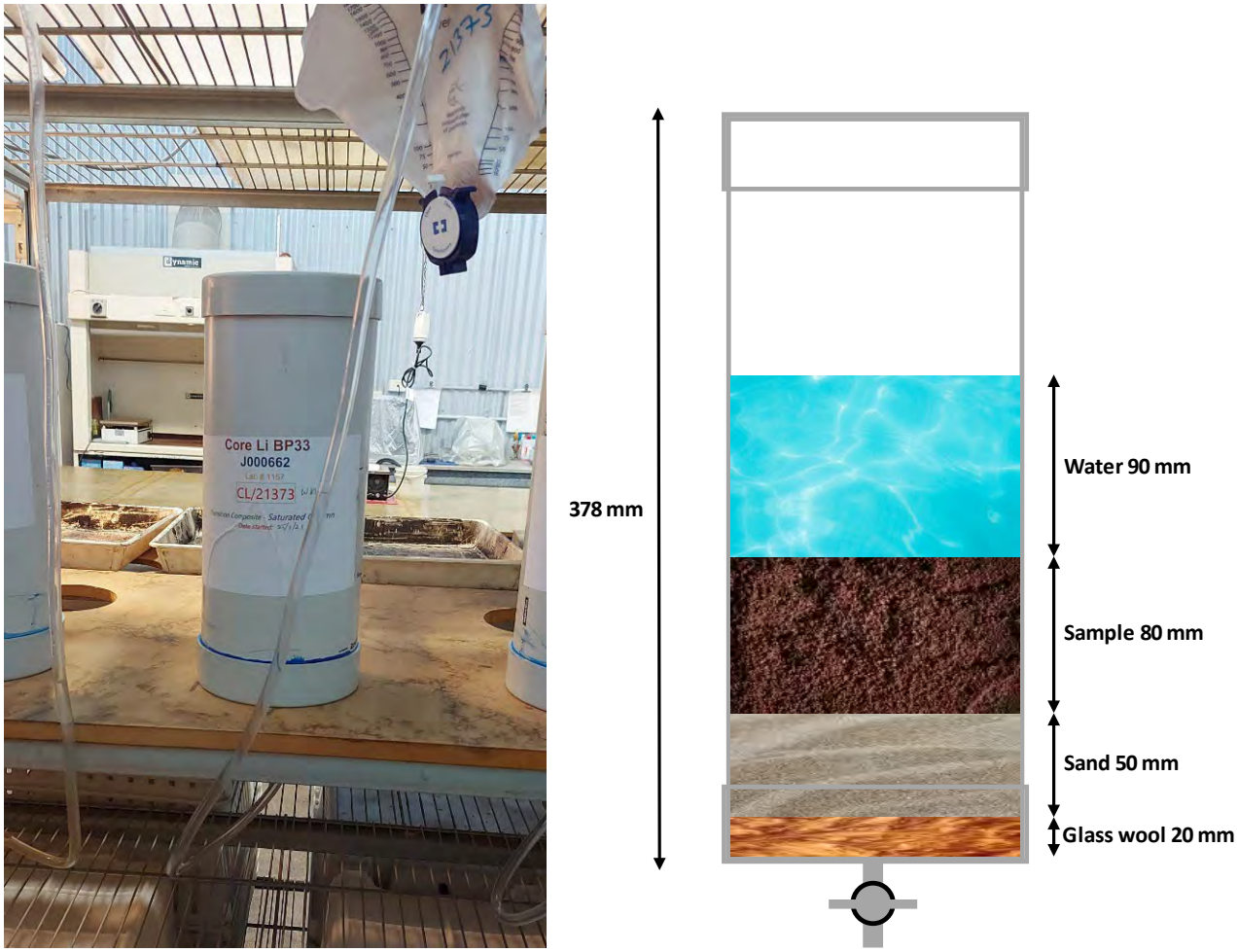


*Figure 2: Photograph (left) and schematic (right) of column setup used for leach column testing conducted under saturated conditions.*

*Table 2: Details of saturated leach column tests.*

| Oxide | 21372 | |
|---|---|---|
| Internal column height | 378 | mm |
| Internal column diameter | 150 | mm |
| Mass of sand | 1501.56 | g |
| Internal column height after sand | 325 | mm |
| Mass dry sample | 1983.27 | g |
| Internal column height after sample | 245 | mm |
| Sample bed height | 80 | mm |
| Sample volume | 1413.7 | $cm^3$ |
| Bulk density | 1.40 | $g/cm^3$ |
| Average particle density | 2.7 | $g/cm^3$ |
| Particle volume | 734.5 | $cm^3$ |
| Porosity | 0.48 | |
| Pore volume | 679 | $cm^3$ |
| Transition | 21373 | |
| Internal column height | 377 | mm |
| Internal column diameter | 150 | mm |
| Mass of sand | 1501.32 | g |
| Internal column height after sand | 327 | mm |
| Mass dry sample | 1987.42 | g |
| Internal column height after sample | 251 | mm |
| Sample bed height | 76 | mm |
| Sample volume | 1343.0 | $cm^3$ |
| Bulk density | 1.48 | $g/cm^3$ |
| Average particle density | 2.7 | $g/cm^3$ |
| Particle volume | 736.1 | $cm^3$ |
| Porosity | 0.45 | |
| Pore volume | 607 | $cm^3$ |
| Fresh | 21374 | |
| Internal column height | 372 | mm |
| Internal column diameter | 150 | mm |
| Mass of sand | 1501.48 | g |
| Internal column height after sand | 319 | mm |
| Mass dry sample | 1988.73 | g |
| Internal column height after sample | 251 | mm |
| Sample bed height | 68 | mm |
| Sample volume | 1201.7 | $cm^3$ |
| Bulk density | 1.65 | $g/cm^3$ |
| Average particle density | 2.7 | $g/cm^3$ |
| Particle volume | 736.6 | $cm^3$ |
| Porosity | 0.39 | |
| Pore volume | 465 | $cm^3$ |

# 4. CHARACTERISATION OF COLUMN LEACH TEST SAMPLES

The three composite samples (oxide, transition and fresh) used in the column leach tests were tested to define their geochemical properties. Testing included analysis or calculation of the following:

- Sulphur and Carbon contents and speciation.
- Acid neutralising capacity (ANC).
- Maximum potential acidity (MPA).
- Net acid producing potential (NAPP).
- Net acid generation (NAG) capacity.
- NAGpH.
- Multi-element analysis of solids.
- XRD Analysis.

The acid forming characteristics of the three composite samples are summarised in Table 3, the multi-element compositions are given in Table 4, and mineralogy data in Table 5. An acid-base account plot for the three samples is presented in Figure 3, and the corresponding ARD classification plot is presented in Figure 4.

Elemental analysis of solids was carried out by ALS and included the following suite of elements: Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Se, Sn, Sr, U, and Zn. In addition, Geochemical Abundance Indices (GAI) were calculated and are presented in Table 4 to provide an indication of which elements are significantly enriched in comparison to median background soil abundance values, where a GAI of 0 indicates the element is present at a concentration similar to, or less than, median soil abundance, a GAI of 1 or 2 represents minor enrichment of an element, and a GAI of 3 to 6 represents significant enrichment above median soil abundance.

The results of the geochemical characterisation tests conducted on column leach test samples can be summarised by the following:

***Oxide Waste***

- Negligible sulphur content (0.01 %S) with essentially a complete absence of sulphides.
- Negligible ANC (4 kg $H_2SO_4$/t) with essentially a complete absence of carbonate.
- Slightly negative NAPP (-4 kg H2SO4/t) and zero NAG, with neutral NAGpH.
- **NAF classification**.
- Significantly enriched (GAI≥3) with arsenic (147 mg/kg) and minor enrichment (GAI 1 or 2) with beryllium (38 mg/kg), bismuth (0.78 mg/kg) and tin (28 mg/kg).
- The results indicate that the sample representing oxide waste is essentially barren with respect to both acid potential and neutralisation potential but has some elemental enrichments that may be environmentally important.

***Transition Waste***

- Negligible sulphur content (0.02 %S).
- Low ANC (8 kg $H_2SO_4$/t) with essentially a complete absence of carbonate.
- Negative NAPP (-7 kg $H_2SO_4$/t) and no evidence of acidification in NAG test.
- **NAF classification.**
- Minor enrichment with arsenic (47 mg/kg).
- Overall, the results indicate the sample representing transition waste is benign with respect to acid potential but has a slightly elevated arsenic content relative to what is regarded as typical for a non-mineralised soil.

***Fresh Waste***

- Minor sulphur content (0.06 %S), mainly as sulphide (0.05 %S).
- Some ANC (13 kg $H_2SO_4$/t), but with limited carbonate content (Inorganic C <0.05 %C, CNV < 4 kg $H_2SO_4$/t).
- Negative NAPP (-11 kg $H_2SO_4$/t) and zero NAG with neutral NAGpH.
- **NAF classification.**
- Significantly enriched with arsenic (88 mg/kg).
- Overall, the results indicate the fresh waste sample is benign with respect to acid potential but has an elevated arsenic content.

QXRD analysis results (Table 5) show the dominant minerals in all three samples are quartz (53.8 - 63.4 wt.%), muscovite (20.6 - 28.4 wt.%) and albite (7.6 - 12.3 wt.%). The three samples also contain minor biotite and kaolinite. Only trace concentrations of pyrite were reported consistent with the low sulphur assay results, and no evidence of dolomite or calcite, consistent with the absence of significant carbonate neutralising capacity (Table 3). This suggests that the limited ANC in these samples is derived from silicate minerals, and as such is unlikely to provide any acid neutralisation at an appreciable rate.

These results suggested that the three leach column tests were unlikely to produce leachates with low pH and significantly elevated metals. The absence of significant sulphide content suggests limited oxidation would occur during leaching under unsaturated conditions, and consequently leaching under saturated conditions is unlikely to significantly reduce any limited sulphide oxidation. This means that under both unsaturated and saturated leaching conditions, neutral pH leachates are likely. Nevertheless, despite the likely neutral pH conditions, mobilisation of metals/metalloids which are soluble under neutral pH conditions (e.g., As and Zn) is possible. Differences in metal/metalloid leaching under unsaturated and saturated conditions may therefore result from possible solubility controls, or differences between the two test conditions resulting in equilibrium as opposed to kinetic control on mineral dissolution/precipitation.

*Table 3: Acid forming characteristics of column leach samples*

| Parameter | Material Type | Oxide | Transition | Fresh |
|---|---|---|---|---|
| | EGi Sample ID | 21372 | 21373 | 21374 |
| **Sulphur Speciation** | | | | |
| - Total-S | (%S) | 0.01 | 0.02 | 0.06 |
| - Sulphate-S | (%S) | 0.01 | <0.01 | 0.01 |
| - Sulphide-S | (%S) | <0.01 | <0.02 | 0.05 |
| - Cr Reducible-S | (%S) | <0.02 | 0.03 | 0.06 |
| **Carbon Speciation** | | | | |
| - Total-C | (%C) | 0.04 | 0.03 | 0.05 |
| - Organic-C | (%C) | 0.03 | 0.02 | <0.02 |
| - Inorganic-C | (%C) | 0.01 | 0.01 | <0.05 |
| **Neutralising Characteristics** | | | | |
| - ANC (Sobek) | (kg $H_2SO_4$/t) | 4 | 8 | 13 |
| - CNV | (kg $H_2SO_4$/t) | 1 | 1 | <4 |
| **Acid Generating Characteristics** | | | | |
| - MPA | (kg $H_2SO_4$/t) | <1 | 1 | 2 |
| - ANC / MPA Ratio | ratio | 13 | 13 | 7 |
| - NAPP | (kg $H_2SO_4$/t) | -4 | -7 | -11 |
| - NAG (to pH7) | (kg $H_2SO_4$/t) | 0 | 0 | 0 |
| - NAGpH | | 7.1 | 7.2 | 7.7 |
| **ARD Classification** | | **NAF** | **NAF** | **NAF** |

**Abbreviations**

*CNV = Carbonate Neutralising Value*
*ANC = Acid Neutralising Capacity*
*MPA = Maximum Potential Acidity*
*NAPP = Net Acid Producing Potential*
*(MPA and NAPP values calculated using Total-S)*
*NAG = Net Acid Generation capacity*
*NAGpH = pH of NAG liquor*
*NAF = Non-Acid Forming*

**Methods**

*Total sulphur - Measured using a Leco sulphur analyser*

*Sulphate-sulphur - Sample leached with hot HCl to remove acid-soluble sulphates. The amount of sulphate within the leachate is then determined by ICPAES.*

*Sulphide-sulphur - Calculated as the difference between Total-S and Sulphate-S values.*

*Cr Reducible S - Sample reacted with hot acidic $CrCl_2$ to reduce (non-sulphate) inorganic sulphur forms to $H_2S$ which are trapped in zinc acetate solution and determined.*

*Total carbon - Measured using a Leco carbon analyser*

*Organic-carbon - Hot HCl to remove any carbonates, then rinsed with distilled water. The residual carbon in the residue (i.e., acid-insoluble carbon) then measured by Leco.*

*Inorganic-carbon - Calculated as the difference between Total-C and Organic-C values.*

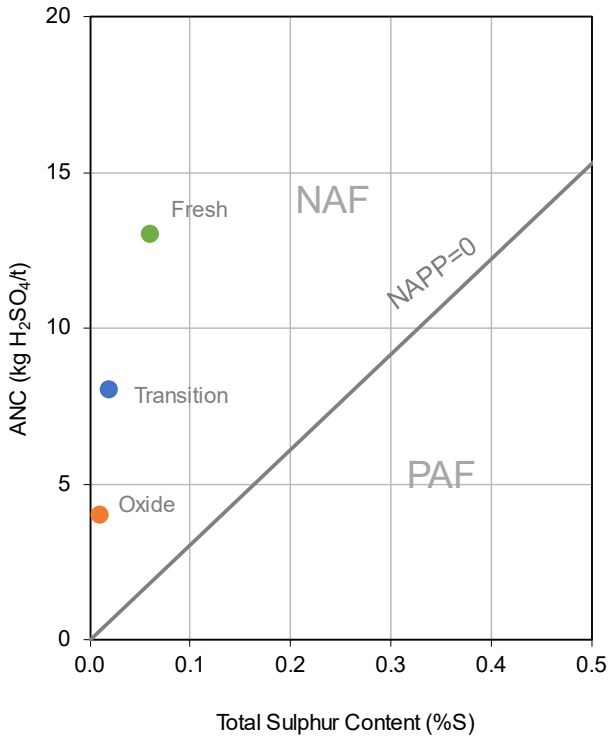


*Figure 3: Acid-base account plot for column leach samples.*

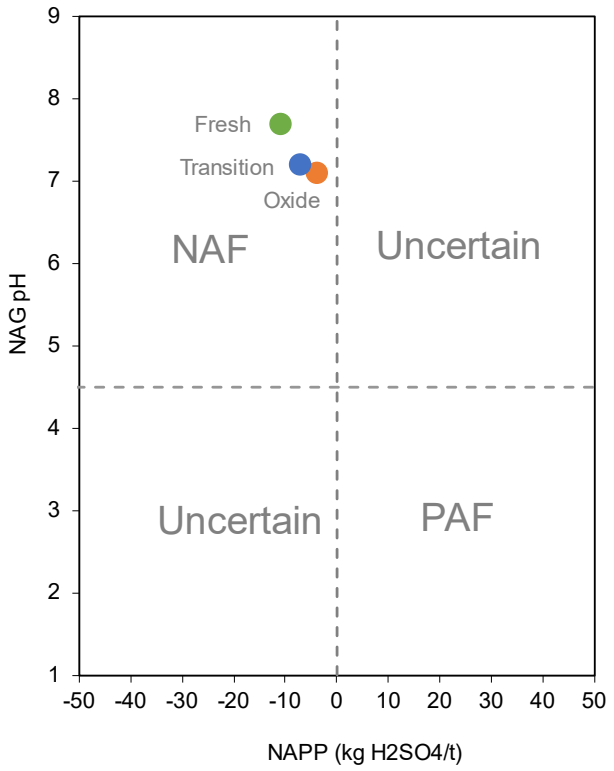


*Figure 4: ARD classification plot for column leach samples.*

*Table 4: Elemental compositions of column leach samples*

| Element | Unit | Limit of Detection | Elemental Composition | | | *Median Soil Content | Geochemical Abundance Indices | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Oxide | Transition | Fresh | | Oxide | Transition | Fresh |
| | | | 21372 | 21373 | 21374 | | 21372 | 21373 | 21374 |
| Al | % | 0.01 | 6.61 | 5.81 | 6.61 | 7.1 | 0 | 0 | 0 |
| Ca | % | 0.01 | 0.06 | 0.24 | 0.29 | 1.5 | 0 | 0 | 0 |
| Fe | % | 0.01 | 3.06 | 2.79 | 3.17 | 4 | 0 | 0 | 0 |
| K | % | 0.01 | 2.22 | 2.35 | 2.82 | 1.4 | 0 | 0 | 0 |
| Mg | % | 0.01 | 0.32 | 0.53 | 0.70 | 0.5 | 0 | 0 | 0 |
| Na | % | 0.01 | 0.97 | 0.55 | 0.65 | 0.5 | 0 | 0 | 0 |
| S | % | 0.01 | 0.01 | 0.02 | 0.06 | 0.07 | 0 | 0 | 0 |
| As | mg/kg | 0.2 | 147 | 47 | 88 | 6 | **4** | **2** | **3** |
| Ba | mg/kg | 10 | 420 | 570 | 580 | 500 | 0 | 0 | 0 |
| Be | mg/kg | 0.05 | 38 | 3 | 2 | 6 | **2** | 0 | 0 |
| Bi | mg/kg | 0.01 | 0.8 | 0.4 | 0.3 | 0.2 | **1** | 0 | 0 |
| Cd | mg/kg | 0.02 | 0.1 | 0.04 | 0.03 | 0.4 | 0 | 0 | 0 |
| Co | mg/kg | 0.11 | 10 | 7 | 8 | 8 | 0 | 0 | 0 |
| Cr | mg/kg | 1 | 31 | 36 | 40 | 70 | 0 | 0 | 0 |
| Cu | mg/kg | 0.2 | 21 | 14 | 19 | 30 | 0 | 0 | 0 |
| Hg | mg/kg | 0.005 | 0.005 | 0.005 | 0.005 | 0.06 | 0 | 0 | 0 |
| Mn | mg/kg | 5 | 383 | 221 | 356 | 1000 | 0 | 0 | 0 |
| Mo | mg/kg | 0.05 | 0.6 | 0.2 | 0.2 | 2 | 0 | 0 | 0 |
| Ni | mg/kg | 0.2 | 14 | 15 | 17 | 50 | 0 | 0 | 0 |
| P | mg/kg | 10 | 300 | 300 | 330 | 800 | 0 | 0 | 0 |
| Pb | mg/kg | 0.5 | 34 | 14 | 13 | 35 | 0 | 0 | 0 |
| Sb | mg/kg | 0.05 | 0.1 | 0.1 | 0.1 | 1 | 0 | 0 | 0 |
| Se | mg/kg | 1 | 1 | 1 | 1 | 0.4 | 0 | 0 | 0 |
| Sn | mg/kg | 0.2 | 28 | 6 | 5 | 4 | **2** | 0 | 0 |
| Th | mg/kg | 0.01 | 12 | 16 | 16 | 9 | 0 | 0 | 0 |
| U | mg/kg | 0.1 | 4 | 4 | 3 | 2 | 0 | 0 | 0 |
| Zn | mg/kg | 2 | 59 | 45 | 48 | 90 | 0 | 0 | 0 |

***GAI Enrichment Factors***

| | | |
|---|---|---|
| *GAI = 0* | *Little or No Enrichment:* | *< 3 times median soil* |
| *GAI=1 or 2* | *Minor Enrichment:* | *1=3 to 6 times, 2=6 to 12 times* |
| *GAI = 3 to 6* | *Significant Enrichment:* | *3=12 to 24 times, 4=24 to 48 times, 5= 48 to 96 times, or 6 ≥ 96 times* |

**** Median soil data from:***

*Bowen, H.J.M. (1979) Environmental Chemistry of the Elements. Academic Press, London.*

*Berkman, D.A. (1976) Field Geologists' Manual, The Australian Institute of Mining and Metallurgy,Australia.*

*Table 5: Quantitative XRD Results (wt.%) for column leach samples*

| Mineral | Oxide | Transition | Fresh |
|---|---|---|---|
| | 21372 | 21373 | 21374 |
| Quartz | 53.8 | 63.4 | 58.4 |
| Albite | 12.3 | 7.6 | 10.1 |
| Muscovite 2M | 28.4 | 20.6 | 21.9 |
| Siderite | 0 | 0 | 0 |
| Clinochlore | 0 | 0.2 | 1 |
| Calcite | 0 | 0 | 0 |
| Dolomite | 0 | 0 | 0 |
| Kaolinite | 3.1 | 0.2 | 0.5 |
| Pyrite | 0.1 | 0 | 0.1 |
| Biotite | 1.7 | 7.7 | 7.4 |
| Orthoclase | 0.6 | 0.3 | 0.6 |
| Sum of Input | 100 | 100 | 100 |

**SOURCE** - McKnight Mineralogy

**METHOD** - X-ray diffraction traces were obtained from the samples with a Panalytical Aeris Powder Diffractometer and Pixcel linear detector. Operating conditions were CoKα, 40kV/15mA, Fe Kß filter, step scan 0.01/29 secs˚2Θ at, 1/4˚ divergence and a 1.0˚ ant-scatter slit. Scan range was 5° to 90° 2Θ. Phases were identified by computer search-match of the ICDD PDF4 2020 Minerals and 2021 COD Databases. Quantitative results have been determined with full pattern Rietveld refinement software.

# 5. LEACH COLUMN TEST RESULTS

## 5.1. Differences in Unsaturated and Saturated Leach Conditions

The unsaturated leaching phase extended for 16 weeks which, in addition to the initial flush, included four 4-week leach cycles. Leaching under unsaturated conditions was discontinued after 16 weeks based on the results of leachate analysis over this period in combination with the geochemical characterisation results. Since all the tested materials were clearly classified as NAF, no decrease in leachate pH and associated increase in metal solubility was expected for these materials. In addition, the concentrations of metals and metalloids in leachates had all plateaued, suggesting that peak leaching concentrations had been reached. Although sulphate concentrations in the leachates from the fresh waste rock column were still increasing, the low sulphide content and clear NAF classification of this material, indicated that high sulphate release was unlikely and continuation of leaching under unsaturated conditions unwarranted.

Following leaching under unsaturated conditions where oxygen is expected to be readily available such that any pore water in contact with sulphide surfaces would be saturated with oxygen, leaching was continued under a blanket of water for a further 32 weeks, where oxygen transfer to the sulphide surfaces would involve diffusion across this water layer. If oxygen was consumed by sulphide oxidation at a rate significantly greater than the diffusion rate, then the oxidation rate would be diffusion controlled and likely significantly slower than oxidation under unsaturated conditions.

A second difference between leaching conducted under unsaturated and saturated conditions is the contact time between the flushing water and the solids. In the free draining columns, the solids are flushed with water every 4 weeks, with contact between the solids and the flushing solution limited to between a few hours and a few days, depending on how quickly the flush water moves through the solids bed. Under saturated conditions, the flush water is in contact with the solids for a period of 4 weeks. It is likely that over this extended period, equilibrium is reached between the minerals in the solids and the flushing solution. In the free draining column where contact time between the solids and the flushing solution is reduced, equilibrium between the solids and the aqueous phase may or may not be achieved. This may result in only partial dissolution of some phases which would fully dissolve under saturated conditions.

A third potential difference between the two leaching conditions is the SLR of the two test conditions. Under unsaturated conditions, an SLR of 2.5 operates, while under unsaturated conditions, the SLR may vary between around 3 to 4 and about 0.85, depending on the amount of mixing which occurs between the pore water and the water cover during the 4-week leaching period between flushes. It is likely that the SLR under saturated conditions is similar to that under unsaturated conditions and consequently solute concentrations can be compared between the two leaching regimes.

A further difference between the two leaching conditions is that under unsaturated conditions the columns constituted an open system, while under saturated conditions, the column was capped (Figure 2) and therefore represents a closed system. Under these conditions, any $CO_2$ generated through sulphide oxidation and concomitant carbonate dissolution will be retained in the sample potentially increasing carbonate dissolution.

## 5.2. Leachate Chemistry and Geochemical Processes

The results of leachate analysis across the 48 weeks of leaching for the three columns are provided in Appendix A. As expected, all columns produced leachates with neutral pH (oxide 7.1 – 7.7, Transition 6.8 – 7.7, Fresh 7.2 – 7.7) during the entire leach test, with no difference in pH between unsaturated and saturated leaching. Despite the uniformity of leachate pH, all column tests gave an increase in leachate alkalinity after the change from unsaturated to saturated leaching. Leachate sulphate concentrations were low in all three columns, with the lowest concentrations from the Oxide column. There were no appreciable differences in sulphate concentrations between unsaturated and saturated leaching.

Figure 5 shows plots of leachate calcium plus magnesium concentrations as a function of alkalinity. The grey line shows the equivalent calcium plus magnesium (measured as mg Ca/L) concentrations corresponding to the alkalinity (measured as mg $CaCO_3$/L). For the Oxide sample, all leachate samples plotted below the equivalence line, suggesting limited alkalinity derived from calcium and magnesium carbonate dissolution, in agreement with C speciation and XRD analysis. For the Transition leachate samples, calcium plus magnesium concentrations plot around the equivalent alkalinity line suggesting calcium and magnesium in the leachates are principally derived from carbonate dissolution. In the Fresh leachate samples, calcium plus magnesium concentrations generally plot above the line under saturated conditions, suggesting that some calcium and magnesium in the leachates is derived from processes, e.g., cation exchange, which do not lead to dissolved carbonate that is measured as alkalinity.

For all materials, there was a general increase in calcium plus magnesium concentration with increasing alkalinity which appears to increase under saturated conditions. This may reflect the fact that when leaching was conducted under saturated conditions, the column was closed, which will increase dissolved carbonate alkalinity if pyrite oxidation results in carbonate dissolution and $CO_2$ cannot be removed from the closed system.

Figure 6 shows time series plots of the Ca + Mg:SO4 mole ratio in leachates for the three columns. For the Oxide column, the Ca + Mg:SO4 ratios were generally above one, increasing significantly under saturated conditions. This increase results from an increase in Ca concentrations in saturated leachates. For the Transition sample leachates, the Ca + Mg:SO4 mole ratio remained close to unity throughout both unsaturated and saturated leaching except for a short period after changing to saturated leaching. Given that the solutions were significantly below gypsum saturation, it is likely that the Ca + Mg:SO4 ratio represents dissolution of carbonate to match acidity ($H_2SO_4$) generated from sulphide oxidation. For the Fresh sample, the Ca + Mg:SO4 mole ratio in leachates remained around 1 during unsaturated leaching, but increased during saturated leaching. This indicates the rate of carbonate dissolution matched acid generation from sulphide oxidation during leaching under unsaturated conditions. The increase in the Ca + Mg:SO4 mole ratio after the column was saturated, corresponds to an increase in calcium and magnesium from carbonate dissolution and decreased sulphate, possibly from a slight reduction in sulphide oxidation.

Intrinsic oxidation rates (IOR) were calculated from leachate sulphate concentrations. The calculation of IOR from sulphate assumes pyrite oxidation by oxygen according to the stoichiometry shown in Equation 1. It also assumes all sulphate resulting from oxidation is dissolved into leachates and is not retained as insoluble secondary minerals, or that sulphate that does report to the leachate is not derived from dissolution of previously formed secondary sulphate minerals. The results for these IOR calculations are shown in Figure 7. For the Oxide sample, calculated IOR are in the order of $10^{-10}$ kg $O_2m^{-3}s^{-1}$. However, because of the lack of sulphides in the Oxide sample, as demonstrated by sulphur speciation analysis, it is unlikely that the sulphate found in leachates is derived from sulphide oxidation and so IOR calculated from sulphate do not represent sulphide oxidation rates. For the Transition and Fresh samples, IOR were similar and in the order of $10^{-9}$ kg $O_2m^{-3}s^{-1}$ and do not vary significantly between leaching conducted under unsaturated and saturated conditions. An IOR in the order of $10^{-9}$ kg $O_2m^{-3}s^{-1}$ is at the very low end of sulphide oxidation rates for waste rock and reflects the very limited amount of sulphide present in these materials. It is also likely that at such a slow rate, oxygen diffusion does not constrain sulphide oxidation, in agreement with the calculated IOR being similar under both unsaturated and saturated conditions.

$$FeS_2 + 3.75O_2 + 3.5H_2O = Fe(OH)_3 + 2SO_4^{2-} + 2H^+ \qquad [1]$$

These results confirm the NAF classification of the Oxide, Transition and Fresh waste rock samples tested during this study. While Acid Base Accounting and NAG testing indicated that the acid neutralising capacity of these materials exceeds their acid generating capacity, kinetic testing demonstrates that this excess alkalinity can be delivered at a rate to match or exceed the rate of acid generation, ensuring neutral pH conditions will be maintained under both oxidising and saturated conditions. This indicates that, if the Oxide sample used in this study reasonably represents oxide waste stored in the Box Cut WRD and subsequently backfilled into the box cut, seepage from the WRD and rebounded groundwater in the backfilled box cut will maintain neutral pH together with low sulphate concentrations. Similarly, if the Transition and Fresh samples used in this study reasonably represent transition and fresh waste rock stored in UG WRD and subsequently backfilled into the UG mine, seepage from the WRD and groundwater in the UG mine will maintain neutral pH together with low sulphate concentrations.

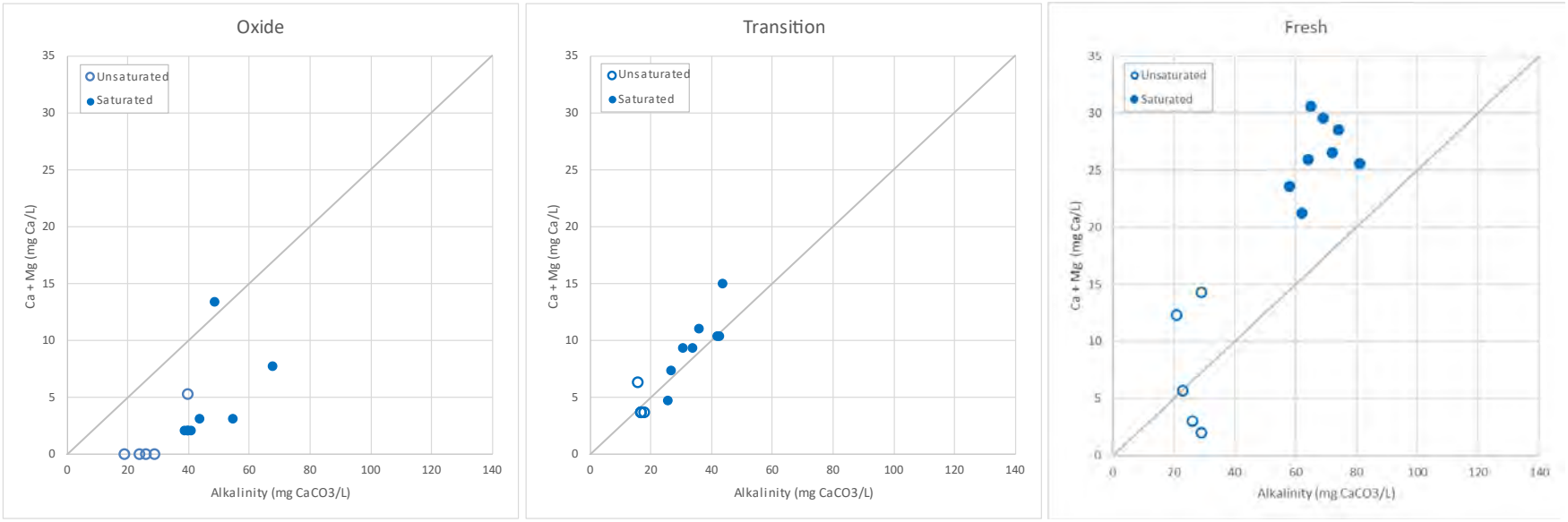


*Figure 5: Comparison of Ca + Mg concentrations and alkalinity in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

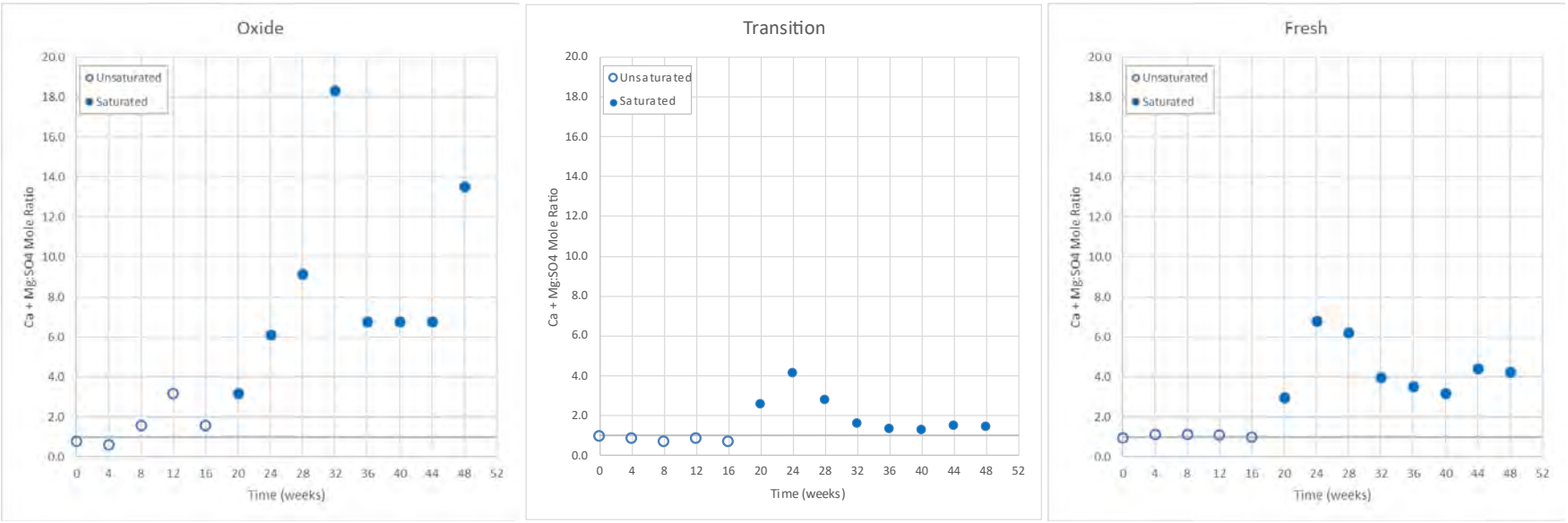


*Figure 6: Ca + Mg:SO4 mole ratio in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

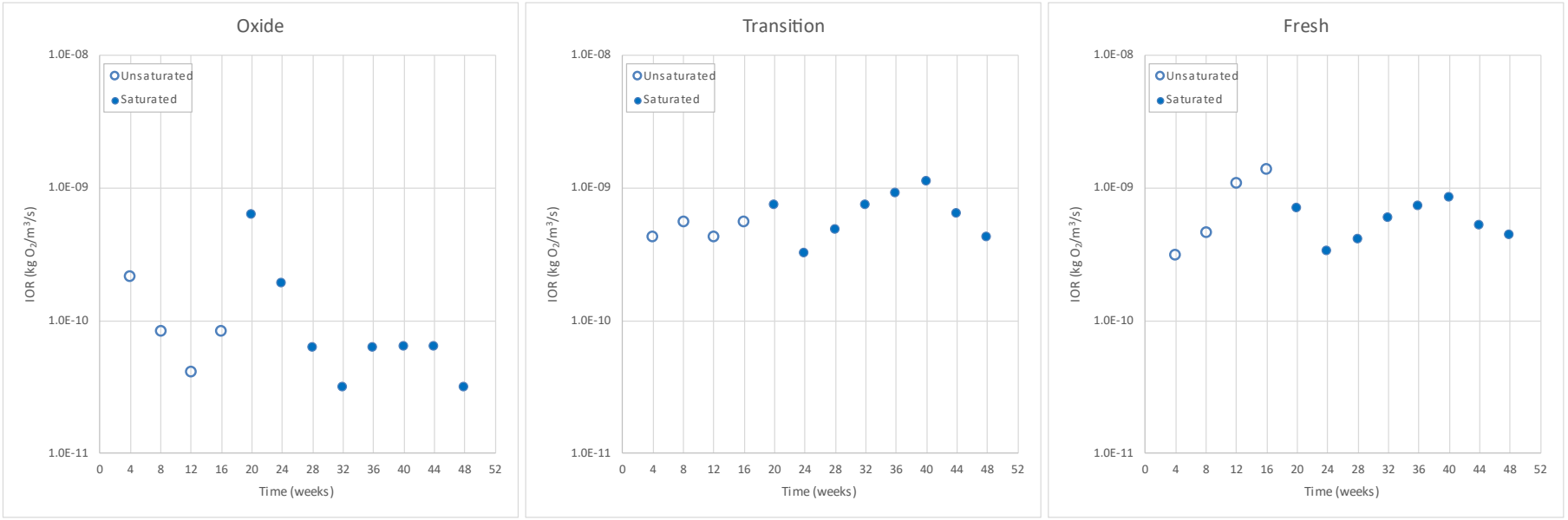


*Figure 7: IOR calculated from SO4 concentrations in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

## 5.3. Comparison of Leachate Solute Concentrations with Baseline Water Quality

While the results of leach column testing suggest that low pH metal laden drainage emanating from waste rock stored either above surface or in backfilled mine voids is unlikely, testing did suggest that elevated concentrations of some metals and metalloids, in particular aluminium, arsenic and zinc, could be present in seepage from oxide, transition and fresh NAF waste rock. As such, waste rock stored in WRDs or in backfilled mine voids, or mine void walls could represent potential sources of these metals/metalloids.

Surface and groundwater studies conducted for the BP33 project[5], suggest that ecosystems associated with these water systems may represent receptors for contaminants originating from mining activities. These include aquatic ecosystems on the Charlotte River and in ephemeral water courses which flow into the Charlotte River to the east and west of the mine. The mine development will intersect groundwaters, including a shallow alluvial aquifer which is largely ephemeral and in close proximity to drainage lines. The mine will also intercept the deeper Burrell Creek Formation (BCF) aquifer which typically lies at the transitional – fresh rock boundary. This aquifer is a low yielding water source and as such is not likely to be used as a water supply, but it may feed some groundwater dependant ecosystems.

As a part of the Draft Environmental Approvals issued by the NT EPA in their assessment report for the BP33 SER, Approval Condition4-1(2) states that "*Discharge of any mine-affected water from the action must not cause water quality at the downstream compliance point(s) to exceed the guideline values*."[6] Guideline values were stipulated as ANZECC Freshwater Default Guideline Values (DGV) using a 95% species protection[7], or where baseline water quality exceeds the DGV, derive a guideline value based on baseline water quality.

Surface water monitoring points located upstream and downstream from the mine footprint were used to collect water quality data to establish baseline water quality for surface water systems. Similarly, bores screened in the alluvial sediments and weathered BCF at shallow depths (to 8 mBGL), in the weathered BCF at intermediate depths (to 36 mBGL) and in the deeper weathered and fresh BCF at depths greater than 36 mBGL, were used to collect water quality data to provide characterisation of pre-mining groundwater quality for detecting and assessing potential impacts once mining commences[8].

Appendix B contains time series plots of various water quality parameters from leach column tests. Each plot also overlays baseline surface water and shallow and deep groundwater quality[9]. Comparison of concentrations of various solutes in leachates from the leach column tests with baseline water quality is not meant to imply significant impact to baseline water quality will occur for surface waters receiving seepages/runoff from WRD, or in groundwater in backfilled mine voids or open mine voids following groundwater recharge. Rather these comparisons can be used to highlight where solute concentrations in leach column leachates significantly exceed baseline water quality and therefore potentially represent a risk of surface or groundwater contamination during mining operations and after

[5] Core Lithium 2021. Finniss Lithium Project BP33 Underground Mine Supplementary Environmental Report, November 2021.
[6] NT EPA 2022. Assessment Report 94, Finniss Lithium Project BP33 Underground Mine, Core Lithium Ltd., NT EPA April 2022.
[7] ANZG (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines
[8] Core Lithium 2021. Finniss Lithium Project BP33 Underground Mine Water Management Plan, November 2021.
[9] Baseline water quality values for various solutes were derived from the 80$^{th}$ percentile values of groundwater metal/metalloid concentrations (20$^{th}$ and 80$^{th}$ percentiles for pH), and from the ANZG DGV (95% species protection, freshwater) for most surface water metals/metalloids, with the exception of Al and Fe (80$^{th}$ percentile), Li (Ecotoxcity Assessment) and pH (20$^{th}$ and 80$^{th}$ percentiles).

closure. Where a potential risk is identified, this would indicate that particular attention should be paid to monitoring of these parameters in seepage/runoff, receiving surface waters and in downgradient monitoring bore water samples.

The results of leachate analysis for leach column tests conducted on Oxide, Transition and Fresh samples under both unsaturated and saturated leaching conditions and comparison with baseline water quality can be summarised by the following:

- pH, EC and alkalinity – There is little difference between leachates from Oxide, Transition and Fresh wastes under both unsaturated and saturated leaching conditions with measured values similar to baseline water quality for surface and groundwaters (Figure B1, Figure B2 and Figure B4).
- Sulphate – Concentrations in leachates from Oxide waste either during unsaturated or saturated leaching are similar to baseline water quality for surface and groundwater. For leachates from Transition and Fresh waste rock samples sulphate concentrations are relatively low, but significantly above baseline water quality for surface and groundwater (Figure B3).
- Calcium, magnesium, sodium, potassium and lithium – Leachates from Fresh waste rock contained calcium concentrations which are significantly higher than baseline water quality for surface water, while magnesium, sodium, potassium and leachate concentrations were slightly higher than surface water baseline water quality. Lithium concentrations in leachates were low for all waste rock types and below baseline water quality for surface and groundwater (Figure B5, Figure B6, Figure B7, Figure B8 and Figure B9).
- Cadmium, chromium, iron, manganese and nickel – Leachate concentrations under unsaturated and saturated leaching conditions were near or below baseline water quality for surface and groundwaters, suggesting these metals are unlikely to pose a significant environmental risk to surface or groundwater receptors (Figure B15, Figure B16, Figure B12, Figure B18 and Figure B19).
- Copper and lead – Concentrations in leachates from the Fresh waste rock leach column test were not elevated relative to baseline water quality, suggesting fresh rock is unlikely to be a significant source of these metals. The Transition waste rock leach column test produced leachates with copper and lead concentrations significantly above SSGV under unsaturated and saturated conditions respectively. This may suggest that transition waste rock could be a source of copper during surface storage and a source of lead if saturated in backfilled mine voids. Concentrations of both metals in leachates from the Oxide waste leach column test were significantly above baseline water quality under unsaturated and saturated leaching conditions. This may suggest that oxide waste rock could be a source of copper and lead during surface storage and if saturated in backfilled mine voids (Figure B17 and Figure B20).

Although concentrations of the metals described above in column leachates were in some instances above baseline water quality, concentrations were in the microgram per litre range. Leachate concentrations of aluminium, arsenic and zinc also exceeded baseline water quality under some conditions, but concentrations of these metals/metalloids were significantly higher, typically in the milligram per litre range.

*Aluminium (*Figure B13*):*

Concentrations of aluminium significantly exceeded baseline water quality in leachates from Oxide and Transition column tests under unsaturated conditions. Aluminium concentrations were also elevated relative to baseline water quality in leachates from the Oxide column under saturated conditions.

Solution speciation modelling conducted on leachate from the Oxide column suggested that these solutions were saturated with respect to several aluminium and iron phases, which may imply the possibility that aluminium and iron concentrations measured in leachate solutions include colloidal as well as solution species. Figure 8 to Figure 10 show concentrations of aluminium, iron and fluoride in leachates from Oxide, Transition and Fresh columns respectively. These figures show that trends in the concentrations of these elements in leachates are similar throughout the leach column test, under both unsaturated and saturated conditions. It is unlikely that aluminium and iron will have the same solubility controls as fluoride, suggesting that at least some of the measured aluminium, iron and fluoride in leachates was derived from colloidal particles which are smaller than 450 nm (samples were filtered through a 0.45 μm membrane prior to analysis). QXRD analysis (Table 5) indicated the presence of clay (kaolinite [$Al_2Si_2O_5(OH)_4$]) and micas (biotite [$K(Mg,Fe)_3(AlSi_3O_{10})(OH,F)_2$], muscovite [$KAl_2(Si_3Al)O_{10}(OH,F)_2$]), with higher clay content in the more

weathered Oxide sample. Colloidal forms of these minerals may be the source of some of the measured aluminium, iron and fluoride in leachates. During column flushing, leachate collection times were in the order Oxide>Transition>Fresh, possibly consistent with higher clay and colloid content in Oxide leachates which reduces filterability.

The lower concentrations of aluminium, iron and fluoride in leachates obtained during the saturated phase of testing in comparison with leachates from unsaturated leaching, may also be consistent with at least some of the measured concentrations of these elements in leachates associated with colloidal material. In the free draining column, leachate is filtered through a filter paper (nominal pore size 30 μm) prior to collection, while when operated in saturated mode, the leachate must first pass through a 50 mm bed of sand and then a 20 mm layer of glass wool, which effectively acts as a multi-media filter.

Previously we have examined the colloidal content of leachates from leach column tests containing material with significant clay content and high aluminium and iron concentrations in neutral pH leachates. Ultrafiltration of a leachate samples with high aluminium, iron and silicon showed that essentially all the aluminium and iron and about 30% of the silicon was present as species greater than 1 nm in size, i.e., present as colloidal material (colloids are defined as particles between 1 nm and 1000 nm[10]), and not dissolved species. Solution modelling calculations showed that if iron was allowed to precipitate as ferrihydrite and aluminium and silicon as kaolinite, modelled solution concentrations matched those of the UF filtered leachate, with aluminium and iron concentrations generally below detection limits and reduced silicon concentrations. These results were consistent with the idea that elevated concentrations of aluminium, iron and iron in leachates were due to small (1 – 450 nm) colloidal iron oxyhydroxides and kaolinite (the sample contained ~10% kaolinite) in equilibrium with the solution. The solution speciation calculations suggested that true solution concentrations of aluminium and iron were likely to be below the measurement detection limit and the measured concentrations in leachates should not be considered as dissolved concentrations. As colloidal species of aluminium are unlikely to have the same toxicity as dissolved aluminium species[11], aluminium was not expected to be present in waste rock drainage at concentrations which will adversely impact receiving environments.

The similarity of leachate chemistry and mineral content of the Oxide and Transition leach columns in this study to the earlier study, suggests the possibility that the high aluminium concentrations in leachates from leach column tests relative to the baseline water quality, may contain a high proportion of colloidal material and consequently a reduced environmental risk. However, further testing would be required to confirm if this is the case.

*Arsenic (*Figure B14*):*

Arsenic concentrations in leachates from the Oxide leach column were similar to baseline water quality for surface water and shallow groundwater and well below the baseline water quality for deeper groundwater and similar under unsaturated and saturated leaching conditions. Concentrations in leachates from the Transition and Fresh waste rock leach columns were higher than for the Oxide column and significantly higher than surface water and shallow groundwater baseline water quality during unsaturated leaching. The change to leaching under saturated conditions resulted in a substantial decrease in leachate arsenic concentrations for the Fresh and Transition waste rock columns.

The arsenic content of the three materials used for leach column testing was in the order Oxide>Fresh>Transition, while the concentrations of arsenic in leachates was generally in the order Fresh>Transition>Oxide. QXRD analysis did not reveal arsenic mineral associations, probably because of the relatively low arsenic content (QXRD typically has a detection limit in the order of 0.1% or higher). However, it is probable that arsenic in the fresh sample is principally associated with sulphide minerals, most likely arsenic enriched pyrite. The source of arsenic in leachates in this case is most likely oxidation of the arsenic enriched sulphide, resulting in release of arsenic, probably as arsenate which is quite soluble at neutral pH and therefore mobile. The higher arsenic in the oxide sample is unlikely to be associated

[10] R. Liu, A. Wilding, A. Hibberd and J.L. Zhou, 2005. Partition of endocrine-disrupting chemicals between colloids and dissolved phase as determined by cross-flow ultrafiltration, *Environ. Sci. Technol*., **39**, 2753 – 2761.
[11] S.L. Simpson et al., 2014. Metal speciation and potential bioavailability changes during discharge and neutralisation of acidic drainage water, *Chemosphere*, **103**, 172 – 180.

with sulphides as this material is largely devoid of any sulphides. Arsenic may therefore be associated with less soluble minerals such as ferric arsenate in the oxide sample and consequently, the arsenic is less mobile when leached. The decrease in arsenic concentration in leachates from Fresh and Transition leach columns when operated under saturated conditions may reflect slower oxidation rates for arsenic enriched sulphides, although IOR calculated from released sulphate (Figure 7) did not indicate a significant decrease in the oxidation rate between unsaturated and saturated leaching.

These results suggest that storage of fresh and to a lesser extent transition waste rock in a WRD prior to back filling the mine voids and inundation, may provide a source of arsenic via seepage/runoff from the WRD which could potentially contain concentrations significantly above the baseline water quality for surface waters and shallow groundwater systems. Following backfilling of mine voids and groundwater rebound, leaching of arsenic is likely to be reduced and given the relatively high background arsenic concentrations in the deeper groundwater system, backfilled mine waste is less likely to present an environmental risk to groundwater through arsenic contamination.

*Zinc (*Figure B21*):*

Concentrations of zinc in leachates from all three leach column tests were very low and similar to baseline water quality for both surface and groundwaters when operated under unsaturated conditions. When these materials were leached under saturated conditions, there was a significant increase in leachate zinc concentrations which in all cases exceeded the baseline water quality by a considerable margin. As with arsenic, QXRD analysis did not reveal zinc mineral associations because of the low zinc content of the samples, and so the source of zinc in the leachates is not known. Nevertheless, the results of leach column testing conducted under saturated conditions do indicate that backfilling of mine voids with oxide, transition or fresh waste rock could potentially provide a source of zinc when saturated after groundwater recharge, which may adversely impact groundwater quality.

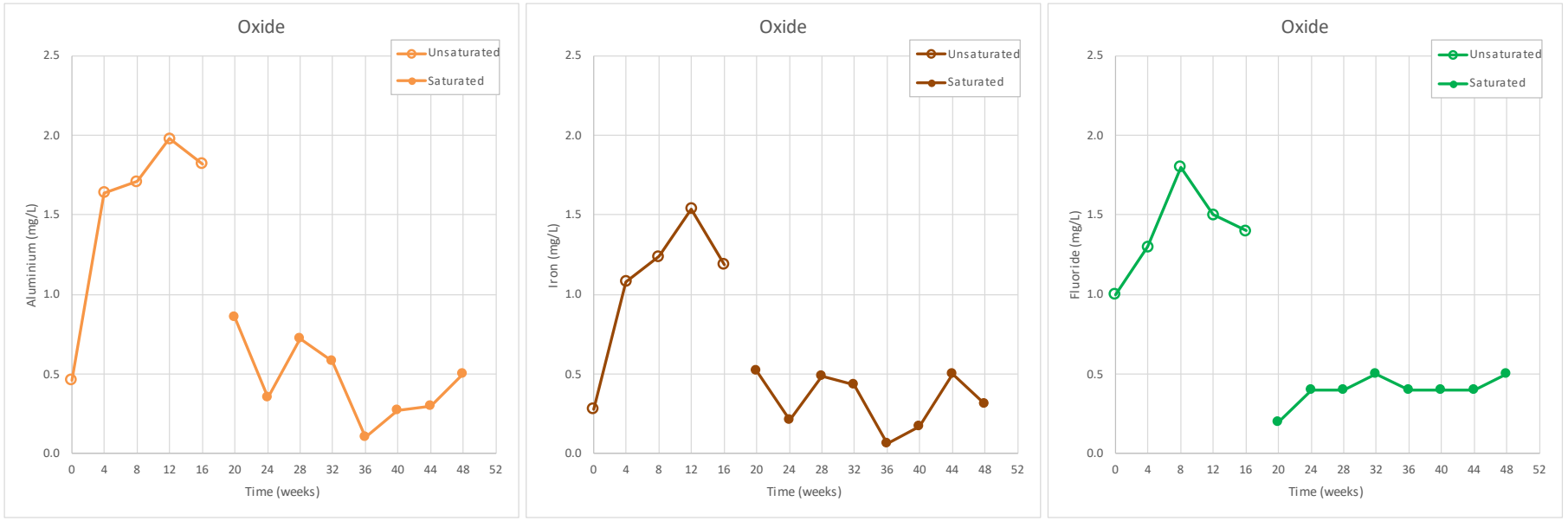


*Figure 8: Concentrations of aluminium (left), iron (middle) and fluoride (right) in leachates from the oxide leach column.*

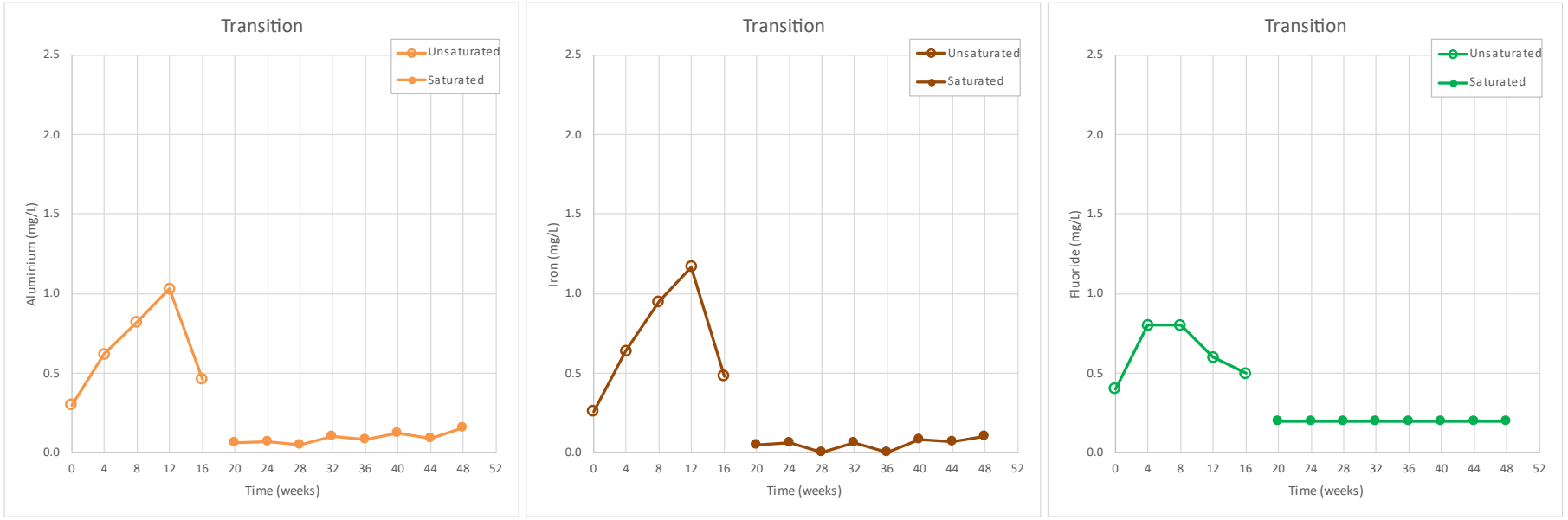


*Figure 9: Concentrations of aluminium (left), iron (middle) and fluoride (right) in leachates from the transition leach column.*

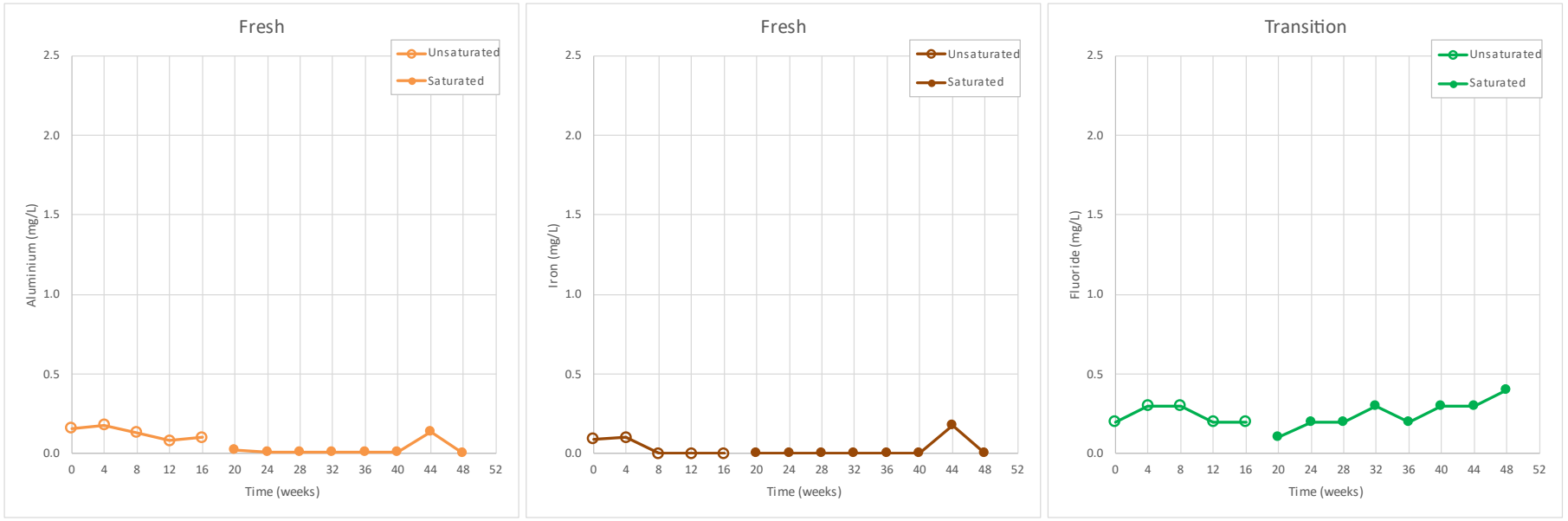


*Figure 10: Concentrations of aluminium (left), iron (middle) and fluoride (right) in leachates from the fresh leach column.*

# 6. CONCLUSIONS AND RECOMMENDATIONS

## 6.1. Study Conclusions

Leach column testing was conducted on three waste rock samples which were blended to be representative of oxide, transition and fresh waste rock from the BP33 deposit. Leach columns were conducted successively under unsaturated and saturated leaching regimes to simulate storage of waste rock in a WRD followed by inundation in backfilled mine voids. Static testing of these blended materials suggested NAF classification for the three materials, which was confirmed by kinetic leach column tests.

If the three materials used for leach column tests are generally representative of oxide, transition and fresh waste rock which will be mined as a part of the BP33 project, then results from column leach testing suggest the following about waste rock stored in the WRD and later backfilled into mine voids:

- Seepage/runoff from waste stored in the WRDs is likely to have neutral pH, low salinity and major cation concentrations probably similar to baseline concentrations in local surface and groundwaters.
- Concentrations of a number of metals including cadmium, chromium, iron, manganese and nickel in seepage/runoff from waste stored in the WRDs are likely to be very low and potentially similar to baseline concentrations in local surface and groundwaters.
- Groundwater contacted with waste which is backfilled in mine voids (including the box cut) following a period of storage in the WRDs is likely to have neutral pH, low salinity and major cation concentrations and potentially similar to baseline concentrations in local groundwaters.
- Concentrations of a number of metals including cadmium, chromium, iron, manganese and nickel in groundwater contacted with waste which is backfilled in mine voids (including the box cut) following a period of storage in the WRDs are likely to be very low and probably similar to baseline concentrations in local groundwaters.

The results of a leach column testing also suggest that, if the tested materials are representative of waste rock which will be mined as a part of the BP33 project, then there is the possibility for potential contamination by several metals of local surface and groundwaters from seepage/runoff from WRDs or of groundwater in contact with backfilled mine wastes. These metals include arsenic, copper, lead and zinc and possibly aluminium. Possible contaminating metal sources and potential receptors are summarised in Table 6 below. Also listed in the table are the average factor by which leach column leachate concentrations exceed the baseline water quality for each metal and water type.

As indicated previously, the concentrations of solutes in leachates from leach column tests are unlikely to be directly relatable to concentrations in seepage/runoff from the WRDs or from backfilled mine wastes. Rather they can provide a qualitative indication of which metals in waste rock leachate may be present at elevated concentrations in comparison with baseline water quality values. Thus, the exceedance factors shown in Table 6 are not designed to represent a risk factor for adverse impact of particular metals on surface or groundwater quality. For example, seepage from the WRDs is most likely to occur during periods of high rainfall when the stockpile is flushed by infiltrating rain, but at the same time surface water flows are likely to be highest due to the same event and consequently leachate dilution highest during such events. Further studies are required to provide a more quantitative framework for risk evaluation of metal/metalloid contamination of local surface and groundwaters.

*Table 6: Potential sources and possible receptors for various metals and comparison of column test leachate concentrations with baseline water quality for the corresponding metals.*

| Metal | Source | Receptor | Average Exceedance Factor of baseline water quality [1] |
|---|---|---|---|
| Al[2] | Box Cut WRD | Surface water<br>Shallow ground water<br>Deeper ground water | 15<br>76<br>5 |
| | UG WRD | Surface water<br>Shallow ground water | 6<br>32 |
| As | UG WRD | Surface water<br>Shallow ground water | 39<br>101 |
| Cu | Box Cut WRD | Surface water<br>Shallow ground water | 20<br>14 |
| | Backfilled box cut | Shallow ground water<br>Deeper ground water | 25<br>49 |
| | UG WRD | Surface water<br>Shallow ground water | 16<br>11 |
| Pb | Backfilled mine voids | Deeper ground water | 12 |
| Zn | Backfilled box cut | Shallow ground water<br>Deeper ground water | 18<br>57 |
| | Backfilled mine voids | Deeper ground water | 50 |

1. Calculated as the average leachate concentration from leach column testing under either unsaturated or saturated leaching conditions divided by the corresponding baseline water quality
2. Concentrations of aluminium measured in leach column testing may include significant amounts of colloidal material, and consequently actual solution concentrations and the calculated corresponding exceedance factors could be much lower.

## 6.2. Recommendations

Results from leach column testing suggest that while acidic drainage from wastes stored in WRD at the BP33 project or following backfilling of mine voids is unlikely, there is potential for water in contact with these materials to contain elevated concentrations of a number of metals/metalloids relative to local surface and groundwaters. While modelling suggests that movement of groundwater away from the mine post closure will be limited[12], contamination of groundwater by metals sourced from backfilled mine waste rock and/or mine voids walls is a possibility. It is therefore recommended that:

- Run-off from WRDs is contained within run-off/seepage ponds and water quality monitored especially in relation to arsenic, copper and aluminium concentrations and, if required, stored (e.g., mine site dam) for later discharge at times of high flow or treated before discharge if required.
- WRD leachate quality/quantity data be used to calibrate leach column results and validate/calibrate modelling results (see below) and the updated/ validated models used to better evaluate any potential impacts on groundwater quality from backfilled mine wastes.
- Mine waste management plans be updated during the operational phase, especially in relation to closure, based on the results of the above monitoring and modelling updates as required, with a view to minimising risk to groundwater quality and potential impacts on associated ecosystems.

As outlined above (Sections 5.3 and 6.1), scaling of metal concentrations in leachate from leach tests to possible concentrations in seepage from the WRDs is difficult, due to likely differences in solid to liquid ratio between the leach tests and the WRD among other factors such as flow regimes of both water and air (oxygen) within the WRD. Consequently, the results from kinetic leach testing provide qualitative evaluation of leachate chemistry in relation to

[12] CloudGMS 2021. Finniss Lithium Project BP33 Groundwater Modelling Report Final Version 3.0, October 2021

WRD or backfilled waste seepages/leachates, but can also provide quantitative data (dissolution rates and solute loads) as inputs to solute transport modelling. It is therefore recommended that a useful next step would be to undertake a more quantitative evaluation of the potential for impact on surface and groundwater quality from WRD seepage and leaching from backfilled materials. This could be done using the existing groundwater model combined with development of a conceptual hydrogeological model for the WRDs, using the leaching rates and loads from the leach column tests as inputs. Specifically, this could include:

- Qualitatively assess the risk of migration of leachable metal contaminants from the site by development of a (schematic) hydrogeological conceptual model of the waste rock dumps and underground mining to assess the potential pathways by which leachable metals may migrate into the water environment.
- Quantitatively assess the same by implementation of components of the hydrogeological conceptual model in 2-dimensional finite element models (using Seep/W and CTran/W) to quantify the migration of soluble metal contaminants from temporary surface WRDs and from permanent underground void backfill, including dilution in groundwater due to advection and dispersion, and removal or capture from groundwater due to adsorption, reaction or decay.

This process would add significant value to the column leach tests and provide further evidence for evaluation of environmental risks associated with the Finniss Lithium Project - BP33 UG Mine and can form a basis for updated mine waste and water management plans if required.

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# APPENDIX A
# Leach Column Test Results

*Table A1: Leachate analysis results from the Oxide leach column (21372)*

| Parameters | | Column Leachate Analyses - Oxide NAF waste | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Initial | Unsaturated Phase | | | | Saturated Phase | | | | | | | | |
| | | Flush | Week 4 | Week 8 | Week 12 | Week 16 | Week 20 | Week 24 | Week 28 | Week 32 | Week 36 | Week 40 | Week 44 | Week 48 | Week 52 |
| Volume | mls | 486 | 463 | 452 | 446 | 449 | 681 | 683 | 680 | 679 | 680 | 681 | 682 | 682 | |
| pH | - | 7.1 | 7.2 | 7.1 | 7.2 | 7.3 | 7.1 | 7.7 | 7.1 | 7.4 | 7.3 | 7.1 | 7.3 | 7.4 | |
| EC | dS/m | 0.23 | 0.12 | 0.10 | 0.089 | 0.076 | 0.10 | 0.13 | 0.11 | 0.11 | 0.10 | 0.10 | 0.08 | 0.08 | |
| Alkalinity | mg/l | 40 | 29 | 26 | 24 | 19 | 49 | 68 | 55 | 44 | 40 | 41 | 40 | 39 | |
| Acidity | mg/l | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Ag | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Al | mg/l | 0.46 | 1.64 | 1.71 | 1.98 | 1.82 | 0.86 | 0.35 | 0.72 | 0.58 | 0.10 | 0.27 | 0.30 | 0.50 | |
| As | mg/l | 0.020 | 0.024 | 0.026 | 0.028 | 0.024 | 0.012 | 0.009 | 0.009 | 0.009 | 0.005 | 0.005 | 0.00 | 0.01 | |
| B | mg/l | 0.13 | 0.08 | <0.05 | <0.05 | <0.05 | 0.11 | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | |
| Ba | mg/l | 0.020 | 0.032 | 0.028 | 0.037 | 0.035 | 0.067 | 0.020 | 0.016 | 0.018 | 0.013 | 0.019 | 0.011 | 0.010 | |
| Be | mg/l | <0.001 | 0.002 | 0.002 | 0.002 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Ca | mg/l | 2 | <1 | <1 | <1 | <1 | 10 | 6 | 3 | 3 | 2 | 2 | 2 | 2 | |
| Cd | mg/l | 0.0002 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0002 | <0.0001 | 0.00 | 0.0001 | 0.0001 | 0.0006 | 0.0001 | <0.0001 | |
| Cl | mg/l | 29 | 4 | 1 | 1 | 2 | 6 | 2 | 1 | <1 | <1 | <1 | 1 | <1 | |
| Co | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.002 | <0.001 | |
| Cr | mg/l | <0.001 | 0.004 | 0.001 | 0.001 | 0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Cs | mg/l | 0.001 | 0.008 | 0.010 | 0.01 | 0.007 | 0.002 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Cu | mg/l | 0.028 | 0.030 | 0.028 | 0.028 | 0.025 | 0.042 | 0.012 | 0.040 | 0.035 | 0.032 | 0.054 | 0.028 | 0.022 | |
| F | mg/l | 1.0 | 1.3 | 1.8 | 1.5 | 1.4 | 0.2 | 0.4 | 0.4 | 0.5 | 0.4 | 0.4 | 0.4 | 0.5 | |
| Fe | mg/l | 0.28 | 1.1 | 1.2 | 1.5 | 1.2 | 0.52 | 0.21 | 0.49 | 0.43 | 0.06 | 0.17 | 0.50 | 0.31 | |
| Hg | mg/l | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | |
| K | mg/l | 2 | 1 | 1 | <1 | <1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | |
| Li | mg/l | 0.042 | 0.019 | 0.016 | 0.016 | 0.012 | <0.001 | 0.001 | 0.001 | <0.001 | 0.002 | <0.001 | <0.001 | 0.001 | |
| Mg | mg/l | 2 | <1 | <1 | <1 | <1 | 2 | 1 | <1 | <1 | <1 | <1 | <1 | <1 | |
| Mn | mg/l | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.004 | 0.003 | 0.004 | 0.004 | 0.001 | 0.001 | 0.002 | 0.001 | |
| Mo | mg/l | 0.001 | <0.001 | <0.001 | 0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Na | mg/l | 39 | 11 | 7 | 6 | 5 | 27 | 19 | 14 | 13 | 10 | 9 | 9 | 7 | |
| Ni | mg/l | 0.004 | 0.004 | 0.003 | 0.004 | 0.004 | 0.005 | 0.002 | 0.003 | 0.003 | 0.002 | 0.004 | 0.005 | 0.003 | |
| P | mg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | |
| Pb | mg/l | 0.002 | 0.007 | 0.007 | 0.008 | 0.007 | 0.007 | 0.005 | 0.010 | 0.018 | 0.010 | 0.010 | 0.009 | 0.005 | |
| Sb | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Se | mg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| Si | mg/l | 4 | 6 | 12 | 13 | 13 | 7.8 | 10.4 | 9.6 | 10.4 | 9.9 | 9.2 | 9.4 | 8.4 | |
| Sn | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| $SO_4$ | mg/l | 16 | 5 | 2 | 1 | 2 | 10 | 3 | 1 | <1 | 1 | 1 | 1 | <1 | |
| Sr | mg/l | 0.022 | 0.008 | 0.006 | 0.006 | 0.007 | 0.03 | 0.03 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | |
| Th | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Tl | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| U | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Zn | mg/l | 0.014 | 0.013 | 0.015 | 0.015 | 0.014 | 0.67 | 0.09 | 0.51 | 0.35 | 0.45 | 0.79 | 0.49 | 0.47 | |

< indicates that the concentration is less than the limit of detection

*Table A2: Leachate analysis results from the Transition leach column (21373)*

| Parameters | | Column Leachate Analyses - Transition NAF waste | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Initial | Unsaturated Phase | | | | Saturated Phase | | | | | | | | |
| | | Flush | Week 4 | Week 8 | Week 12 | Week 16 | Week 20 | Week 24 | Week 28 | Week 32 | Week 36 | Week 40 | Week 44 | Week 48 | Week 52 |
| Volume | mls | 470 | 491 | 488 | 494 | 492 | 610 | 611 | 613 | 610 | 609 | 610 | 610 | 610 | |
| pH | - | 6.8 | 6.9 | 6.8 | 7.1 | 6.9 | 6.9 | 7.7 | 7.0 | 7.1 | 7.1 | 7.0 | 7.2 | 7.3 | |
| EC | dS/m | 0.13 | 0.12 | 0.11 | 0.092 | 0.087 | 0.18 | 0.14 | 0.12 | 0.12 | 0.11 | 0.11 | 0.068 | 0.069 | |
| Alkalinity | mg/l | 16 | 18 | 17 | 17 | 17 | 44 | 42 | 43 | 31 | 34 | 36 | 27 | 26 | |
| Acidity | mg/l | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Ag | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Al | mg/l | 0.30 | 0.62 | 0.82 | 1.03 | 0.46 | 0.06 | 0.07 | 0.05 | 0.10 | 0.08 | 0.12 | 0.09 | 0.16 | |
| As | mg/l | 0.024 | 0.116 | 0.161 | 0.176 | 0.149 | 0.010 | 0.014 | 0.028 | 0.012 | 0.012 | 0.010 | 0.014 | 0.015 | |
| B | mg/l | <0.05 | 0.05 | <0.05 | <0.05 | <0.05 | 0.09 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | |
| Ba | mg/l | 0.011 | 0.012 | 0.015 | 0.018 | 0.009 | 0.047 | 0.028 | 0.024 | 0.024 | 0.021 | 0.023 | 0.017 | 0.012 | |
| Be | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Ca | mg/l | 3 | 2 | 2 | 2 | 2 | 10 | 7 | 7 | 6 | 6 | 6 | 4 | 3 | |
| Cd | mg/l | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0004 | 0.0003 | 0.0001 | 0.0002 | <0.0001 | <0.0001 | |
| Cl | mg/l | 6 | <1 | <1 | <1 | 2 | 3 | <1 | <1 | <1 | <1 | <1 | <1 | 2 | |
| Co | mg/l | <0.001 | 0.001 | 0.001 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Cr | mg/l | <0.001 | 0.004 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Cs | mg/l | 0.001 | 0.002 | 0.003 | 0.004 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Cu | mg/l | 0.053 | 0.015 | 0.018 | 0.016 | 0.009 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| F | mg/l | 0.4 | 0.8 | 0.8 | 0.6 | 0.5 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | |
| Fe | mg/l | 0.26 | 0.64 | 0.95 | 1.17 | 0.48 | 0.05 | 0.06 | <0.05 | 0.06 | <0.05 | 0.08 | 0.07 | 0.10 | |
| Hg | mg/l | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | |
| K | mg/l | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 3 | 2 | |
| Li | mg/l | 0.227 | 0.222 | 0.175 | 0.156 | 0.128 | 0.017 | 0.017 | 0.013 | 0.012 | 0.018 | 0.011 | 0.018 | 0.018 | |
| Mg | mg/l | 2 | 1 | 1 | 1 | 1 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | |
| Mn | mg/l | 0.027 | 0.030 | 0.024 | 0.027 | 0.017 | <0.001 | <0.001 | 0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Mo | mg/l | <0.001 | 0.001 | 0.001 | 0.001 | <0.001 | 0.001 | 0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Na | mg/l | 10 | 9 | 7 | 6 | 6 | 19 | 8 | 6 | 5 | 4 | 3 | 2 | 2 | |
| Ni | mg/l | 0.002 | 0.004 | 0.003 | 0.003 | 0.002 | 0.002 | <0.001 | 0.002 | 0.004 | 0.002 | 0.002 | 0.001 | <0.001 | |
| P | mg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | |
| Pb | mg/l | <0.001 | 0.001 | 0.002 | 0.002 | <0.001 | 0.005 | 0.010 | 0.016 | 0.022 | 0.014 | 0.009 | 0.001 | 0.001 | |
| Sb | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Se | mg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| Si | mg/l | 1.4 | 3.9 | 4.7 | 5.1 | 4.9 | 7.5 | 7.2 | 6.6 | 7.0 | 6.6 | 6.0 | 5.2 | 4.3 | |
| Sn | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| $SO_4$ | mg/l | 16 | 10 | 13 | 10 | 13 | 14 | 6 | 9 | 14 | 17 | 21 | 12 | 8 | |
| Sr | mg/l | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 | |
| Th | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Tl | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| U | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Zn | mg/l | 0.010 | <0.005 | <0.005 | <0.005 | <0.005 | 0.35 | 0.18 | 0.52 | 0.83 | 0.50 | 0.61 | 0.25 | 0.24 | |

< indicates that the concentration is less than the limit of detection

*Table A3: Leachate analysis results from the Fresh leach column (21374)*

| Parameters | | Column Leachate Analyses - Fresh NAF waste | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Initial | Unsaturated Phase | | | | Saturated Phase | | | | | | | | |
| | | Flush | Week 4 | Week 8 | Week 12 | Week 16 | Week 20 | Week 24 | Week 28 | Week 32 | Week 36 | Week 40 | Week 44 | Week 48 | Week 52 |
| Volume | mls | 476 | 500 | 494 | 510 | 516 | 471 | 470 | 471 | 470 | 467 | 468 | 469 | 471 | |
| pH | - | 7.2 | 7.4 | 7.6 | 7.7 | 7.6 | 7.3 | 7.4 | 7.4 | 7.3 | 7.3 | 7.3 | 7.4 | 7.5 | |
| EC | dS/m | 0.096 | 0.092 | 0.11 | 0.12 | 0.13 | 0.22 | 0.22 | 0.27 | 0.20 | 0.18 | 0.18 | 0.16 | 0.16 | |
| Alkalinity | mg/l | 29 | 26 | 23 | 21 | 29 | 58 | 81 | 74 | 72 | 69 | 65 | 64 | 62 | |
| Acidity | mg/l | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Ag | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Al | mg/l | 0.16 | 0.18 | 0.13 | 0.08 | 0.10 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.14 | <0.01 | |
| As | mg/l | 0.031 | 0.484 | 0.790 | 0.616 | 0.615 | 0.095 | 0.065 | 0.082 | 0.089 | 0.103 | 0.115 | 0.147 | 0.186 | |
| B | mg/l | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.09 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | |
| Ba | mg/l | 0.003 | 0.003 | 0.002 | 0.007 | 0.004 | 0.137 | 0.080 | 0.062 | 0.050 | 0.043 | 0.042 | 0.032 | 0.022 | |
| Be | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Ca | mg/l | 2 | 3 | 4 | 9 | 11 | 17 | 19 | 22 | 20 | 23 | 24 | 21 | 18 | |
| Cd | mg/l | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0014 | 0.0001 | <0.0001 | 0.0002 | <0.0001 | <0.0001 | |
| Cl | mg/l | 4 | 2 | 2 | 1 | 4 | 2 | <1 | <1 | <1 | 6 | <1 | <1 | <1 | |
| Co | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Cr | mg/l | <0.001 | 0.003 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Cs | mg/l | 0.001 | 0.002 | 0.002 | 0.003 | 0.003 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.003 | <0.001 | <0.001 | |
| Cu | mg/l | 0.012 | 0.009 | 0.004 | 0.004 | 0.004 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.003 | <0.001 | <0.001 | |
| F | mg/l | 0.2 | 0.3 | 0.3 | 0.2 | 0.2 | 0.1 | 0.2 | 0.2 | 0.3 | 0.2 | 0.3 | 0.3 | 0.4 | |
| Fe | mg/l | 0.09 | 0.1 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.18 | <0.05 | |
| Hg | mg/l | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | |
| K | mg/l | 7 | 7 | 8 | 10 | 10 | 8 | 7 | 8 | 6 | 6 | 6 | 5 | 4 | |
| Li | mg/l | 0.076 | 0.105 | 0.092 | 0.095 | 0.073 | <0.001 | 0.001 | <0.001 | 0.002 | 0.001 | <0.001 | <0.001 | 0.002 | |
| Mg | mg/l | <1 | <1 | 1 | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 2 | |
| Mn | mg/l | 0.030 | 0.054 | 0.047 | 0.069 | 0.025 | 0.001 | 0.004 | 0.006 | 0.001 | 0.001 | <0.001 | 0.003 | <0.001 | |
| Mo | mg/l | 0.001 | 0.004 | 0.004 | 0.005 | 0.003 | 0.002 | 0.002 | 0.002 | 0.002 | 0.001 | 0.003 | 0.003 | 0.004 | |
| Na | mg/l | 7 | 9 | 7 | 6 | 6 | 18 | 6 | 5 | 3 | 10 | 2 | 2 | 2 | |
| Ni | mg/l | 0.002 | 0.006 | 0.002 | 0.001 | <0.001 | 0.003 | 0.003 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | <0.001 | |
| P | mg/l | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | |
| Pb | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.002 | 0.002 | 0.002 | 0.001 | 0.001 | 0.002 | <0.001 | |
| Sb | mg/l | <0.001 | 0.002 | 0.001 | <0.001 | <0.001 | 0.002 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | <0.001 | <0.001 | |
| Se | mg/l | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | |
| Si | mg/l | 0.7 | 0.7 | 1.1 | 1.6 | 1.6 | 5.5 | 5.5 | 4.9 | 5.3 | 5.0 | 4.6 | 4.2 | 3.7 | |
| Sn | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| | mg/l | 7 | 8 | 12 | 27 | 34 | 19 | 9 | 11 | 16 | 20 | 23 | 14 | 12 | |
| Sr | mg/l | 0.01 | 0.02 | 0.02 | 0.05 | 0.05 | 0.06 | 0.06 | 0.07 | 0.07 | 0.08 | 0.08 | 0.07 | 0.06 | |
| Th | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| Tl | mg/l | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | |
| U | mg/l | <0.001 | 0.002 | 0.003 | 0.002 | 0.003 | 0.001 | <0.001 | 0.001 | 0.002 | 0.002 | 0.003 | 0.005 | 0.005 | |
| Zn | mg/l | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.31 | 0.34 | 0.33 | 0.26 | 0.22 | 0.29 | 0.24 | 0.15 | |
| < indicates that the concentration is less than the limit of detection | | | | | | | | | | | | | | | |

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# APPENDIX B

# Comparison of Leach Column Test Results with Baseline Water Quality

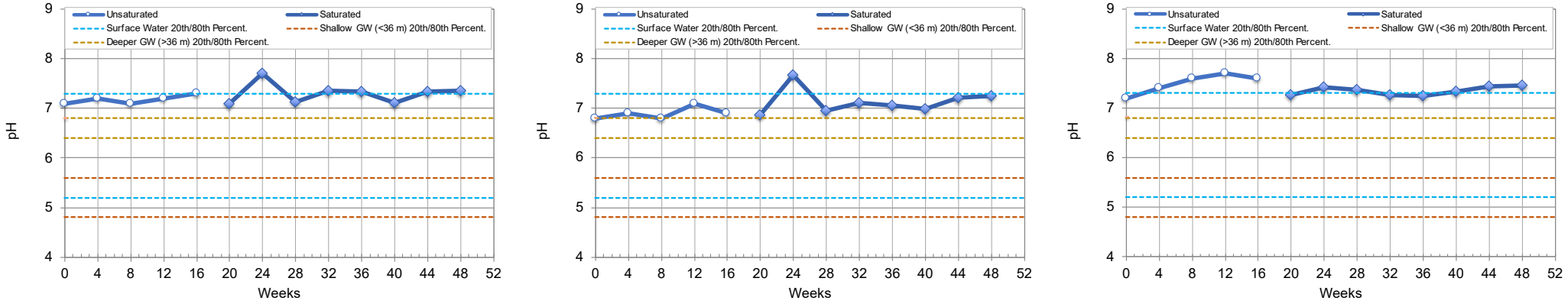



*Figure B1: pH of leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

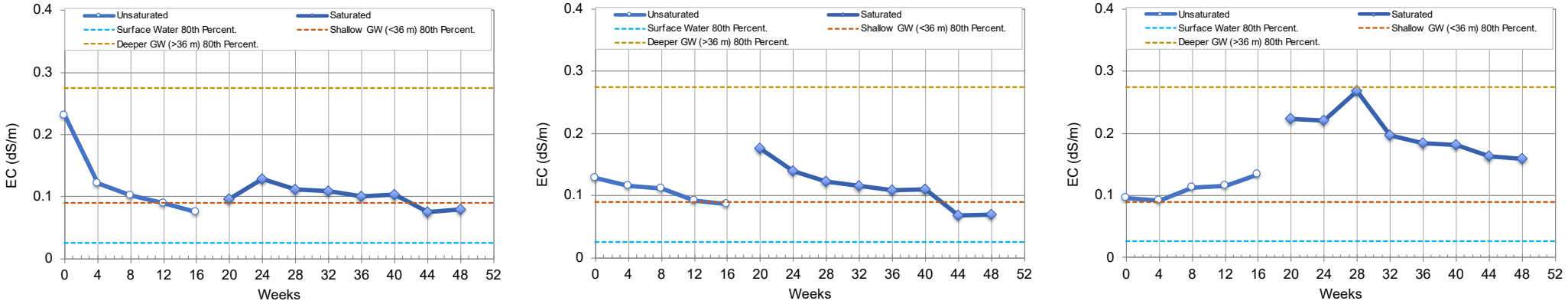



*Figure B2: EC of leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

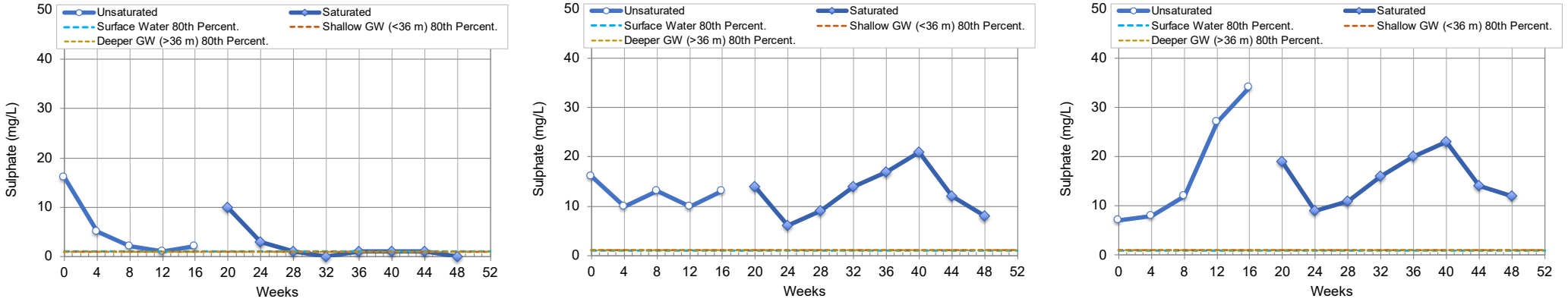



*Figure B3: Sulphate in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

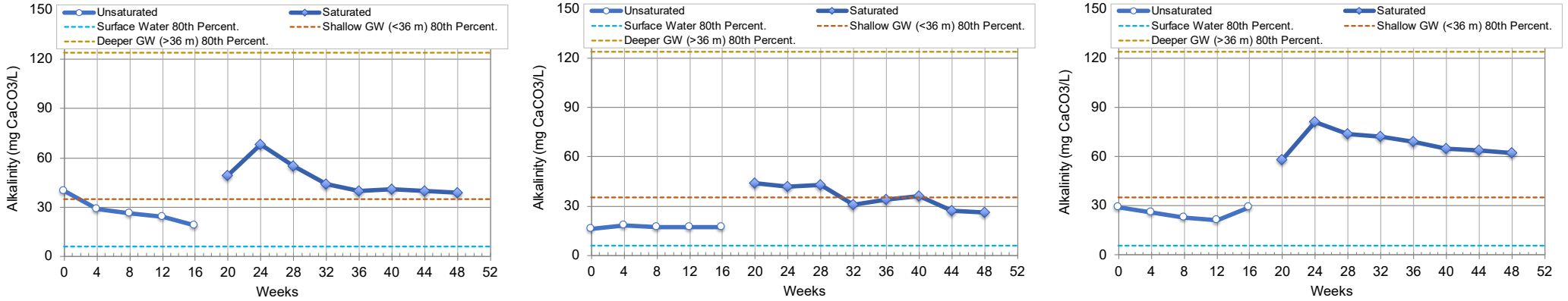



*Figure B4: Alkalinity in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

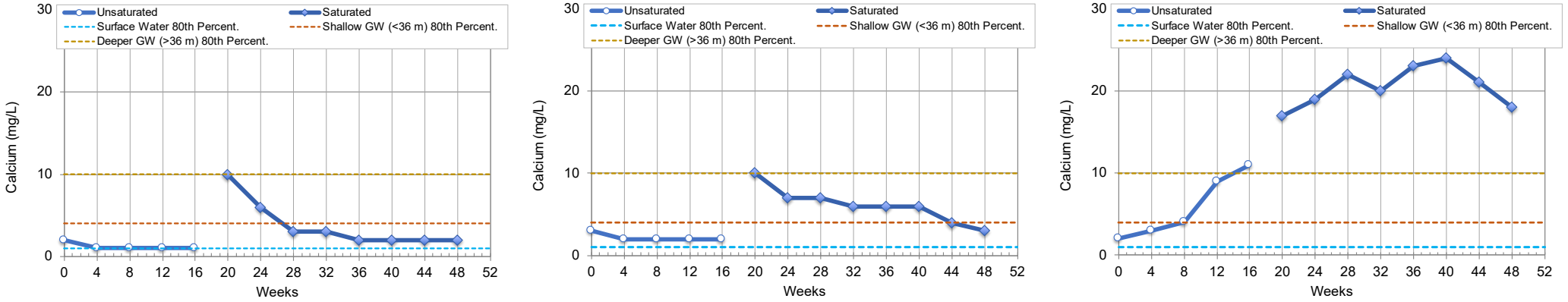



*Figure B5: Calcium in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

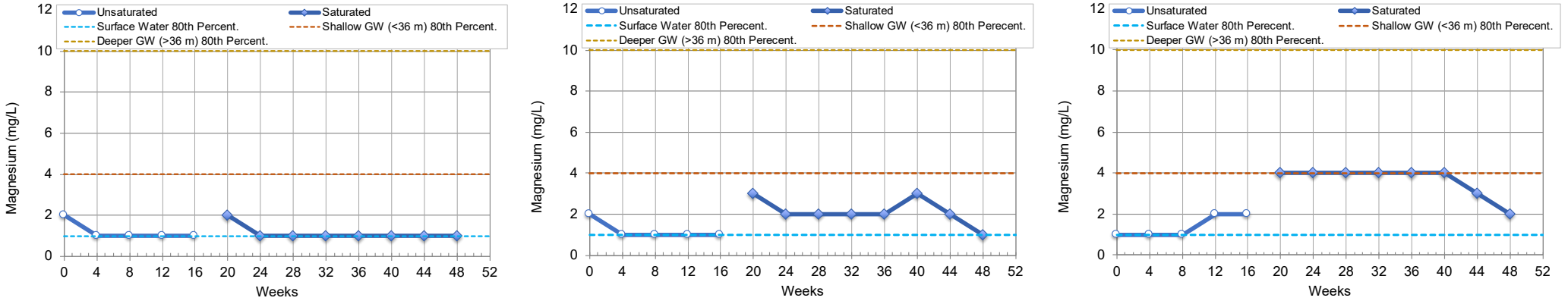



*Figure B6: Magnesium in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

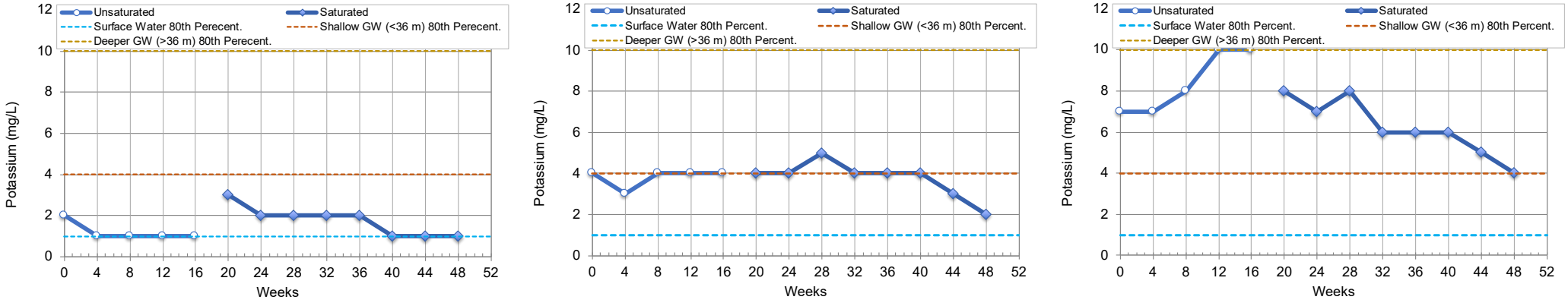



*Figure B7: Potassium in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

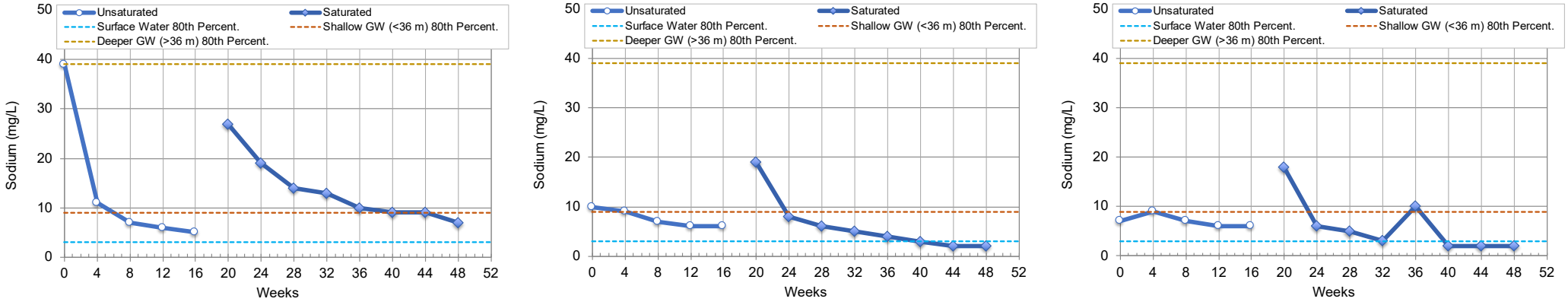



*Figure B8: Sodium in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

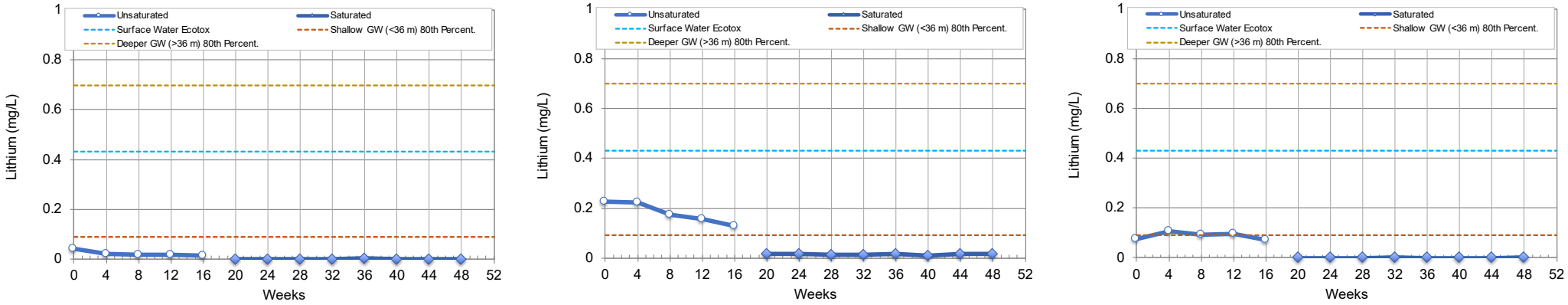



*Figure B9: Lithium in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

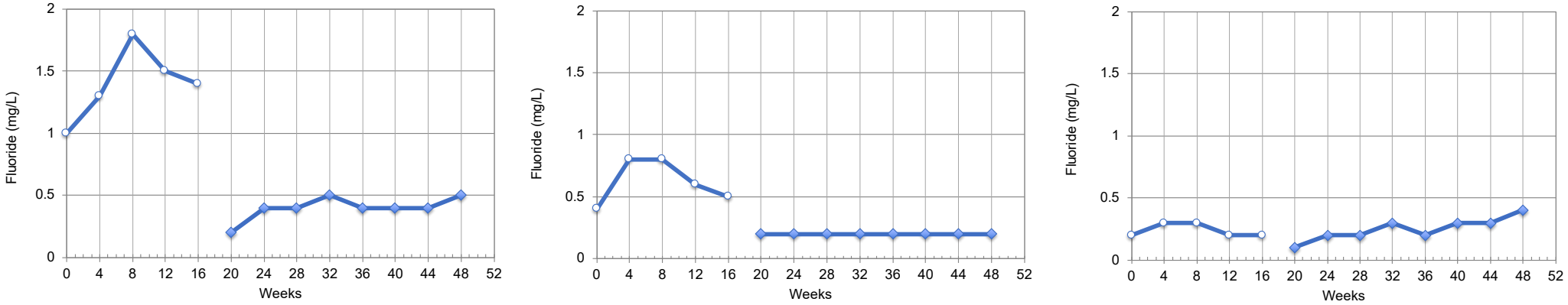



*Figure B10: Fluoride in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

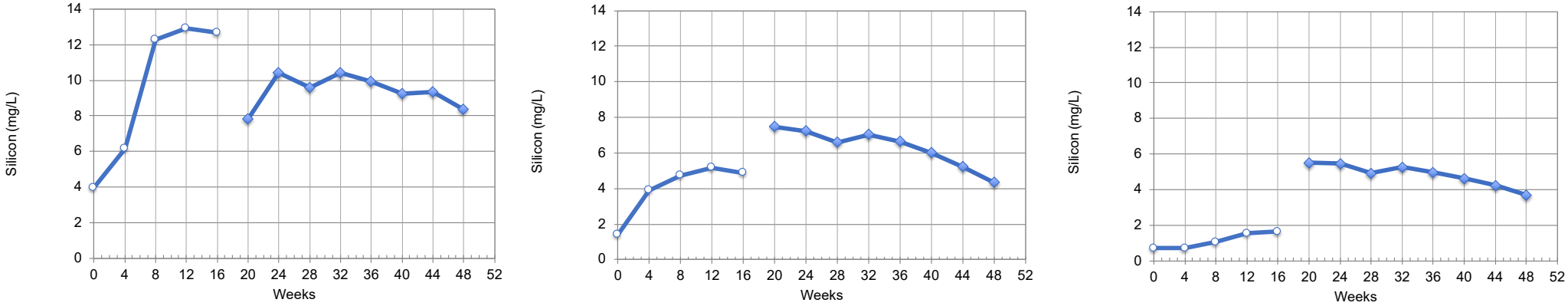



*Figure B11: Silicon in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

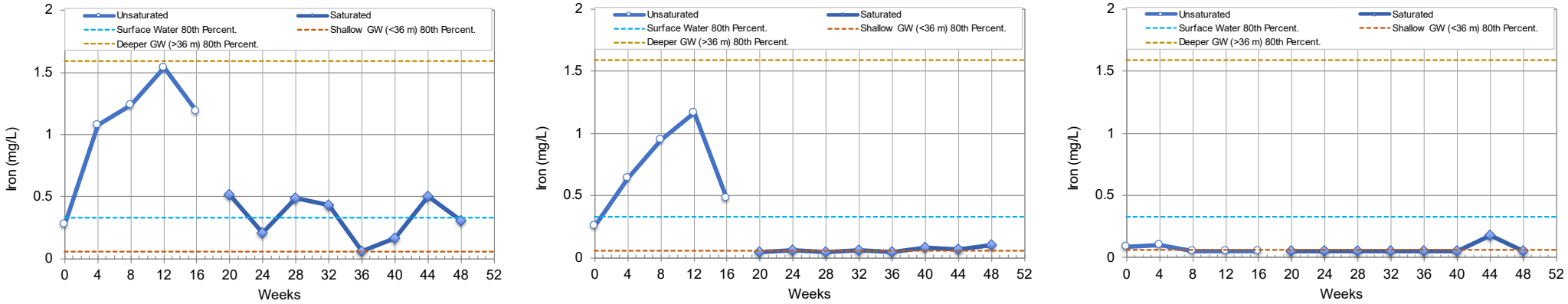



*Figure B12: Iron in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

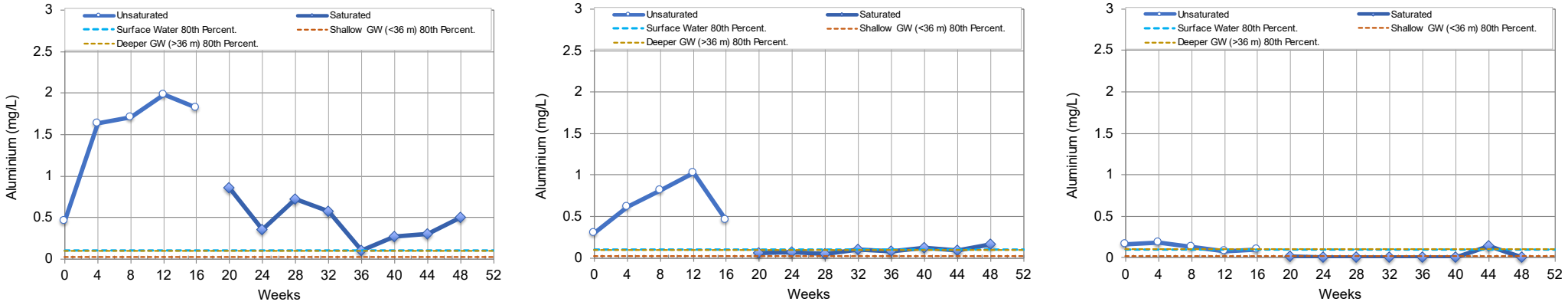



*Figure B13: Aluminium in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

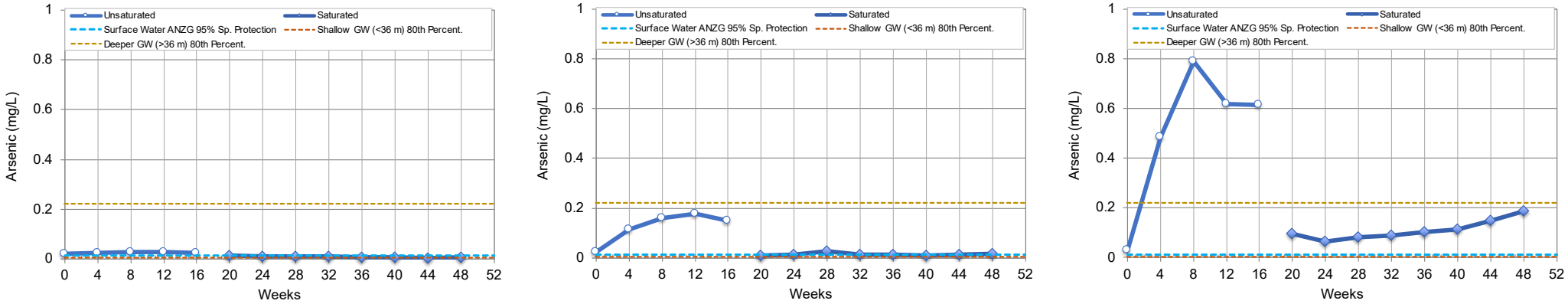



*Figure B14: Arsenic in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

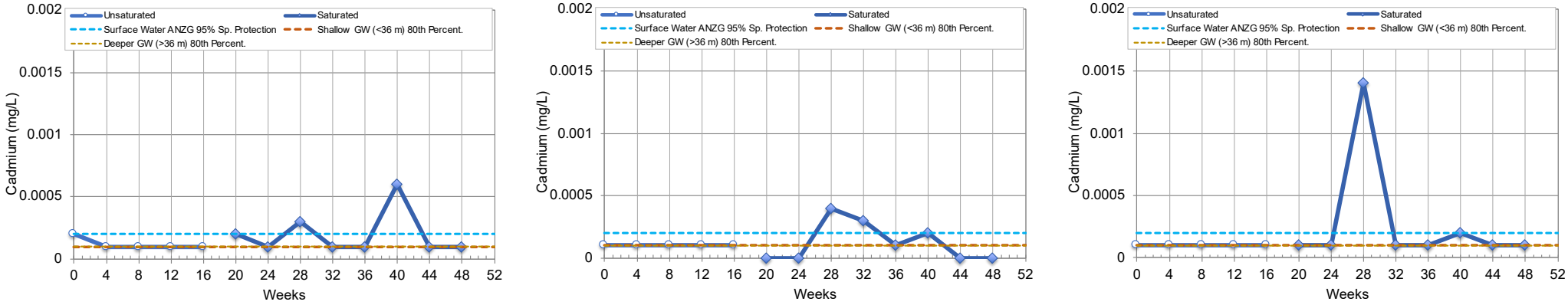



*Figure B15: Cadmium in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

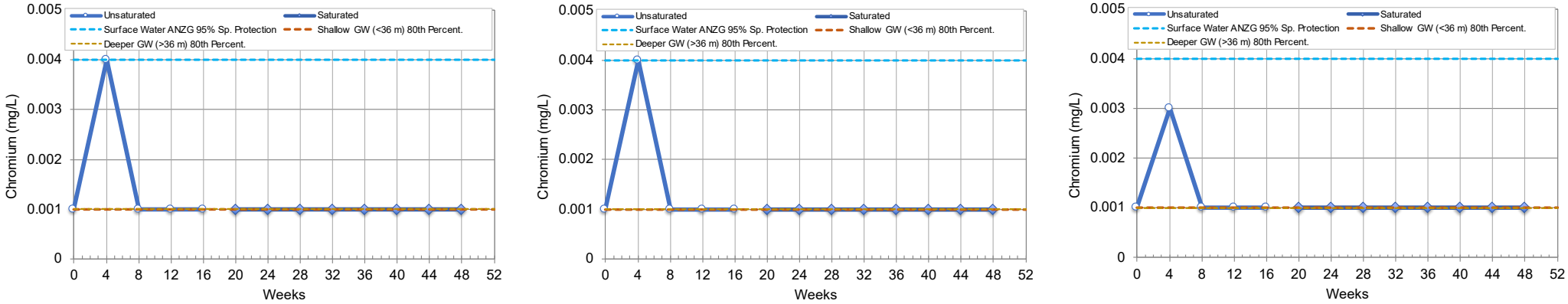



*Figure B16: Chromium in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

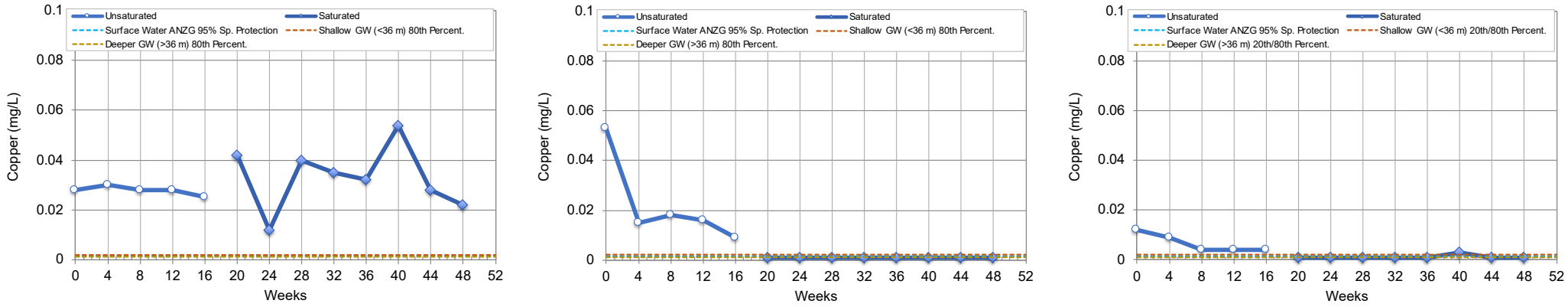



*Figure B17: Copper in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

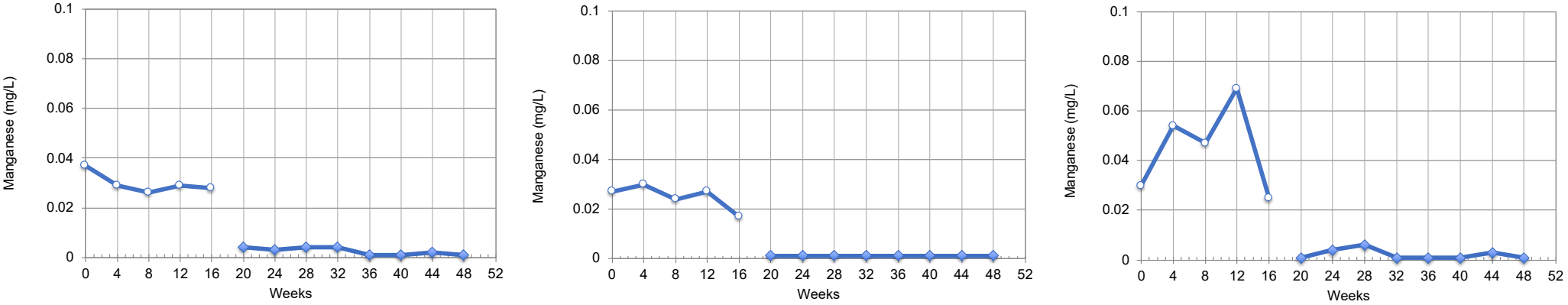



*Figure B18: Manganese in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

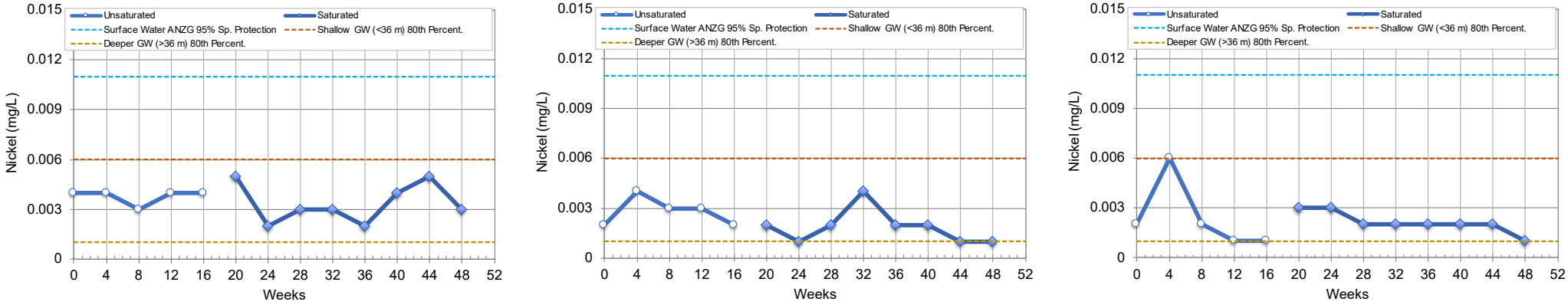



*Figure B19: Nickel in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

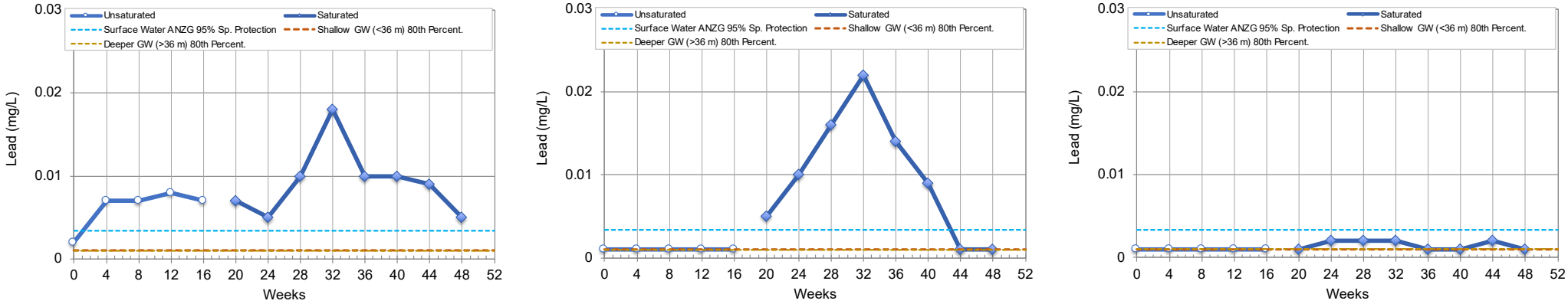



*Figure B20: Lead in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*

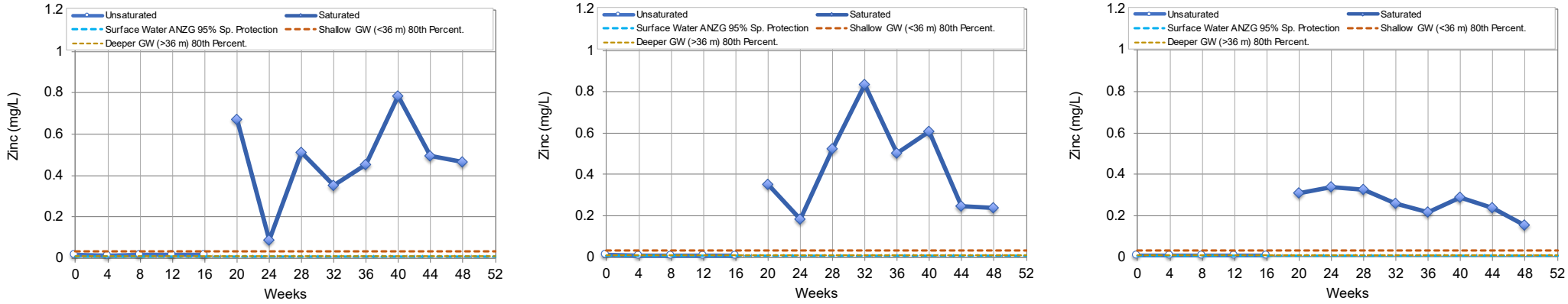
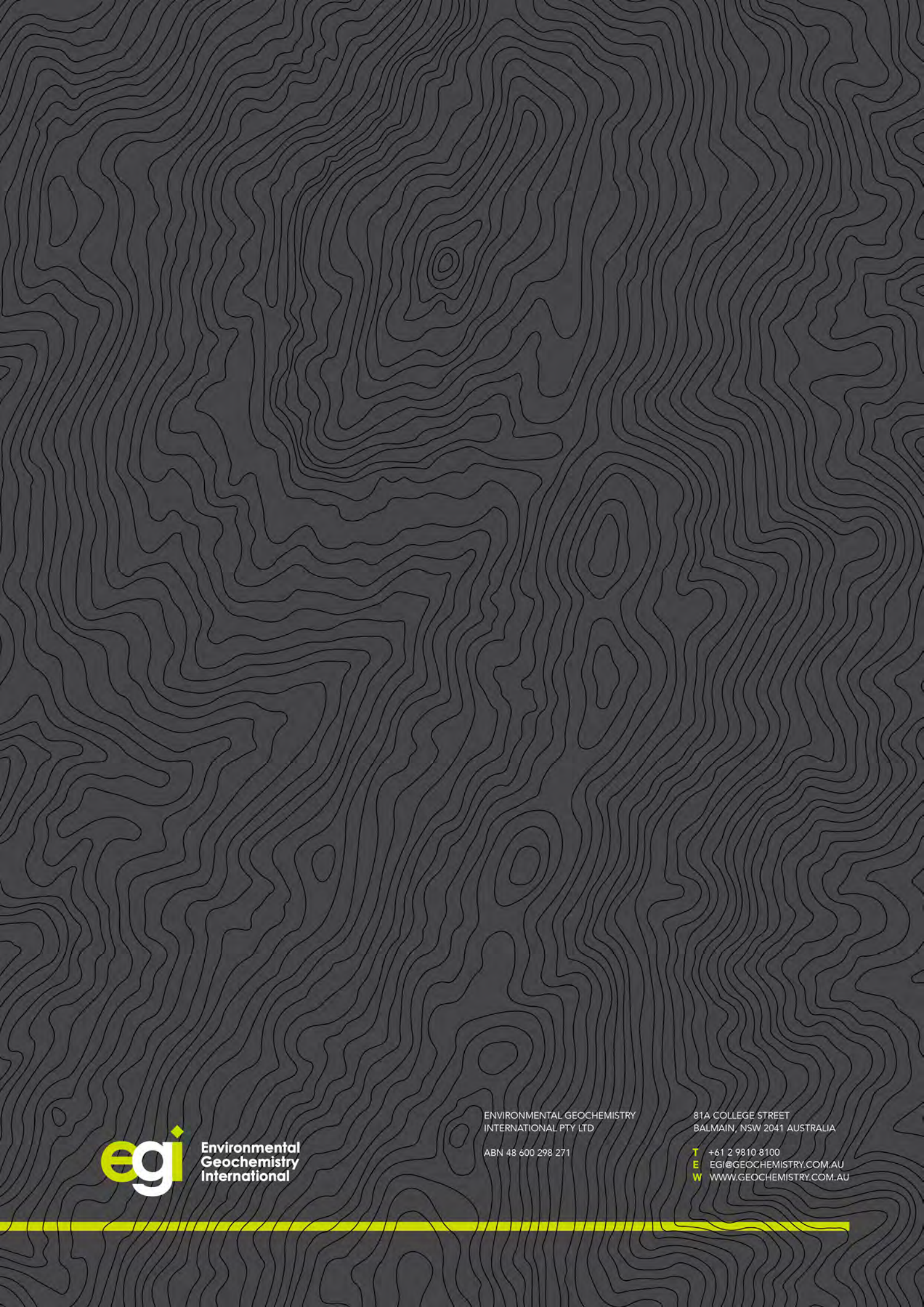



*Figure B21: Zinc in leachates from the oxide (left), transition (middle) and fresh (right) leach columns.*



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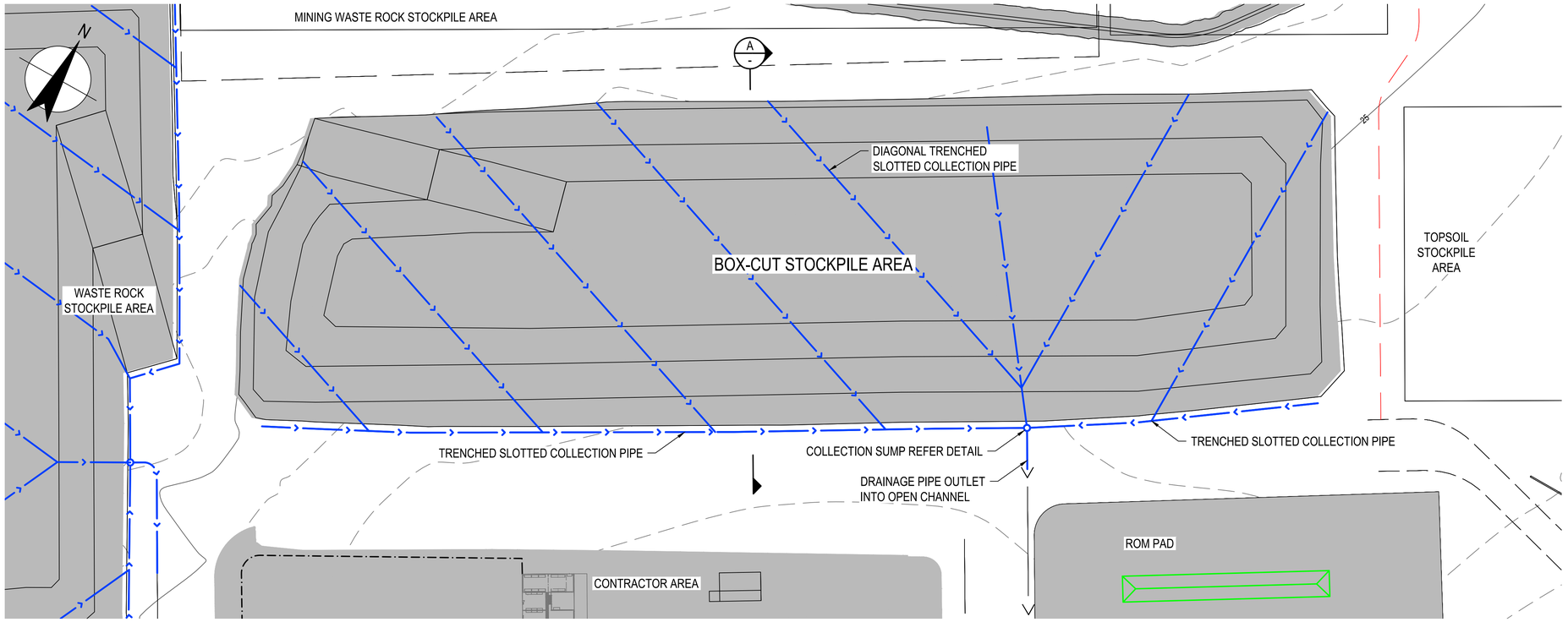
# ATTACHMENT B

WRD DESIGNS




LAYOUT PLAN
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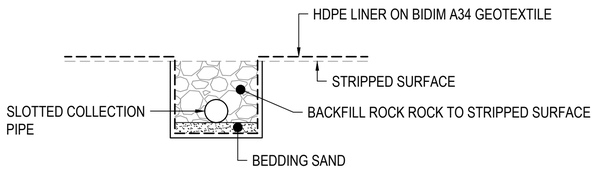
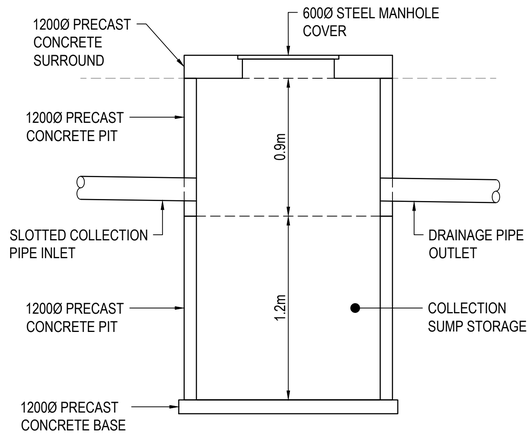



TYPICAL SECTION - COLLECTION PIPE HDPE LINER OPTION
SCALE 1:20




TYPICAL SECTION - COLLECTION SUMP
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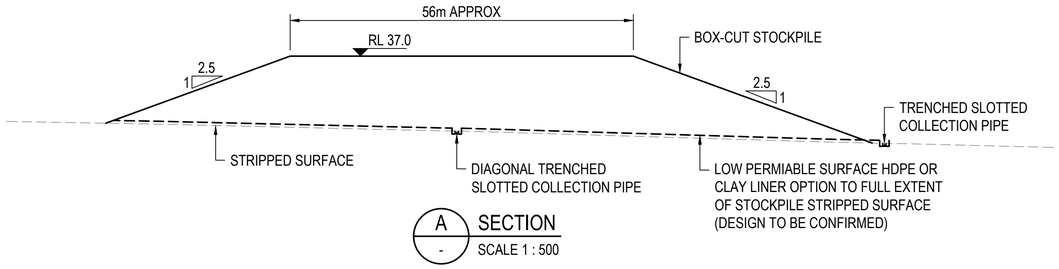
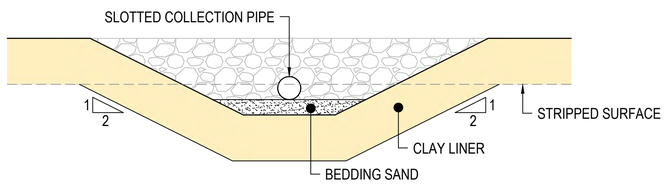



A - SECTION
SCALE 1 : 500




TYPICAL SECTION - COLLECTION PIPE CLAY LINER OPTION
SCALE 1:20

CONCEPT

| rev | description | app'd | date |
|---|---|---|---|
| A | ISSUED FOR CONCEPT | SC | 29.09.23 |

0 0.2 0.4 0.6 0.8 1.0m
SCALE 1:20 AT ORIGINAL SIZE

0 5 10 15 20 25m
SCALE 1:500 AT ORIGINAL SIZE

0 10 20 30 40 50m
SCALE 1:1000 AT ORIGINAL SIZE

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scale for A1

project no. 12614588

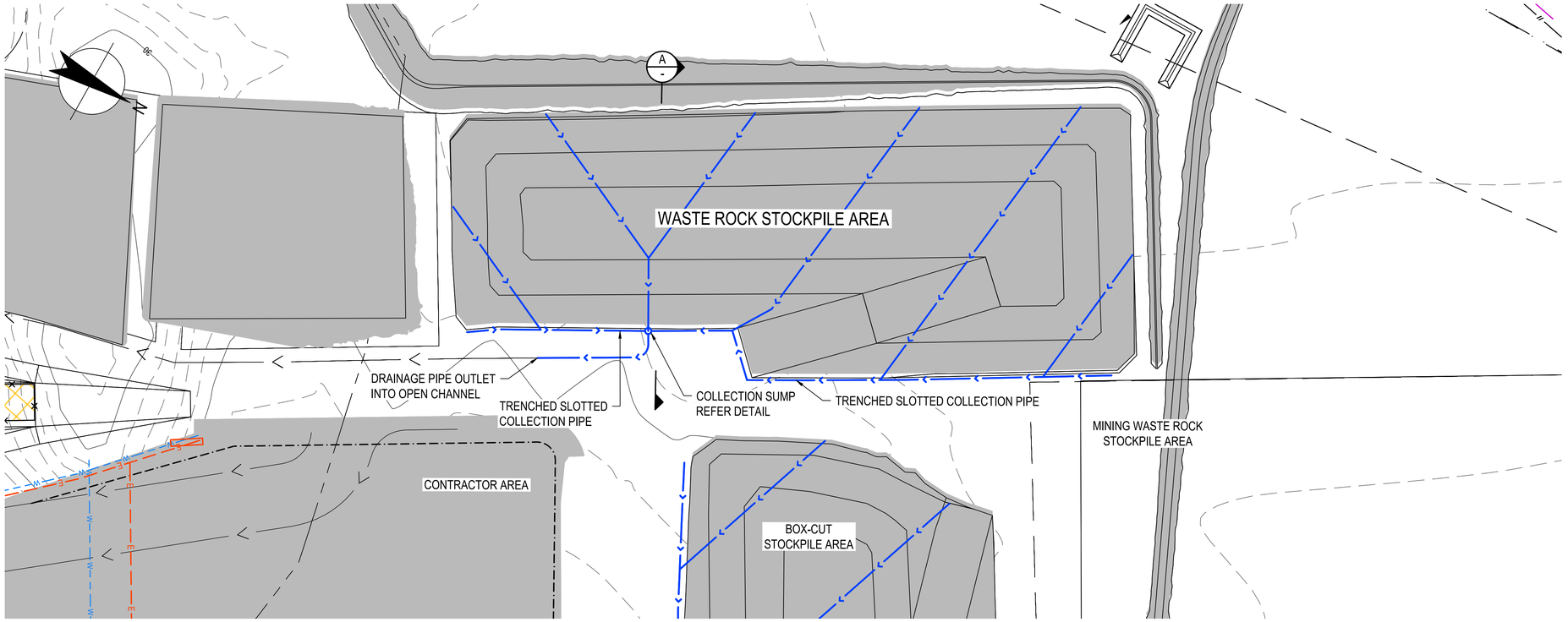
CORE LITHIUM
BP33 MINE - INFRASTRUCTURE DESIGN
BP33 MINE SITE
WASTE ROCK DUMP #1
LAYOUT AND TYPICAL DETAILS

size A1

sketch no. 12614588-GHD-00-00-SKT-CI-00042

rev no. A

plot date: 29 September 2023 - 11:30 AM plotted by: John Hurlstone
file name: C:\12d\SW\data\P-00-12D-001\41-12614588 - Core Lithium BP33 Study_2628\CADD\Drawings\Civil\12614588-GHD-00-00-SKT-CI-00042.dwg

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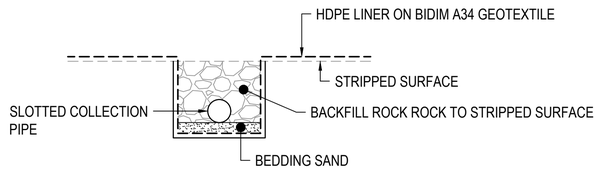


## TYPICAL SECTION - COLLECTION PIPE HDPE LINER OPTION
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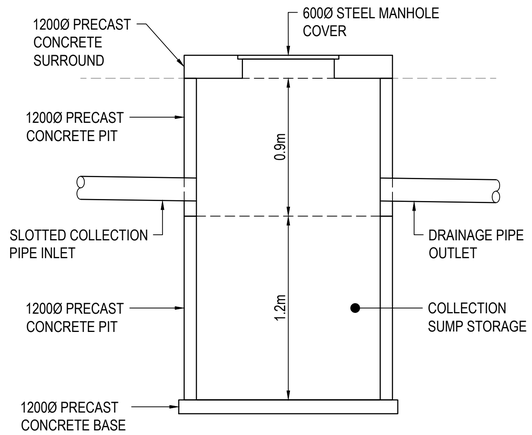


## TYPICAL SECTION - COLLECTION SUMP
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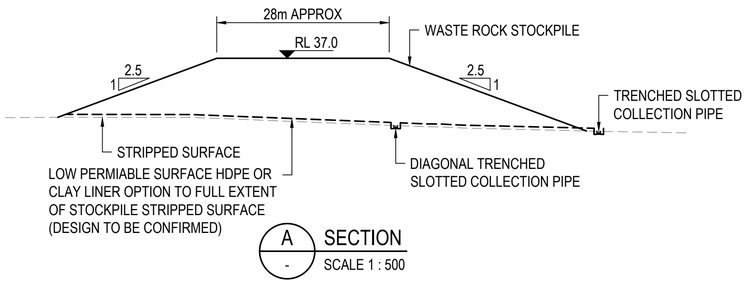


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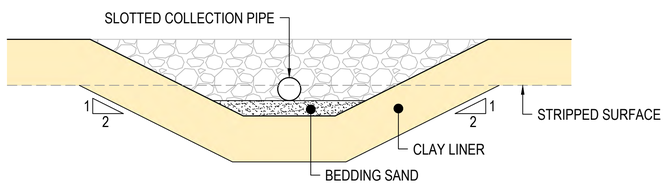


## TYPICAL SECTION - COLLECTION PIPE CLAY LINER OPTION
SCALE 1:20

CONCEPT

| rev | description | app'd | date |
|---|---|---|---|
| A | ISSUED FOR CONCEPT | SC | 29.09.23 |

0 0.2 0.4 0.6 0.8 1.0m
SCALE 1:20 AT ORIGINAL SIZE

0 5 10 15 20 25m
SCALE 1:500 AT ORIGINAL SIZE

0 10 20 30 40 50m
SCALE 1:1000 AT ORIGINAL SIZE

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CORE LITHIUM
BP33 MINE - INFRASTRUCTURE DESIGN
BP33 MINE SITE
WASTE ROCK DUMP #2
LAYOUT AND TYPICAL DETAILS

scale for A1
project no. 12614588
sketch no. 12614588-GHD-00-00-SKT-CI-00043
size A1
rev no. A

plot date: 29 September 2023 - 11:30 AM plotted by: John Hurlstone
file name: C:\12d\SW\data\P-00-12D-001\41-12614588 - Core Lithium BP33 Study_2628\CADD\Drawings\Civil\12614588-GHD-00-00-SKT-CI-00043.dwg

# Appendix G Risk Matrices

**Risk matrices (sourced from ICMM 2019[1])**

| Consequence rating | | | | | |
|---|---|---|---|---|---|
| **Consequence type** | **Insignificant (1)** | **Minor (2)** | **Moderate (3)** | **High (4)** | **Major (5)** |
| Schedule | Less than 1% impact on overall project timeline | May result in overall project timeline overrun of equal to or more than 1% and less than 3% | May result in overall project timeline overrun of equal to or more than 3% and less than 10% | May result in overall project timeline overrun of equal to or more than 10% and less than 30% | May result in overall project timeline overrun of 30% or more |
| Financial | Less than 1% impact on the overall budget of the project | May result in overall project budget overrun of equal to or more than 1% and less than 3% | May result in overall project budget overrun of equal to or more than 3% and less than 10% | May result in overall project budget overrun of equal to or more than 10% and less than 30% | May result in overall project budget overrun of 30% or more |
| Safety | First-aid case | Medical treatment case | Lost-time injury | Permanent disability or single fatality | Numerous permanent disabilities or multiple fatalities |
| Environment | Lasting days or less; affecting small area (m); receiving environment altered with no sensitive habitats and no biodiversity value (eg urban/ industrial areas) | Lasting weeks; affecting limited area (hundreds of m); receiving environment altered with little natural habitat and low biodiversity value | Lasting months; affecting extended area (km); receiving environment comprising largely natural habitat and moderate biodiversity value | Lasting years; affecting area on sub-basin scale; receiving environment classified as having sensitive natural habitat with high biodiversity value | Permanent impact; affecting area on a whole basin or regional scale; receiving environment classified as highly sensitive natural habitat with very high biodiversity value |
| Legal and regulatory | Technical noncompliance. No warning received; no regulatory reporting required | Breach of regulatory requirements; report/ involvement of authority. Attracts administrative fine | Minor breach of the law; report/ investigation by authority. Attracts compensation/ penalties/ enforcement action | Breach of the law. May attract criminal prosecution, penalties/ enforcement action; individual licence temporarily revoked | Significant breach of the law. Individual or company lawsuits; permit to operate substantially modified or withdrawn |
| Social / community | Minor disturbance of culture/social structures | Some impacts on local population, mostly repairable. Single stakeholder complaint in reporting period | Ongoing social issues. Isolated complaints from community members/ stakeholders | Significant social impacts. Organised community protests threatening continuity of operations | Major widespread social impacts. Community reaction affecting business continuity. Licence to operate in jeopardy |
| Reputation | Minor impact; awareness/ concern from specific individuals | Limited impact; concern/ complaints from certain groups/ organisations (e.g. NGOs) | Local impact; public concern/ adverse publicity localised within neighbouring communities | Suspected reputational damage; local/ regional public concern and reactions | Noticeable reputational damage; national/ international public attention and repercussions |

| Scale | Likelihood |
|---|---|
| **Improbable (1)**<br>**<3%** | Likelihood of occurring is less than 3% in the 10 year post closure period.<br>It would require a substantial change in circumstances to create an environment for this to occur, and even then, this is a rare occurrence. |
| **Unlikely (2)**<br>**3-10%** | Likelihood of occurring more than or equal to 3% and less than 10%in the 10 year post closure period. There are no specific circumstances to suggest this could happen. |
| **Possible (3)**<br>**10–30%** | Likelihood of occurring more than or equal to 10% and less than 30%. in the 10 year post closure period. There is a possibility of this risk occurring as it has occurred before (albeit infrequently) in the mining and metals industry / area. |
| **Likely (4)**<br>**30-90%** | Likelihood of occurring more than or equal to 30% and less than 90% in the 10 year post closure period. This consequence is not uncommon in the mining and metals industry/area. |
| **Almost Certain (5)**<br>**>90%** | Greater than 90% likelihood of occurring in the 10 year post closure period.<br>Has happened/will probably happen during the mine life and there is no reason to suspect it won't happen. |

| Likelihood¤ | Consequence¤ | | | | |
|---|---|---|---|---|---|
| | Insignificant¤ | Minor¤ | Moderate¤ | High¤ | Major¤ |
| Improbable¤ | Low¶ (1)¤ | Low¶ (3)¤ | Medium¶ (6)¤ | Medium¶ (10)¤ | Significant¶ (15)¤ |
| Unlikely¤ | Low¶ (2)¤ | Low¶ (5)¤ | Medium¶ (9)¤ | Significant¶ (14)¤ | Significant¶ (19)¤ |
| Possible¤ | Low¶ (4)¤ | Medium¶ (8)¤ | Significant¶ (13)¤ | Significant¶ (18)¤ | High¶ (22)¤ |
| Likely¤ | Medium¶ (7)¤ | Medium¶ (12)¤ | Significant¶ (17)¤ | High¶ (21)¤ | High¶ (24)¤ |
| Almost-Certain¤ | Medium¶ (11)¤ | Significant¶ (16)¤ | Significant¶ (20)¤ | High¶ (23)¤ | High¶ (25)¤ |

[1] International Council on Mining & Metals 2019, Integrated Mine Closure, Good Practice Guide, 2nd Edition