APPENDIX D BP33 DESKTOP GROUNDWATER STUDY

BP33 Lithium Prospect

Preliminary Groundwater Assessment

Prepared for	CORE LITHIUM	October 2019

Prepared for Core Lithium by Groundwater Enterprises

Version 1.0 Final

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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 Grants was completed in June, 2019.

1.1 Project Description

The proposed mining activities at BP33 involve the construction of a box cut to an approximate depth of 60 m to remove the weathered zone from the Burrell Creek Formation. 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 on 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 source 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 of Assessment

Core Lithium have requested the completion of a preliminary groundwater desktop assessment at the BP33 site. The assessment has the following scope:

- Identify groundwater values at the BP33 site.
- Scope potential risks and impacts from the proposed mining activities.
- Provide recommendations for a network of monitoring bores that will be used to develop a groundwater model.

2 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 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.

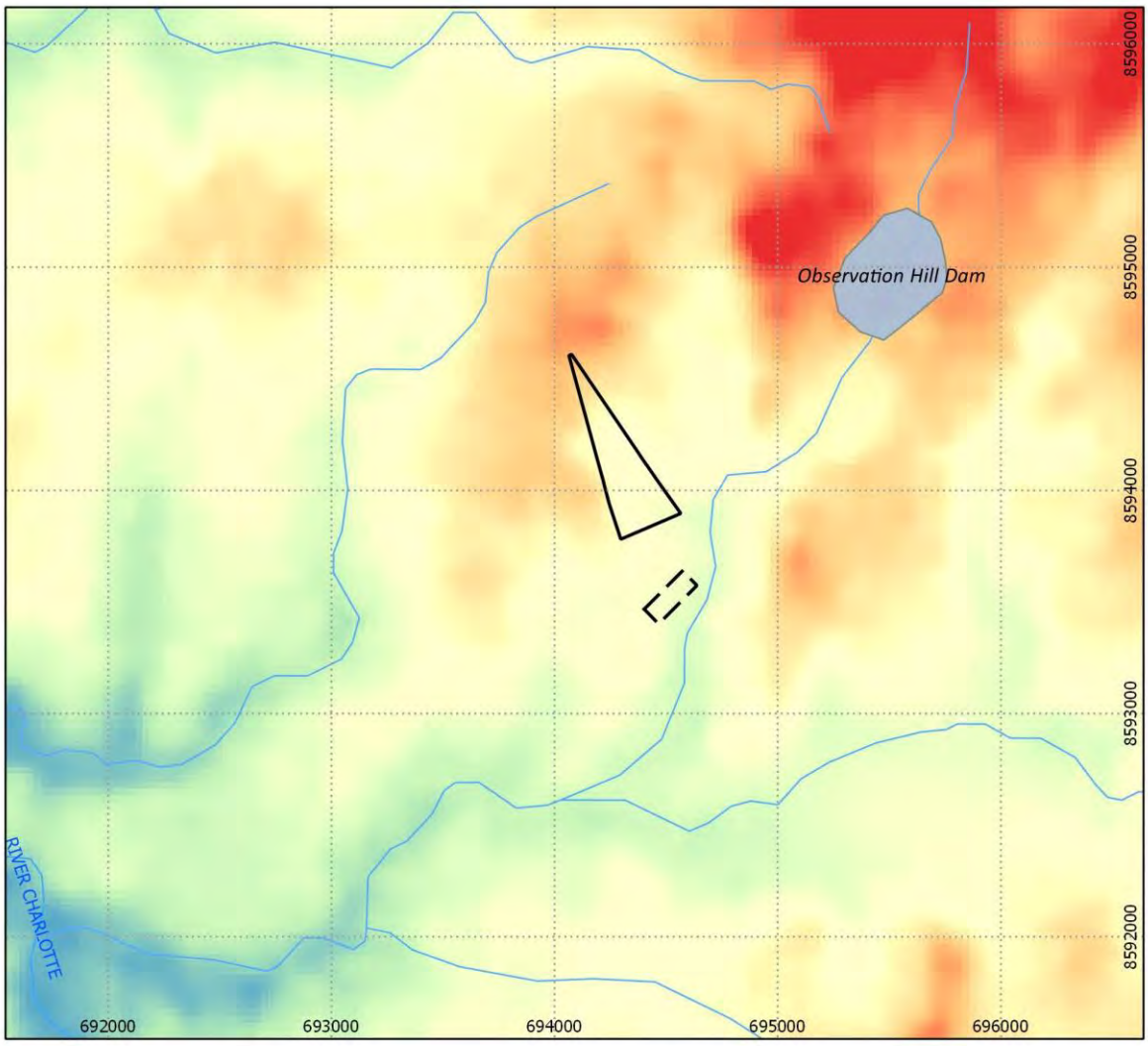

Figure 2-1 BP33 Topography and Drainage

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

3 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 wide) at its base. It is essentially unmineralised 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 surface geology around BP33, sourced from the Darwin 250K geology map (Pietsch, 1988) is shown in Figure 3-1.

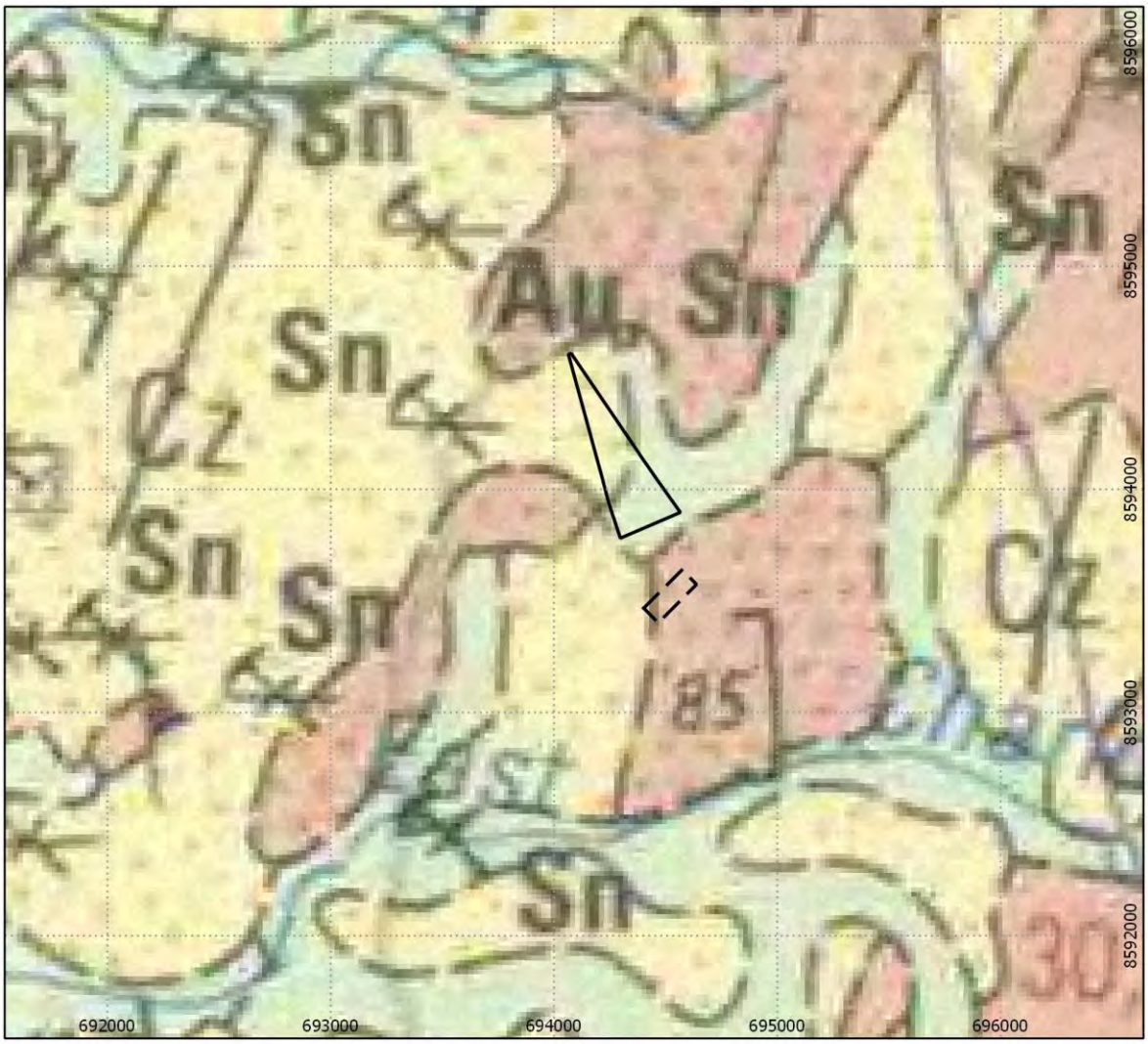

Figure 3-1 BP33 Surface Geology

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Proposed BP33 mine workings

Approx. extent of box cut

Approx. extent of underground workings

0 500 1000 m

GDA 94 Zone 52, 1:30 000 @ A4

Surface Geology (Darwin 1:250 000 mapsheet)

Cz (Ferruginous clayey, sandy and gravelly soils)

Qa (Gravel, sand silt)

Burrell Creek Formation (Shale, siltstone, phyllite)

4 Hydrogeology

4.1 Burrell Creek Formation

The Burrell Creek Formation forms the main aquifer surrounding 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) have been recorded 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 formation is typically less permeable, this is largely because fractures are more likely to stay open in the competent, fresh rock. Hydraulic conductivities from slug tests undertaken at the Grants deposit range from 0.003 – 0.017 m/day, no storage estimates are available for the Burrell Creek Formation. There is no information available on the aquifer 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 closest groundwater bore to BP33 is RN023177 located 2.5 km north of the BP33 pit lake. It is constructed in the Burrell Creek Formation and has a reported yield of 1.75 L/s and a standing water level of 8.5 m below ground. To provide information on groundwater levels at BP33 Core Lithium dipped a series of exploration bores around the site in late October 2019. The groundwater levels have been corrected to account for the dip of the exploration holes. The depth to groundwater ranges from 4.2 to 10.5 m below ground being typically shallower in the east between the pit lake and the drainage line (see Figure 4-1).

There is no available information to determine groundwater elevations and flow directions. However, 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.

Water quality in the Burrell Creek Formation is limited to historic analyses collected from RN023177. These reveal a water quality reflecting rainfall with an Electrical Conductivity (EC) of 38 μS/cm and low concentrations of ions and metals. Groundwater samples from Burrell Creek Formation bores at the Grants site report a groundwater EC range of 168 – 270 μS/cm and a pH of 6.4 – 7.2.

4.2 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) 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.

Figure 4-1 BP33 Depth to Groundwater

Approx. extent of underground workings

Depth to groundwater October 2019 (mBGL)

5 Groundwater Receptors

5.1 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 5-1). 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.

5.2 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 5-1 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 5-1) 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 5-1 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 also established two surface water monitoring sites on the drainage line south of OHD: BPUS SW1 and SW2 (see Figure 5-1). 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.

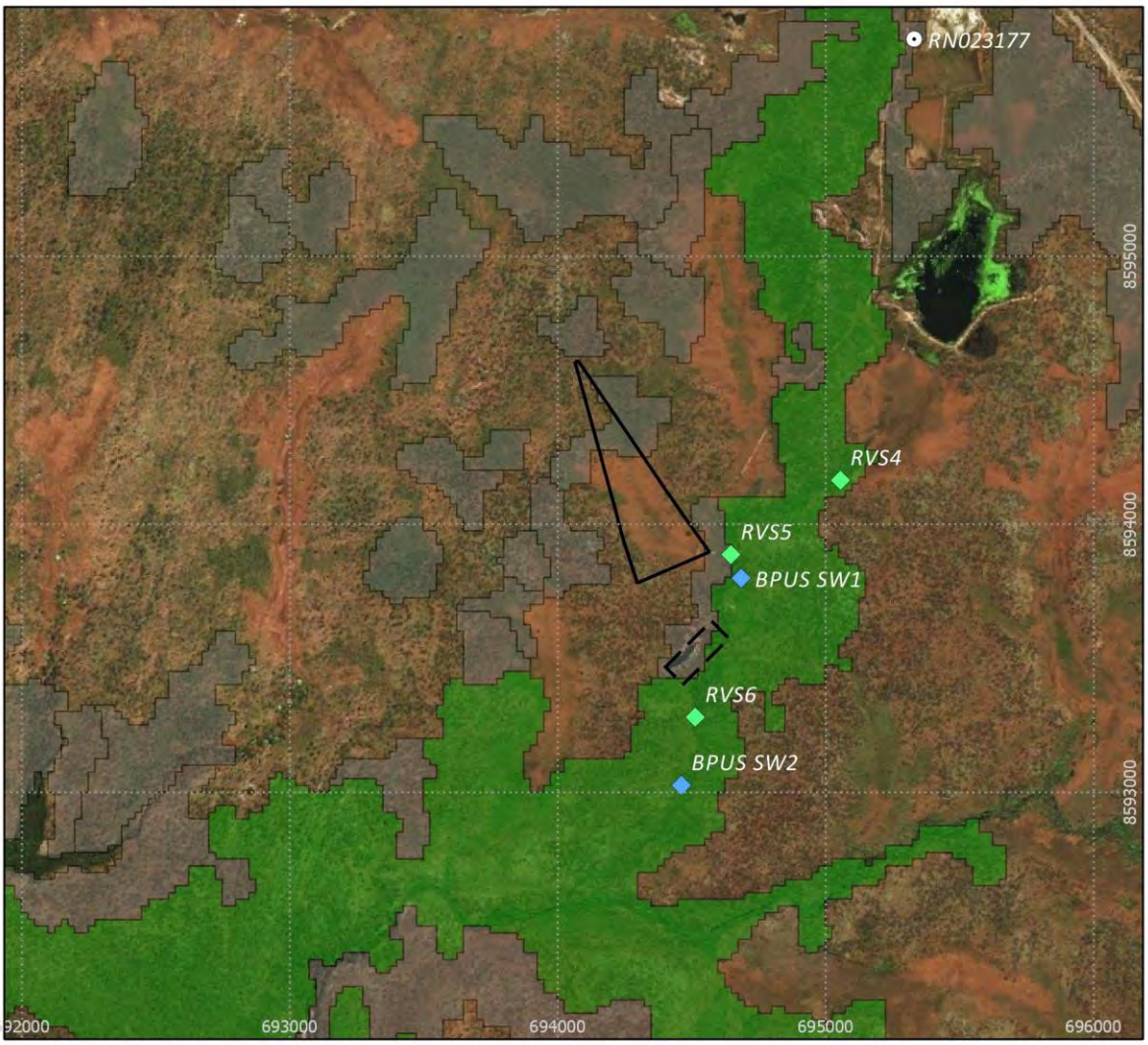

Figure 5-1 BP33 Groundwater Receptors

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

6 Conclusions and Recommendations

6.1 Conclusions

Core Lithium are scoping an underground mining operation at their BP33 deposit, located 5 km south-east of the Grants lithium prospect. The proposed mining activities at BP33 involve the construction of a 60 m deep box cut which will provide access to underground workings completed to a depth of approximately 320 m. Both the box cut and the underground mine will require de-watering during the mining process.

The proposed mine targets lithium hosted in a narrow, steeply dipping pegmatite that is intruded into the Burrell Creek Formation, a sedimentary unit largely comprising siltstone and phyllite. Alluvial deposits consisting of sand, gravel and clay occur around BP33 where drainage lines have incised the Burrell Creek Formation.

There is limited information on groundwater at the BP33 site. From regional data, a marginal fractured rock aquifer is expected in the Burrell Creek Formation. A shallow aquifer (<6 m thick) is also likely to occur along the drainage lines where the alluvial deposits are thickest and most developed. At the end of October (2019) the groundwater depth around BP33 ranged from 4.5 – 10.5 m below ground. Levels are shallower (typically <5 m deep) to the east of the BP33 pit lake in an area adjacent to an un-named drainage line that connects Observation Hill Dam to Bynoe Harbour.

Regional GDE mapping suggests moderate potential for GDEs along drainage lines to the east and south of BP33. Field surveys have confirmed the presence of terrestrial GDEs (riparian vegetation) and surface water pools along the drainage line to immediate east of BP33. The location of the GDEs along the drainage line suggests they are supported by a shallow alluvial aquifer.

There is a risk that dewatering of the box cut and underground mine will lower groundwater levels beneath the drainage lines and reduce groundwater availability to the GDEs. The extent and thickness of the alluvial aquifer, and the degree of connection with the Burrell Creek Formation aquifer represent key unknowns in determining the potential impact on the GDEs from the proposed mining activities.

No impacts are expected on groundwater production in the area surrounding BP33 as the nearest active groundwater bore is located 9 km to the south.

6.2 Recommendations

It is recommended that a drilling investigation is undertaken at BP33 to inform a numerical groundwater model aimed at assessing potential groundwater impacts from the proposed mining development. The investigation should include:

- The drilling and installation of a series of monitoring bores into both the Burrell Creek Formation and the alluvial aquifer. Drilling should be completed by a Northern Territory licensed and registered driller in accordance with national minimum bore construction guidelines (NUDLC, 2011)
- Hydraulic testing of completed groundwater bores – at a minimum this should involve slug tests but where bore yields permit pumping tests should also be conducted. Test durations, rates and monitoring targets should be determined on the basis of drilling results.
- Groundwater sampling and groundwater level monitoring should be undertaken on completed groundwater bores.
- All completed bores should be surveyed to Australian Height Datum (mAHD).

The recommended drilling sites, the number of bores and the rationale for each site are detailed in Table 6-1, locations are shown in Figure 6-1

Table 6-1 Recommended drilling locations and investigation activities at BP33

SITE NAME	EASTING	NORTHING	SITE TYPE	NO. BORES	TARGET	NOMINAL DEPTH (m)	RATIONALE
BPG1	694130	8594620	Single bore	1	Burrell Creek Formation	60	• Assess groundwater conditions up gradient of proposed box cut
BPG2	694790	8594330	Nested	2	Alluvial Aquifer Burrell Creek Formation	8 60	• Assess groundwater conditions up gradient between proposed box cut and Observation Hill Dam in area of mapped GDE potential
BPG3	694620	8593880	Nested	2	Alluvial Aquifer Burrell Creek Formation	8 60	• Assess groundwater conditions and establish a groundwater monitoring point at field verified GDE and vegetation monitoring site RVS5
BPG4	694495	8593420	Nested	3	Alluvial Aquifer Burrell Creek Formation (weathered) Burrell Creek Formation/pegmatite	8 50 320	• Assess groundwater conditions within the Burrell Creek Formation/pegmatite deposit to the full depth of proposed underground workings (320 m) • 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
BPG5	694440	8593025	Nested	2	Alluvial Aquifer Burrell Creek Formation	8 60	• Assess groundwater conditions and establish monitoring at field verified GDE and surface water monitoring site BPUS SW2
BGP6	693920	8593910	Single bore	1	Burrell Creek Formation	60	• Assess conditions downgradient of proposed box cut
BPG7	693960	8593060	Nested	2	Alluvial Aquifer Burrell Creek Formation	8 60	• Assess groundwater conditions downgradient of proposed mine in area of mapped GDE potential

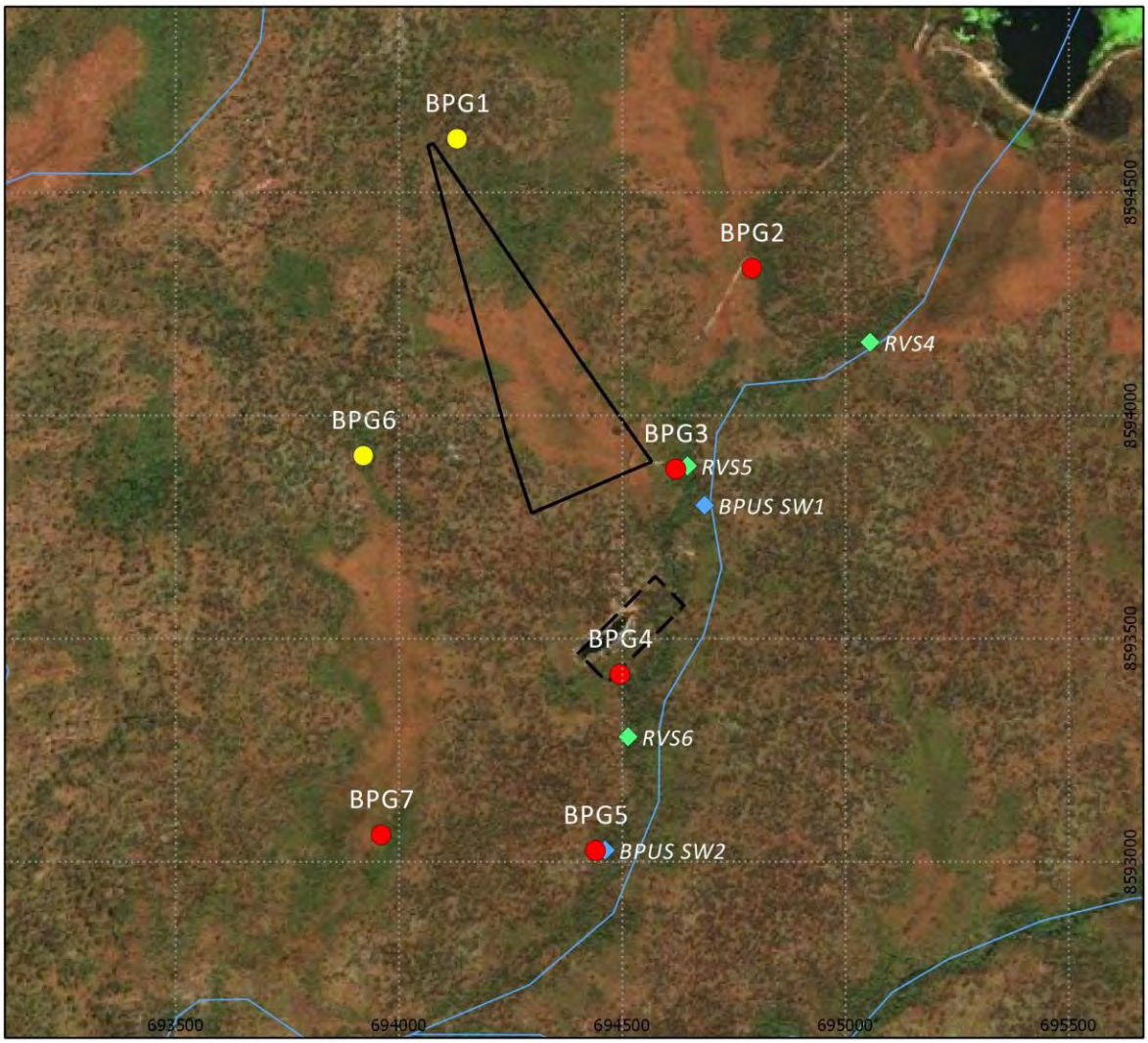

Figure 6-1 BP33 Recommended Drilling Sites

Proposed BP33 mine workings

Approx. extent of box cut

Approx. extent of underground workings

0 200 400 600 800 1000 m

GDA 94 Zone 52, 1:15 000 @ A4

BP33 Recommended drilling locations

Nested

Single bore

BP33 Existing monitoring sites

Surface water monitoring site

Vegetation monitoring site

N

7 References

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