



Rustlers Roost and Quest 29 Open-Cut Mine Redevelopment

Referral Report

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ACRONYMS

AAPA	Aboriginal Areas Protection Authority
ABS	Australian Bureau of Statistics
AMD	Acid and Metalliferous Drainage
ANC	Acid neutralising capacity
BOM	Bureau of Meteorology
BUDs	Beneficial Use Declarations
CEMP	Construction Environment Management Plan
DENR	Department of Environment and Natural Resources (Northern Territory) – now DEPWS
DEPWS	Department of Environment, Parks and Water Security – formerly DENR
DITT	Department of Industry, Tourism and Trade – formerly DPIR
DOEE	Department of the Environment and Energy (Commonwealth)
DPIR	Department of Primary Industry and Resources – now DITT
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EL	Exploration Lease
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act (1999) (Commonwealth)</i>
ESCP	Erosion and Sediment Control Plan
GDE	Groundwater Dependent Ecosystems
LOM	Life of Mine
MCP	Mine Closure Plan
ML	Mineral Lease (granted)
MLA	Mineral Lease Application
MMP	Mining Management Plan
MNES	Matters of National Environmental Significance
MRE	Mineral Resource Estimate
NAF	Non-Acid Forming
NMD	Neutral Mine Drainage
NOI	Notice of Intent
NT	Northern Territory
NVIS	National Vegetation Information System
PAF	Potentially Acid Forming
PER	Preliminary Environmental Report
PPL	Perpetual Pastoral Lease
RIL	Resin in Leach
RMCP	Rehabilitation and Mine Closure Plan
ROM	Run of Mine
SD	Saline Drainage
SGVs	Site Specific Guideline Values
SOCS	Site of Conservation Significance
SOR	Statement of Reason
SSAN	Security Sensitive Ammonium Nitrate
SSTVs	Site Specific Trigger Values
SWGs	Stock Water Drinking Guidelines

TARP	Trigger Action Response Plan
TOR	Terms of Reference
<i>TPWC Act</i>	<i>Territory Parks and Wildlife Conservation Act (Northern Territory)</i>
TSF	Tailings Storage Facility
WCD	Water Control District
WDL	Waste Discharge Licence
WRD	Waste Rock Dump

PREFACE

This document provides supplementary information to the Referral Form submitted to the NT Environmental Protection Authority (NT EPA) for the Rustlers Roost and Quest 29 (Q29) open-cut mine redevelopment proposal by the operator, Primary Gold Limited (here-in referred to as *PGO*). *PGO* is a fully owned subsidiary of Hanking Australia Investment Pty Ltd.

The Rustlers Roost and Q29 (here-in referred to as the *Proposal area*) is a brownfields site on Mineral Leases located in the Mount Bunday locality, approximately 100 km south-east of Darwin. The site has a history of gold mining activity. *PGO* is proposing to redevelop the area, expanding open-cut gold mining operations. The action is being referred to the NT EPA for consideration under section 48 of the *Environmental Protection Act 2019* (EP Act).

This document is intended to be read in conjunction with the Referral Form.

In the event that an EIS is determined by the NT EPA to be the method of assessment, a draft terms of reference (TOR) and statement of reason (SOR) has been developed by *PGO* (see Appendix A and Appendix B respectively) as part of the Proponent initiated environmental impact statement (EIS) referral.

1 PROPOSAL DESCRIPTION

1.1 Location

The proposal area is located approximately 100 km south-east of Darwin, and approximately 15-20 km south of the Arnhem Highway on Old Mount Bunday Station, Perpetual Pastoral Lease (PPL) 1163 and McKinlay River Pastoral Station (PPL1184). Site access is approximately 11.5 km east of Corroboree Park Tavern off the Arnhem Highway. The location of the project area is shown on Figure 1-1.

1.2 Land tenure and zoning

The land tenure underlying the proposal area is Pastoral Leasehold land. The land is unzoned under the *NT Planning Scheme*.

Rustlers Roost is located on Mineral Lease 1083 (MLN1083) which covers approximately 756 ha.

Q29 is located 10 km southeast of Rustlers Roost; and is located across five Mineral Leases, which collectively cover approximately 658 ha. There are currently no proposed activities, other than exploration, on Q29 ML29781, ML29785 or ML29786.

Table 1-1 provides a summary of the Mineral Leases.

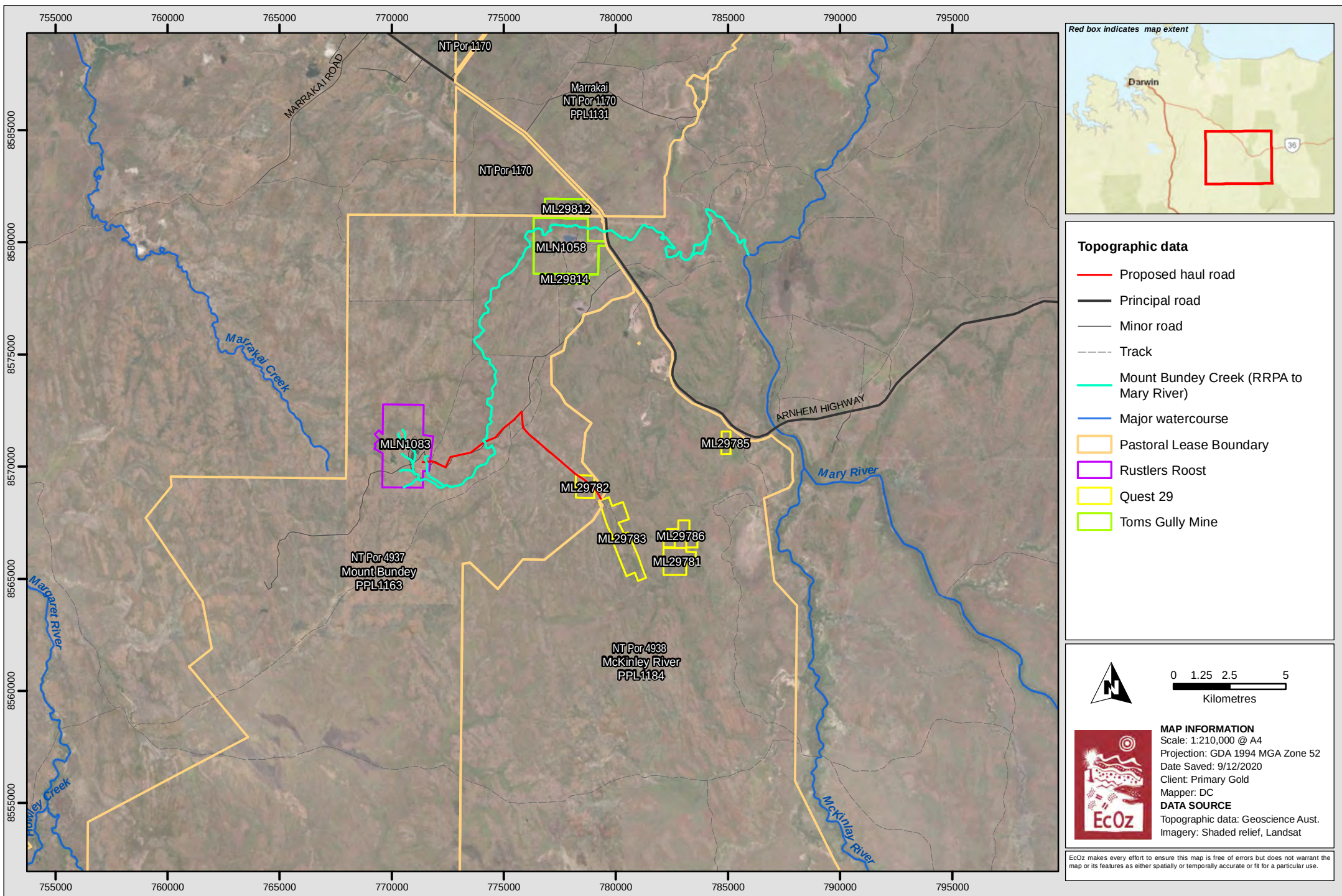
Table 1-1. Mineral Lease details

Project area	Title number	Title Holder	Grant Date	Area (ha)	Expiry Date
Rustlers Roost	MLN1083	Primary Minerals Pty Ltd (80%), Karen On (10%) & Ricky Fletcher (10%)	04 March 1991	755.6	*31 December 2020
Q29	ML29781	Primary Minerals Pty Ltd	06 February 2013	140	05 February 2023
	ML29782	Primary Minerals Pty Ltd	06 February 2013	80	05 February 2023
	ML29783	Primary Minerals Pty Ltd	06 February 2013	285	05 February 2023
	ML29785	Primary Minerals Pty Ltd	06 February 2013	40	05 February 2023
	ML29786	Primary Minerals Pty Ltd	06 February 2013	112.52	05 February 2023
Total				1413.12	

*Renewal application date 4 December 2020.

1.3 Current land use

Rustlers Roost and Q29 have *Mining Authorisations* in place (0738-01 and 0739-01 respectively) for care and maintenance activities. Rustlers Roost has been in care and maintenance since 1998, with exploration works being conducted by PGO in 2003, 2017 to 2018 and more recently during 2020. At Q29, limited exploration activities have taken place until recently during 2020. No mining activities have been conducted at Q29 since 2004. Under care and maintenance, the pastoral land owner of Old Mount Bunday Station has been engaged by PGO to assist in monitoring and managing the mining tenements, in terms of weed, fire and water management compliance requirements.



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Figure 1-1. Map of Rustlers Roost and Quest 29 project location

1.4 Historic land use

This section provides an overview of historical land use related to the mining disturbance and associated landforms and infrastructure existing on Rustlers Roost and Q29.

1.4.1 Rustlers Roost

Approximately 15% of MLN1083 has been disturbed for mining the Rustlers Roost gold deposit. Rustlers Roost is a former open-cut gold mine and heap leach facility with gold first being discovered in the 1940s. Over a three to four-year period, the oxide ore was mined and trucked to a nearby stamp battery plant for processing. The mine was abandoned until the 1970s when sporadic alluvial gold mining commenced and was undertaken until the early 1980s.

In 1994, a Public Environmental Report (PER) was lodged by Valdora Minerals NL and an approval was granted under the *Environmental Assessment Act*, for the recommencement of mining operations. The PER outlined a two-stage expansion of the mine. Stage one proposed the mining of four oxide pits; construction of two WRD landforms; four heap leach pads; surface water containment infrastructure; processing facilities and additional haul access roads. Stage one covered an area of 110.5 ha.

Valdora was taken over by William Resources Inc in late 1995 and in 1996 Valdora was renamed to Rustlers Roost Mining Pty Ltd (RRMPL). In August 1996, RRMPL lodged a Notice of Intent (NOI) for the Stage 2 expansion of the RRP. A Draft EIS was prepared in January 1997 which outlined the proposed combining and deepening of the existing pits, combining and increasing the height of the Waste Rock Dumps (WRDs), installation of a new resin in leach (RIL) process and the addition of a Tailings Storage Facility (TSF) over an area of 181ha.

The assessment of the Draft EIS (and supplementary information) was completed by the NTG Environment Protection Division in August 1997. The Environmental Assessment Report and Recommendations accepted the proposal and noted that several matters needed to be further addressed before granting approval to proceed via a MMP.

Due to low commodity prices, the Stage two expansion, which would have seen the mine expand over an additional 70.5 ha, did not proceed and mining ceased in August 1997. A Decommissioning and Rehabilitation Plan was prepared; however, the work was only partially completed. The infrastructure and landforms that remain on the site are listed below and locations are shown on Figure 1-2.

- WRD (approximate dimensions 30 m in height, 1,000 m length and 400 m width).
- Associated open pits that have flooded and are considered one pit (approximate dimensions 50 m, 1,000 m length and 300 m width). The pit lake currently holds approximately 3.16 GL of water based on post mining pit shell dxf. and current water level 56.90 mAHD (surveyed on 3 November 2020).
- Annie's Dam – an existing pastoral dam and a potential raw water resource for the proposal with nominal water storage capacity of 0.29 GL (GRES 2018).
- Two heap leach pads (total approximate dimensions 20 m in height, 600 m in length and 450 m width) and heap leach ponds.
- Remnants of old processing plant. In 1997 most of the plant, buildings and other mining infrastructure were removed, apart from three large tanks and some concrete footings.

From 1997 to now, exploration and care and maintenance activities have been undertaken at the project areas.

There is no indication of acid and metalliferous drainage (AMD) issues associated with the existing infrastructure and landforms at Rustlers Roost. A high-level desktop and field geochemical assessment was conducted by CDM Smith (2019), on the existing surface waste material (WRD, Run of Mine pad (ROM), Heap leach pad). The objective was to assess the spatial distribution and quantities of the various mine wastes on site and to provide advice on the likelihood of AMD to be released off site. The assessment determined that the materials currently stored on-site had low-potential to leach significant dissolved chemical load to the receiving environment. This was based on surface and groundwater quality monitoring,

targeted surface rock samples and field observations. AMD and water quality is further discussed in sections 4.1 and 4.4 respectively.

1.4.2 Q29

Of the five Mineral Leases covering Q29, ML29783 is the only tenement that has had historical disturbance, aside from exploration drilling. Approximately 7.5 % of ML29783 has been disturbed for the purpose of mining the Q29 gold deposit. Q29 was operated as an open-cut gold mine from 1999 to early 2002. The existing infrastructure and landforms on the site are listed below and locations are shown in Figure 1-3.

- Five open-cut pits (largest of the pits approximately 10 m depth, 280 m length and 50 m width)
- Five WRD's (largest of the WRDs approximately 10 m height, 280 m length and 80 m width)
- One heap leach pad (approximate dimensions 20 m in height, 200 m length and 200 m width)
- Heap leach ponds
- Remaining infrastructure of the Carbon in-leach (CIL) tanks.

The existing disturbances and landforms cover an area of approximately 21 ha.

The current indicated AMD risk from previously mined materials is considered low based on the existing shallow pit depth, predominantly mining of the weathered oxide zone, available pit water quality and no visual AMD observations from site visits or satellite imagery.

1.5 Proposed action

This section provides an overview and description of the key physical and operational components of the proposed action.

1.5.1 Overview

The Rustlers Roost and the Q29 proposal will involve open-cut mining and expansion of all existing open-cut pits, which will be conducted using a drill and blast technique and the use of ammonium nitrate (ANFO). No new pits are proposed for development.

The mine sites are located approximately 11 km apart and are connected by an existing unsealed access track, which will be upgraded to accommodate haulage of ore from the Q29 satellite pits to Rustlers Roost processing facility. Ore mined at both sites will be processed at a new purpose-built processing facility located at the Rustlers Roost site to produce gold bullion. The rate of production will be 3 Mtpa over an approximately seven-year life of mine (LOM).

Waste rock will be deposited in surface WRDs and will be used to backfill a number of pits where mine scheduling permits. At Q29, a new surface WRD is proposed to dispose of the waste from mining Zamu pit, with waste material from the remaining pits to be backfilled into Zamu pit and a portion of oxide material from BHS pit used for rehabilitation of the decommissioned heap leach facility. At Rustlers Roost, the majority of the waste rock material will be deposited within the existing surface WRD (expansion to the north-west) and a portion backfilled into Rustlers Roost pit.

Mined ore will be processed using a RIL processing method, which extracts gold from the ore by mixing with a cyanide solution. Tailings produced from the processing facility will be deposited in a TSF to be constructed as part of the proposal.

The mining operations is expected to employ up to 210 staff. A mine camp will be constructed between the two project areas as part of the proposal.

The key physical components of the Rustlers Roost and Q29 proposed action are summarised in Table 1-2.

The disturbance footprint is defined as the direct disturbance area. The mine development envelope is defined as the maximum area within which the proposed footprint will occur. This terminology has been used below to assess the overall extent of disturbance.

Table 1-2. Physical and operational components of proposed action.

Components	Location	Tenement	Existing extent	Proposed extent
Physical				
Open cut mine and associated infrastructure at Rustlers Roost	Figure 1-2	MLN1083	115 ha of 755.6 ha of MLN1083 is currently disturbed for existing mining infrastructure. Refer to Table 1-3 for breakdown of infrastructure.	Additional clearing of no more than 274.8 ha of native vegetation within 497.5 ha mine development envelope.
Open cut mine and associated infrastructure at Quest 29	Figure 1-3	ML29783	21 ha of the total 285 ha of ML29782 is currently disturbed for existing mining infrastructure. Refer to Table 1-4 for breakdown of infrastructure.	Additional clearing of no more than 44.6 ha of native vegetation within 160.7 ha mine development envelope.
Haul road	Figure 1-1	Currently no tenement covering access between projects – private access road on PPL 1163 (Old Mount Bunday Station).	Approximately 1.1 ha (11 km long x 10 m wide)	Total of 2.2 ha (11 km long x 20 m wide)
Accommodation village	Figure 1-3	ML29782	No historic disturbance.	Clearing of no more than 7.3 ha of native vegetation within 21.2 ha development envelope.
Operational				
Open cut mining (drill and blasting)	Figure 1-2 and Figure 1-3	MLN1083 ML297839	Q29 - 5 pits (8 ha and maximum depth of 10 m). Rustlers Roost – 1 pit (23 ha and 50 m depth)	Q29 - 5 pits (additional 20.2 ha and depth 25 m to 75 m). Rustlers Roost – 1 pit (additional 21.6 ha and 175 m depth). Use of ammonium nitrate for mining explosives.
Waste rock disposal – surface WRD	Figure 1-2 and Figure 1-3	MLN1083 ML297839	N/A	Disposal of no more than 29.71 Mt of waste rock for the LOM into surface waste rock dumps at Rustlers Roost and Q29 at current cut-off grade of 0.4 g/t.

Components	Location	Tenement	Existing extent	Proposed extent
Waste rock disposal - backfilling of pits	Figure 1-4 Figure 1-5	ML297839	N/A	A total 12.25 Mt of waste material backfilled into open-cut pits.
Dewatering of pits	Figure 1-6	MLN1083 ML297839	N/A	Water will be transferred within existing pits at Q29 at various stage of mining. Water will be dewatered from the pit at Rustlers Roost during mining to an existing water storage dam and proposed ponds for reuse.
Ore processing	Figure 1-2	MLN1083	N/A	Resin in leach (RIL) process with use of cyanide
Tailings disposal	Figure 1-2	MLN1083	N/A	Disposal of no more than 3 Mt per annum of potentially acid forming (PAF) tailings into the new TSF at Rustlers Roost.
Water use and water management systems	Figure 1-6	MLN1083 ML297839 ML29782	N/A	Overall water demand for operations is estimated to be 3.3 GL/yr. Groundwater bores to supply potable water and raw water; Annie's Dam (raw water dam) supplied by groundwater, catchment rainfall and pit dewatering; Process water dam supplied by Annie's dam and processing return water from TSF/decant dam.
Workforce and onsite accommodation	Figure 1-3	N/A	N/A	210 people.

1.5.2 Proposed footprint and site layout

Rustlers Roost

The Rustlers Roost mine development envelope will encompass 497.5 ha, of which 111.5 ha has been previously disturbed by previous mining activities. The new mining proposal will require clearing of a further 274.8 ha of land.

A summary for the existing and proposed expansion is summarised in Table 1-3. An overview of the proposed site layout, indicative footprint and development envelope is provided in Figure 1-2.

Table 1-3. Rustlers Roost existing and proposed expansion area of mining infrastructure

Description Area (Ha)	Existing disturbance (Ha)	Proposed disturbance (Ha)	Total disturbance area (Ha)
Open Pit (proposed pit depth -175m)	23.0	21.6	44.6
WRD	37.4	29.4	66.8
Heap Leach Pad (decommissioned)	29.1	0.0	29.1
Heap Leach Pond (decommissioned)	3.4	0.0	3.4
ROM Pad	2.5	2.9	5.4
TSF	0.0	165.1	165.1
Annie's Dam	11.4	0.0	11.4
Processing Plant	0.1	54.7	54.8
Haul road (Rustlers Roost to Q29)	1.1	1.1	2.2
Previous disturbance (infrastructure removed)	3.5	0.0	3.5
Total	111.5	274.8	386.3
Development envelope = 497.5 ha			

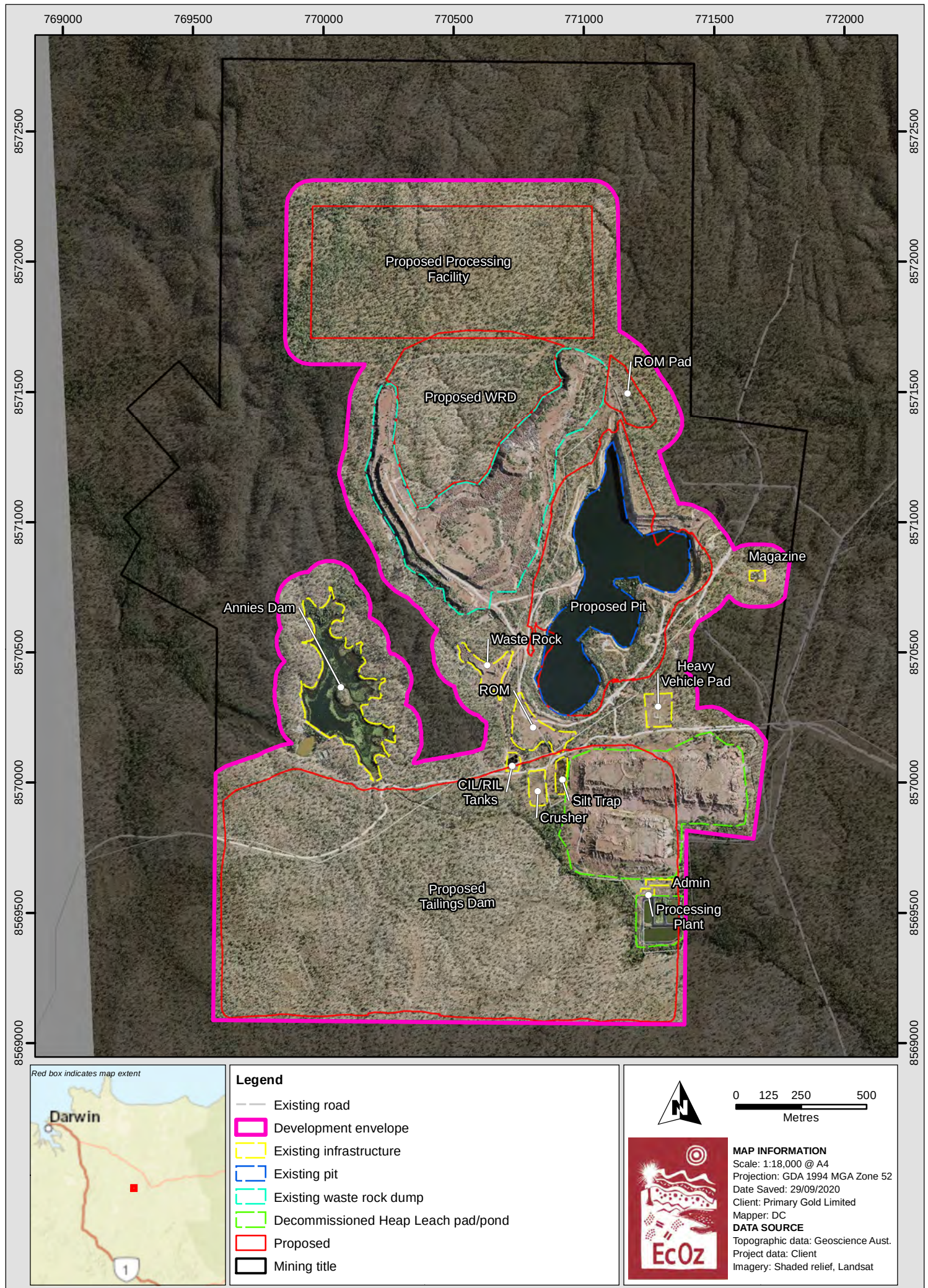
Q29

The Q29 mine development envelope will encompass 160.7 ha, of which 21 ha has been previously disturbed by past mining activities. The new mining proposal will require clearing of a further 44.6 ha of land.

A summary for the existing and proposed expansion is summarised in Table 1-4. An overview of the proposed site layout, indicative footprint and development envelope is provided in Figure 1-3.

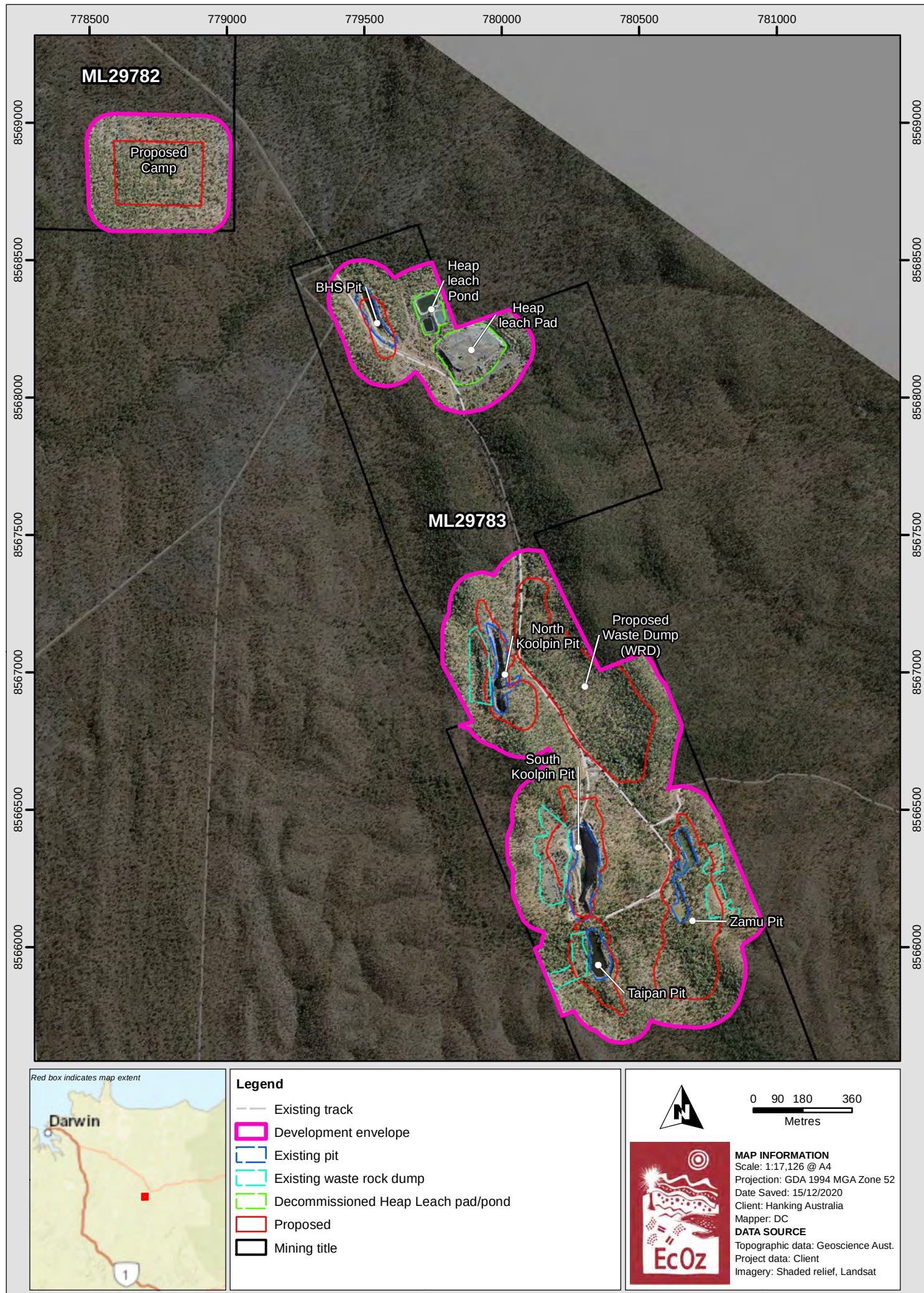
Table 1-4. Q29 existing and proposed expansion area of mining infrastructure

Description Area (Ha)	Existing disturbance (Ha)	Proposed disturbance (Ha)	Total disturbance area (Ha)
Pits (proposed pit depth 25 to 75m)	8	20.2	28.2
WRDs	7.9	16.6	24.5
Leach Pond (decommissioned)	1.3	0	1.3
Leach Pad (decommissioned)	3.8	0	3.8
Go-Line/Crib (Heavy vehicle park up area)	0	0.5	0.5
Accommodation Camp facilities	0	7.3	7.3
Total	21	44.6	65.6
Development envelope = 160.7 ha			



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Figure 1-2. Map of Rustlers Roost existing disturbances and proposed site layout



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Figure 1-3. Map of Q29 existing disturbance and proposed site layout

1.5.3 Proposal schedule

Subject to receipt of approvals, PGO plan to commence mining activities in 2022.

Construction

Construction activities will occur within the first 12 months following approvals. Construction will employ 100 full time personnel, comprised of mainly contractors. Construction activities will include:

- Upgrade of access/haul road
- Office/administration and amenities
- Processing facility
- Accommodation village
- Construction of TSF.

Operations

Mining operations will commence in year two on completion of the critical infrastructure.

The Rustlers Roost open-cut pit mining schedule is proposed to occur in five stages over a seven-year duration.

Q29 will be mined over a four-year period in five stages as a satellite reserve to feed the processing plant located at Rustlers Roost.

Processing

Processing will occur in year two following commencement of mining and will be on-going (24/7) for the seven year LOM. Processing will continue for a number of months following cessation of mining until all remaining ore stockpiles have been processed.

Closure and rehabilitation

During operations, rehabilitation will be undertaken on the decommissioned heap leach facilities using suitable available oxide waste material. The proposed surface WRD at Q29 will be rehabilitated during year three following mining of the first pit (Zamu). The Rustlers Roost surface WRD will be rehabilitated on completion of mining during year seven, as oxide material from the existing WRD will be utilised to ensure sufficient available oxide capping material for the WRD expansion. The TSF will be rehabilitated at completion of processing (year seven) following sufficient drying time prior to capping and revegetation. All infrastructure will be removed from site and disturbed areas rehabilitated.

1.5.4 Construction activities

Proposed areas of disturbance will be progressively cleared as required. The methodology for removal of vegetation from the open pits and waste rock dumps will be consistent over the two sites, and will be conducted by a standard clearing and grubbing method. The topsoil will be stripped and stockpiled adjacent to the pit and dumps for reuse during rehabilitation.

The key components to be constructed on site will be the processing facility, TSF, accommodation village and haul road upgrade.

Processing facility

The processing facility will be constructed in the northern portion of MLN1083, immediately north of the WRD. The area of disturbance will be approximately 54.8 ha. This area will include the crushed ore stockpile, process water and storm water pond, process plant infrastructure, power station and transformers, diesel facility, refuelling area, Liquid petroleum gas (LPG) tanks, process plant and reagent stores, building infrastructure (admin, maintenance, ablutions, crib room, laboratory and prep room, mining contractor area).

TSF

The TSF will be located in the southern section of the MLN1083 over 165.1 ha. The TSF size is based on a treatment rate of 3 Mt/pa for a total of 21 Mt capacity. The TSF will be raised in height progressively over a 7-year period to reach storage capacity for the LOM.

TSF construction will occur during the dry season of the construction and development phase. The area will be cleared and topsoil stripped and stockpiled for later use. The foundation will be worked and any unsuitable material removed to prepare the ground for construction.

Construction material will be sourced from within the TSF basin as well as pre-stripped areas of the initial Rustlers Roost Pit redevelopment. Suitable (geochemically benign and structurally apt) mine waste material (waste rock and existing heap leach dump) will be used for the construction of the TSF. The finalised TSF lining design requirements will be determined from the geochemical characterisation of the ore. It is not expected that tailings will contain high levels of cyanide as residual cyanide will be removed from tailings during the refining process and reused in the processing circuit.

The TSF construction will include the following features:

- An underdrainage system will be constructed to minimise seepage losses and maximise recovery.
- A seepage recovery tower will be installed to pump the underdrainage back into the TSF.
- A decant tower will be installed within the decant pond of the TSF to return water to the processing facility for reuse.
- An emergency spillway constructed as part of each wall raise.

The final design will be assessed following adequate ore characterisation.

Accommodation Village

Due to the remote location of Rustlers Roost and Q29 project areas, construction of an accommodation village is required to accommodate the workforce within proximity to the mine. The Rustlers Roost Accommodation Village is proposed for construction within tenement ML29782 (Figure 1-3). The Accommodation Village will be cyclone rated and have a 192 rooms constructed from transportable accommodation units and will accommodate personnel for both the Rustlers Roost and Q29 operations.

Haul road upgrade

The 11 km existing access road between Q29 and Rustlers Roost will be upgraded to accommodate heavy vehicles for haulage of ore. This will require widening the existing road from approximately 10 m to 20 m width, building up the road with screening of suitable material from the existing oxide WRDs, upgrade of existing culverts and construction of a new bridge at the Creek crossing on the Rustlers Roost access and Q29 access.

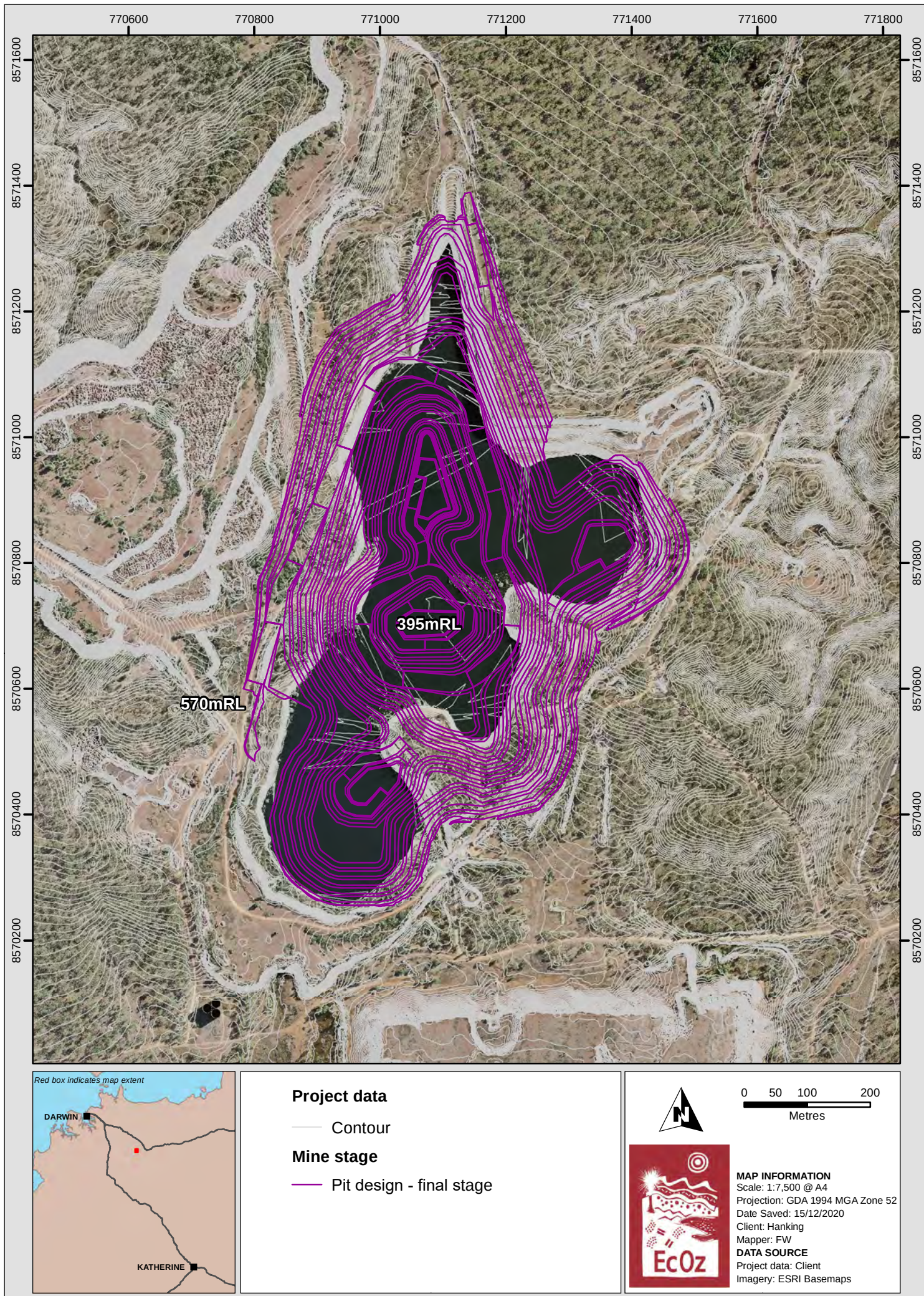
1.5.5 Mining operations

The mining methodology will be consistent over Rustlers Roost and Q29, with the open-cut mining operation being conducted with conventional truck and shovel methods. Mining of Rustlers Roost and Q29 will be undertaken concurrently with each site having their own mining fleet. The fleet will be comprised of excavators, haul and dump trucks, dozers, grader, water cart and front-end loader at each project.

Dewatering of the pits will be undertaken with diesel powered in-pit sumps. Dewatering will occur as required as a result of direct precipitation from rain events and groundwater in-flow.

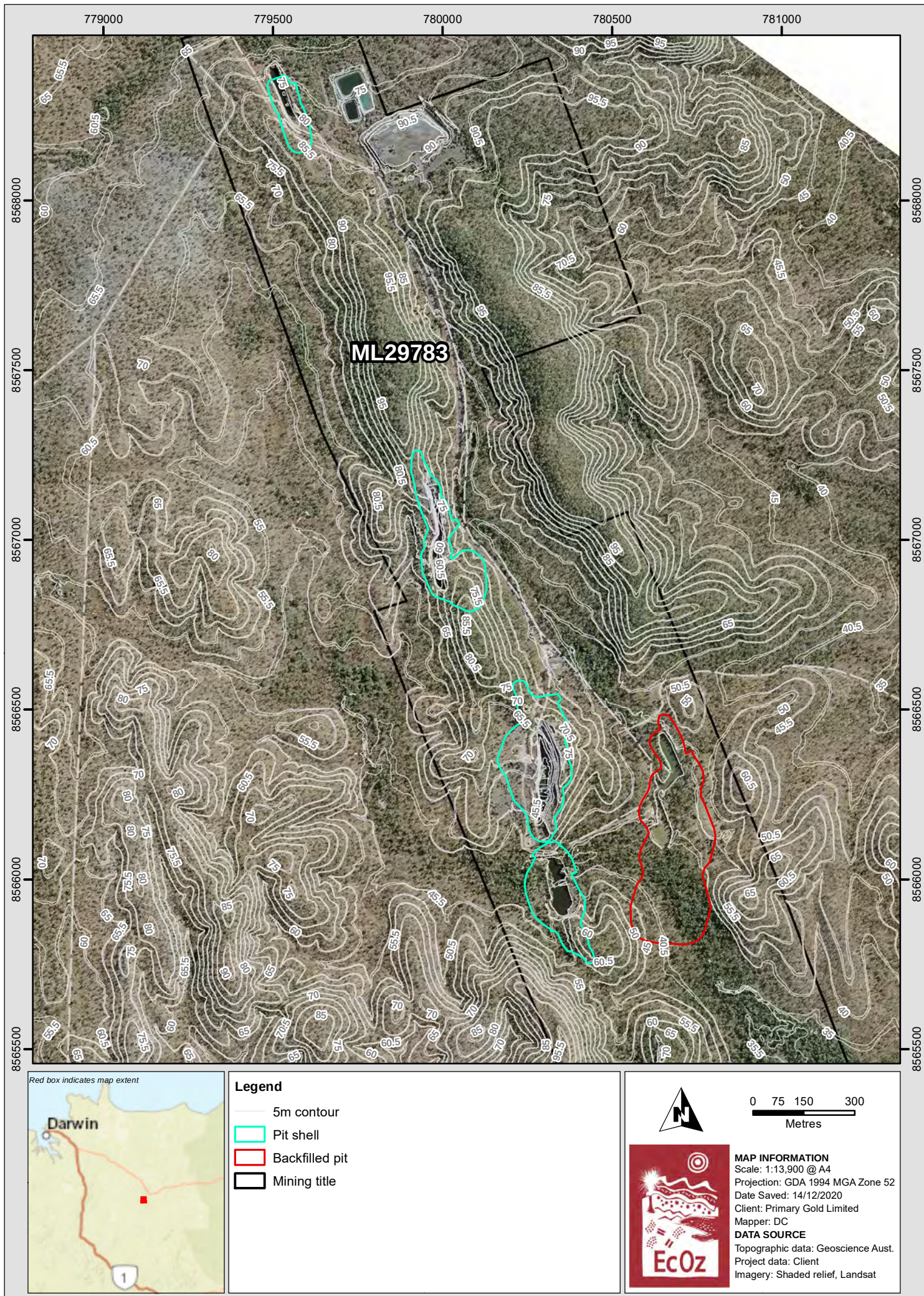
Mined ore from Rustlers Roost will be hauled directly to the ROM pad adjacent to the pit. Mined ore from each of the Q29 pits will be placed on the surface crest of the pit where it will be loaded into a haul truck and carted to the Rustlers Roost ROM for processing.

All existing pits (one at Rustlers Roost and five pits at Q29) are proposed for expansion in surface area and depth. Figure 1-4 and Figure 1-5 below shows the Rustlers Roost pit shell design and Q29 pit shell designs respectively.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ20143 - Rustlers Roost EIS\01 Project Files\Figure X-X. Map of Rustler's Roost mining stage five.mxd

Figure 1-4. Map of Rustler's Roost final pit design



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Figure 1-5. Map of Q29 Pit Designs

1.5.6 Waste rock material

Waste rock material mined at both Rustlers Roost and Q29 will be deposited in surface WRD's. Details of the proposed dump designs are provided below.

Rustlers Roost waste rock dump design

The area to the north of the existing U-shaped WRD will be the designated location for the disposal of waste rock from Rustlers Roost pit. The expansion of the existing WRD was selected to minimise haulage distances and keep haulage costs low as it is close to the main pit exit.

During construction the WRD, face angle will be 37°, with a berm width of 19.5 m and 3 x 10 m lifts. Final landform WRD design will have a continuous 17° slope and a height of 30 m.

Material classified as Non-acid forming (NAF) will be placed at the outer annulus of the WRD. NAF material with sufficient acid neutralising capacity (ANC) will be placed on the natural surface, lining the drainage lines. Potentially-acid forming (PAF) material will be encapsulated with the central areas of the dump, not near the outer slopes or toe areas and covered with NAF waste material from the outer perimeter of the existing WRD.

A total of 30.67 Mt of waste material will be produced from Rustlers Roost pit. Approximately 23.31 Mt will be placed within the surface WRD and 5.36 Mt of fresh waste backfilled into the pit. A large portion of the waste material will be transitional (77 %) and fresh (22 %) (Table 1-5). Based on the results of waste characterisation work undertaken by Graeme Campbell and Associates (1997) it is expected that fresh material will be PAF and transitional material will be a mixture of NAF and PAF.

The final WRD design will be developed following complete geochemical characterisation of waste material. An assessment of recent drilling is currently being undertaken to further characterise the material, classification volumes and determine appropriate management of PAF material within the WRD.

Table 1-5. Rustlers Roost Pit waste volumes by weathering zone

Waste volumes	Tonnes
Oxide	160,732
Transitional	23,686,001
Fresh	6,828,846
Total waste	30,675,579

Q29 waste rock dump design

The proposed surface WRD will be developed in the area north of Zamu Pit. This was selected to minimise haulage distances for the initial stage of mining Zamu pit. During construction the WRD face angle will be 37°, with a berm width of 19.5 m and 4 x 10 m lifts. The WRD construction will commence with the placement of NAF material for the base and outer annulus. PAF material encountered will be placed onto of the NAF base, and encapsulated within the centre of the WRD. No PAF material will be placed on outer perimeter, slopes, toe, surface or base of the dump.

A perimeter drain and sediment basin will be construction at the down-gradient base of each of the surface WRDs (tow drain) to manage sediment and monitor surface water quality runoff and seepage. Sediment will be cleaned out of the sediment basins as required. The sediment basins will remain post rehabilitation until the landform is stable.

Total waste produced from Q29 is approximately 12.23 Mt (Table 1-6), the total volumes and placement of waste material produced at Q29 is detailed in Table 1-6 and Table 1-7.

Table 1-6. Q29 Pit waste volumes by weathering zone

Waste volumes	Tonnes	% Total waste
Oxide	4,610,362	38
Transitional	2,871,185	23
Fresh	4,743,726	39
Total waste	12,225,274	100%

Table 1-7. Q29 waste material volumes and placement

Waste rock placement	Tonnes
Surface WRD	4,397,893
Backfilled Zamu pit	6,884,509
Heap leach pad and ponds capping material	848,839
Total waste material	12,131,241

On completion of mining Zamu pit, the pit will be backfilled with waste material from mining of the remaining Q29 pits. The final landform WRD design will have a continuous 17° slope and a maximum height 40 m in total from initial surface.

1.5.7 Processing

The processing facility will be located at the Rustler Roost site. The nominal processing throughput of 425 t per operating hour will amount to an annual production rate of 3 Mt.

Cyanide leaching will be used for recovering gold from ore, with the Resin in leach (RIL) processing method of extraction. Resin recovery involves the use of solid spherical polystyrene resin beads, adsorbing the gold onto the surface of the resin beads. Due to the high graphite content in some of the ore, the process requires crushing and milling, followed by a blanking stage to deactivate carbonaceous/graphite material, prior to the RIL process to extract the gold.

Tailings within the processing circuit, will be screened to recover resin and then will go through a detoxification to remove residual cyanide. The recovered resin and residual cyanide will be reused in the processing circuit. The tailings will be thickened at the processing facility prior to being pumped to the TSF for disposal.

1.5.8 Tailings disposal

The TSF design will be for a peripheral discharge paddock-style, multi-zone earth and rockfill dam. Deposition of tailings will be via sub-area deposition method from spigots in a deposition pipeline around the perimeter of the TSF. Solids will settle and water will flow to the supernatant (decant) pond. The decant water from the TSF will be returned to the processing facility for reuse.

1.5.9 Transport

Ore will be hauled from Q29 via the 11 km haul road to the Rustlers Roost ROM for processing.

Gold bullion will be secured in the gold room vault at the Rustlers Roost processing facility until it is required for transport off site in an armoured van.

1.5.10 Wastewater discharge requirements

Both the Rustlers Roost and Q29 sites contain previously mined pits that have filled with water. The base of the pits is below the groundwater table and groundwater flows into the pits. Dewatering will be required prior to mining at Rustlers Roost and during mining at both sites.

Rustlers Roost

Prior to commencement of mining, the calculated 3.16 GL (volume at water level 56.90 mAHD) of 'clean' water accumulated in the pit will need to be emptied. It is proposed that this water will be pumped out of the pit and discharged during the wet season into the drainage lines that flow to Mount Bunday Creek and/or Marrakai Creek. It is expected that it will take two wet seasons to empty the pit. A WDL application has been submitted to DEPWS and an amendment to the Care and Maintenance MMP for Rustlers Roost to DITT for independent assessment to this referral.

Dewatering of groundwater and surface water inflows will be required during mining activities. A dewatering bore may be installed to actively reduce the groundwater level adjacent to the pit. The rates of dewatering are currently being investigated. Water may also be pumped from within the pit sump to a turkey's nest dam for reuse as dust suppression and/or raw water from processing. Any excess water during the wet season will be discharged into the drainage lines that flow to Mount Bunday Creek and/or Marrakai Creek under an approved operational WDL.

Q29

The existing pits are shallow and contain only small volumes of water. Bunding surrounding existing pit crests will be improved to reduce surface water ingress. Immediately prior to and during mining, each pit will be dewatered into other existing pits.

1.5.11 Water use and supply

Water demand

The overall total water demand for both sites is estimated to be approximately 3.3 GL year based on processing and raw water requirements. During ramp-up operations the water requirements are expected to peak at 9,000 m³/day. Steady-state raw water requirements are estimated at 7,200 m³/day, including 1,080 m³/day potable water.

Rustlers Roost water management system

Surface water management systems proposed at Rustlers Roost include the existing Annie's Dam (raw water dam), Rustlers Roost pit, process water pond, turkeys' nest, TSF and TSF decant pond and storm water runoff pond (Figure 1-6). Processing facility water requirements include reagent mixing, gravity concentrators and elution circuit.

Groundwater may be sourced from a bore field. The bore field will supply potable water and raw water as required. Potable water supply will be required for the accommodation village, offices, ablutions and safety showers. A camp water supply bore will be drilled and constructed within proximity to the accommodation village. The bore will supply fresh water and will be treated by reverse osmosis (RO) water treatment plant. Total potable water requirements are estimated at 394,200 m³/yr.

Table 1-8. Proposed surface water infrastructure and conceptual storage capacity

Infrastructure	Purpose	Capacity (m3)
Open-cut pit	Dewatering during mining activities	-
Turkeys nest	Dust suppression activities, estimated to be 175,000 m ³ /yr.	50,000
Raw water dam (Annie's dam)	Annie Dam will be repurposed as the raw water supply dam for processing. Raw water will be sourced from dewatering of the pit,	200,000

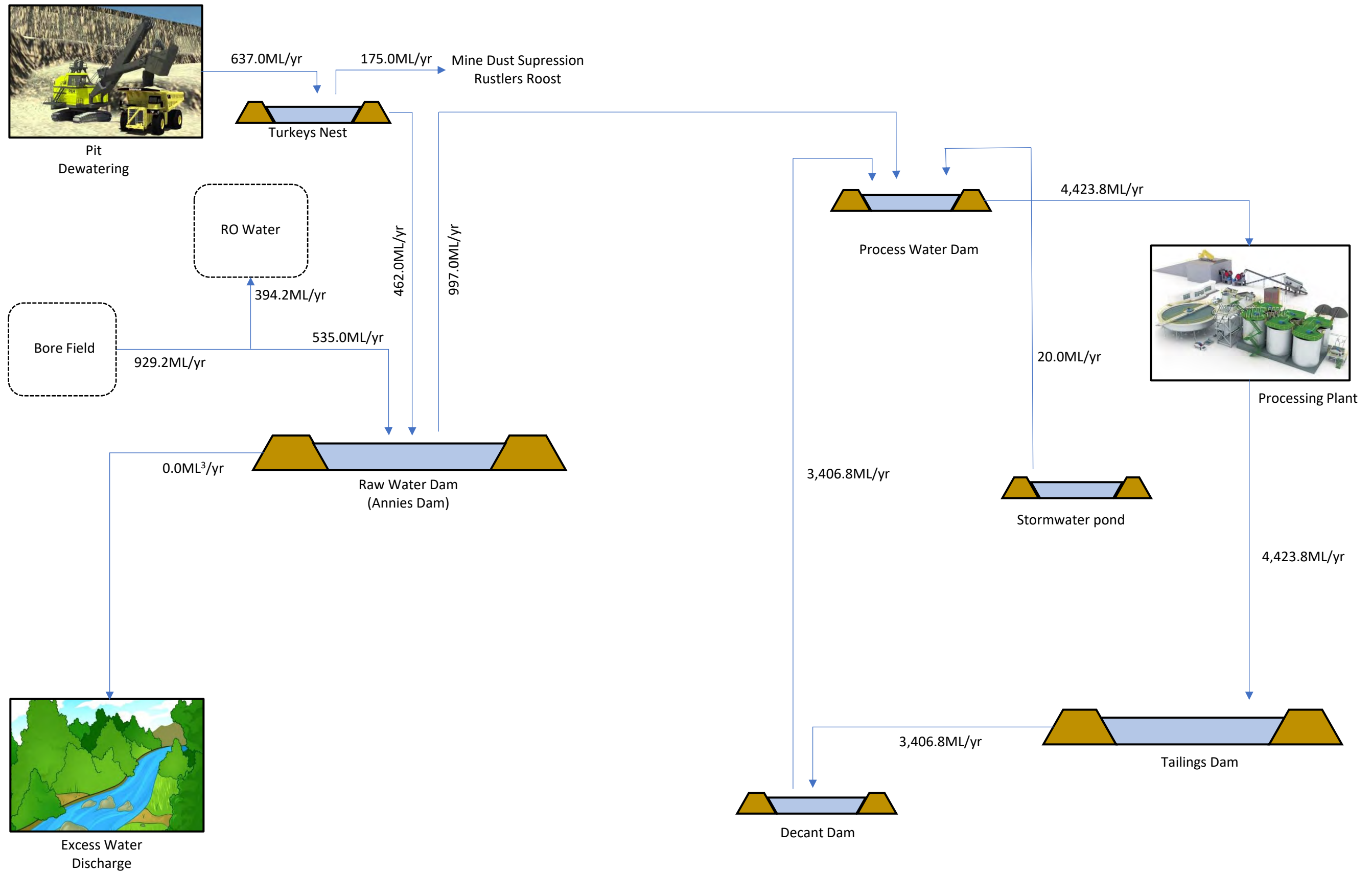
Infrastructure	Purpose	Capacity (m3)
	bore field and rainfall.	
Process water dam	Process water supply dam (receives return water from decant pond, raw water from Annie's dam and stormwater runoff from processing plant.	100,000
Tailings dam	Receives tailings from processing plant and catchment rainfall.	100,000
Decant dam	Receives decant water from tailings dam and tailings dam seepage. Decant water returned to process water dam for reuse in processing plant.	50,000
Stormwater pond	Capture process plant stormwater runoff. Water transferred to process pond for reuse.	50,000

A revised water balance will be developed as part of the EIS to account for rainfall, evaporation and seepage and, following groundwater modelling, quantify groundwater inflows into the pit during mining operations. A conceptual water balance for the proposed operations and water management systems is illustrated in Figure 1-6, based on 3 Mtpa production rate.

Q29 water management system

Current water management systems at Q29 comprise of the five existing pits and the decommissioned heap leach ponds. The heap leach ponds and pad are proposed to be rehabilitated at the commencement of mining Q29. Active management of pit water during mining operations will involve the pumping of water from one pit into another in accordance with mine scheduling. Existing pit water will be used for dust suppression activities.

Figure 1-6. Rustlers Roost conceptual water management schematic (3 Mtpa)



1.5.12 Sewage waste

Sewage wastewater from the accommodation village will be treated through a suitably designed sewerage treatment plant. The finalised on-site wastewater systems will comply with the requirements of the Code of Practice for On-site Wastewater Management (Department of Health, 2014).

1.5.13 Energy supply and demand

Rustlers Roost

The processing facility will be powered by gas. Liquefied Natural Gas (LNG) for the plant and Liquid Petroleum Gas (LPG) for the elusion circuit. Annual estimated gas use is 930,000 GJ LNG and 1,140,000 L LPG gas. Power (LNG gas) will eventually be connected to the accommodation village following construction. In the interim, diesel generators will be used to supply power to the village.

The existing power line running along the Arnhem Highway does not have the capacity of carrying the load requirements of the proposed processing facility. A further feasibility study assessing power alternatives such as solar energy will be undertaken during 2021.

Q29

Only diesel powered pumps will be required for dewatering of the pits and a diesel powered generator for the crib room / go bay area. Power will be supplied initially via diesel generator with the intention to connect the village to the main power station located at the processing facility once operational.

1.5.14 Air Emissions

Exhaust emissions will be produced by operation of diesel powered heavy plant and equipment in the mining process. Given the relatively small-scale and short mine life, the emission levels are not anticipated to be a magnitude that would cause any measurable changes to air quality beyond the mine site.

Preliminary greenhouse gas emissions estimates have been prepared based on the following information:

- Estimated diesel usage per year is 3,529 kL for Rustlers Roost and 1,627 kL for Q29 (including equipment diesel consumption for production, drilling and dewatering).
- Annual estimated LNG gas is 23,135 kL and 1,140 kL of LPG gas.
- Total land clearing 319.4 ha.

Per annum the total emissions estimate for the proposal is 69,228 t CO₂-e, or 0.43 % of NT emissions¹. On this basis the proposal will trigger the reporting threshold under the *National Greenhouse and Energy Reporting Act (2007)*, which is 50,000 t CO₂-e per annum (Table 1-9).

Table 1-9. NGER Emissions and Energy thresholds

Project area	Total emissions (t CO ₂ -e)	Energy consumed (GJ)
NGER facility threshold	25,000	100,000
NGER corporate group threshold	50,000	200,000
Rustlers Roost (facility 1)	61,561	750,857
Q29 (facility 2)	7,667	62,836
Total (corporate reporting)	69,228	813,692

¹ Total emissions for the Northern Territory in 2018 were 16.0 Mt t CO₂-e (DISER 2020).

1.5.15 Handling (storage and transport) of hazardous chemicals

Drill and blast technique with the use of ammonium nitrate (ANFO) will be required for the open-cut mining operations. An explosives compound (magazine) will be located within MLN1083. The magazine will be used for both Rustlers Roost and Q29 Projects. Storage for security sensitive ammonium nitrate (SSAN) will be in accordance with the NT *Dangerous Goods Act 1998* and the NT *Work Health and Safety (National Uniform Legislation) Act 2011*.

Storage and management of cyanide will be in accordance with the Commonwealth of Australia *Leading Practice Handbook for Sustainable Mining - Cyanide Management* (2008).

Hazardous material used in the processing facility and the estimated storage volumes are indicated in Table 1-10. The hazardous materials storage will be located within the designated processing facility area.

Table 1-10. Hazardous materials and storage volumes for processing activities

Hazardous materials	Estimated storage volumes
Cyanide	165 m ³
Hydrochloric acid	70 m ³
Sodium hydroxide	30 m ³
Copper sulphate	10 m ³
Hydrogen peroxide	16.7 m ³
Blanking agent	700 m ³
Quicklime	100 t
Flocculent	54.0 m ³
Activated carbon	Nil
Liquid petroleum Gas (LPG)	66 m ³
Smelting fluxes	4 t
Diesel fuel.	68,000 L

1.5.16 Social and economic

This section provides an overview of the social and economic components of the proposal, including workforce extent; rostering and accommodation requirements, economic and consultation components.

Workforce and accommodation

The majority of workforce will be working roster arrangements consisting of 8 days on 6 days off (8:6) or 14 days on 7 days (14:7). They will reside in the Rustlers Roost Accommodation Village during their 'on' roster and commute back home for their time off. The roster will be based on 12 hour days, 2 shifts (day/night) and a 3-crew panel.

Economic

The recommencement of mining operations will enable the employment of approximately 210 people during the production process. 100 people will be required for the construction stage. Construction material will be sourced locally where possible.

Consultation

Consultation for the proposed action will be undertaken through the approvals process.

Potential stakeholders include:

- Pastoral lease owners

- o Old Mount Bunday Station
- o McKinlay River Station
- Land Council
 - o Northern Land Council
- Neighbouring commercial businesses
 - o Allan King & Sons Construction Pty Ltd
 - o Boral Resources Limited
 - o Halkitis Bros Pty Limited
 - o Mousellis & Sons Pty Ltd
 - o Ostoic Group Pty Ltd
 - o Tomazos Group Pty Ltd
 - o Corroboree Park Inn Owner and Manager
- Government agencies
 - o Department of Industry, Tourism and Trade (DITT) (Formerly Department of Primary Industry and Resources)
 - o Department of Environment, Parks and Water Security (DEPWS) (Formerly Department of Environment and Natural Resources)
- Other agencies
 - o Aboriginal Areas Protection Authority (AAPA).

Recent stakeholder consultation has taken place with the landowners regarding exploration activities.

1.5.17 Closure and rehabilitation

Following completion of mining activities, the mine site will be closed and rehabilitated in accordance with an approved Mine Closure Plan. The final land use and closure objectives will be determined in consultation with the pastoral lease holders and other stakeholders.

The processing facility and associated mining infrastructure will be removed from site and the areas rehabilitated. The final WRD and TSF landforms will be suitably shaped, capped, rehabilitated and remain *in-situ*. Abandonment bunds will be constructed around the remaining open pits, which will be left to form pit lakes. The legacy heap leach facilities will be capped and revegetated and the backfilled pits will be covered with topsoil, shaped and revegetated. Haul roads, ROM, go-line and all other disturbed areas will be ripped and revegetated.

A post-closure monitoring programme will be implemented when closure commences. This will be incorporated as part of the Mining Closure Plan.

1.6 Alternatives

Initially, the existing processing facility at the Toms Gully mine was assessed for the processing of ore from all projects within the Mt Bunday Project area. The type of ore from Rustlers Roost and Q29 requires a different process to extract the gold, thus the option to build a processing facility at the Rustlers Roost project was selected.

A TSF location option study was undertaken by Knight Piesold Consulting Pty Ltd (2018). Five locations were considered at the Rustlers Roost project. During 2020, PGO reassessed these options and selected the location of the proposed TSF within the southern section of MLN1083. The location was selected on the basis that it was within available area of the existing MLN1083, suitable site topography and further economic potential to the north-east of the MLN1083.

An assessment of power supply options to operate the processing facility has been undertaken as discussed in section 1.5.13. A further study assessing the feasibility of alternatives such as solar will be undertaken.

Accommodation alternatives were assessed off-site but it was decided to establish a purpose-built camp facility on ML29782.

Backfilling of a portion of fresh waste material within open-cut pit voids has been assessed where mine scheduling permits to minimise volumes of potentially PAF waste to be disposed of within surface WRDs.

2 EXISTING ENVIRONMENT

This section provides an overview of the existing environmental values, important sites and features present within the proposal area and surrounding areas. Where relevant, these are described in detail in subsequent chapters for the particular environmental factors pertinent to this referral.

2.1 Natural environment

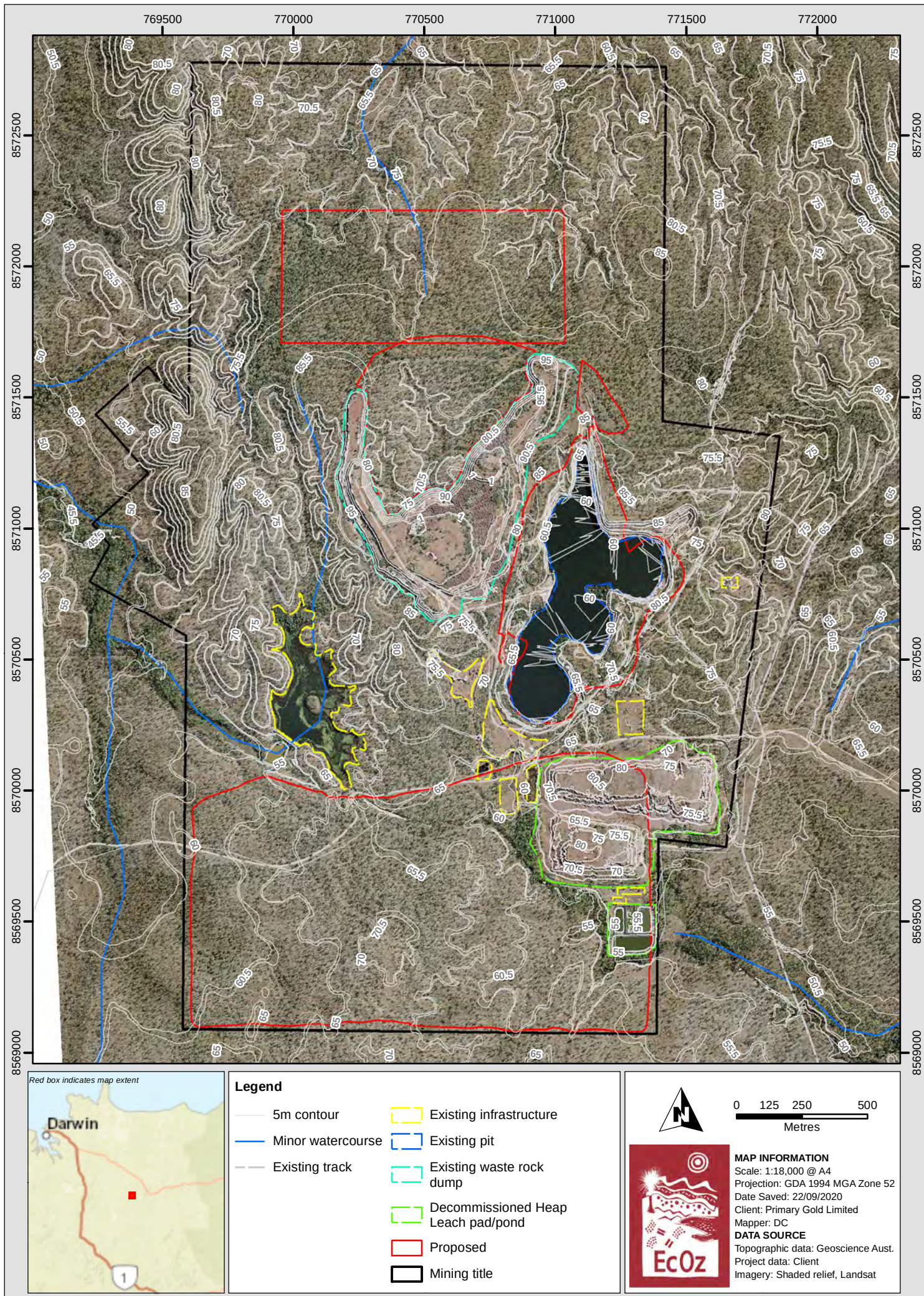
2.1.1 Landform

The proposal area is predominantly low hills to rises (Table 2-1). Mount Bunday, an area of outcropping granite, is a significant landform in the region located approximately 12 km north east of Rustlers Roost and 7 km north of the Q29 MLs. Existing vegetation and extensive stone surface outcrops provide land stability; however, land disturbed on slopes >2 % may have increased surface water runoff velocities and consequently a higher erosion risk. Rustlers Roost and Q29 topography is shown in Figure 2-1 and Figure 2-2 below.

Table 2-1. Land units of the Proposal area

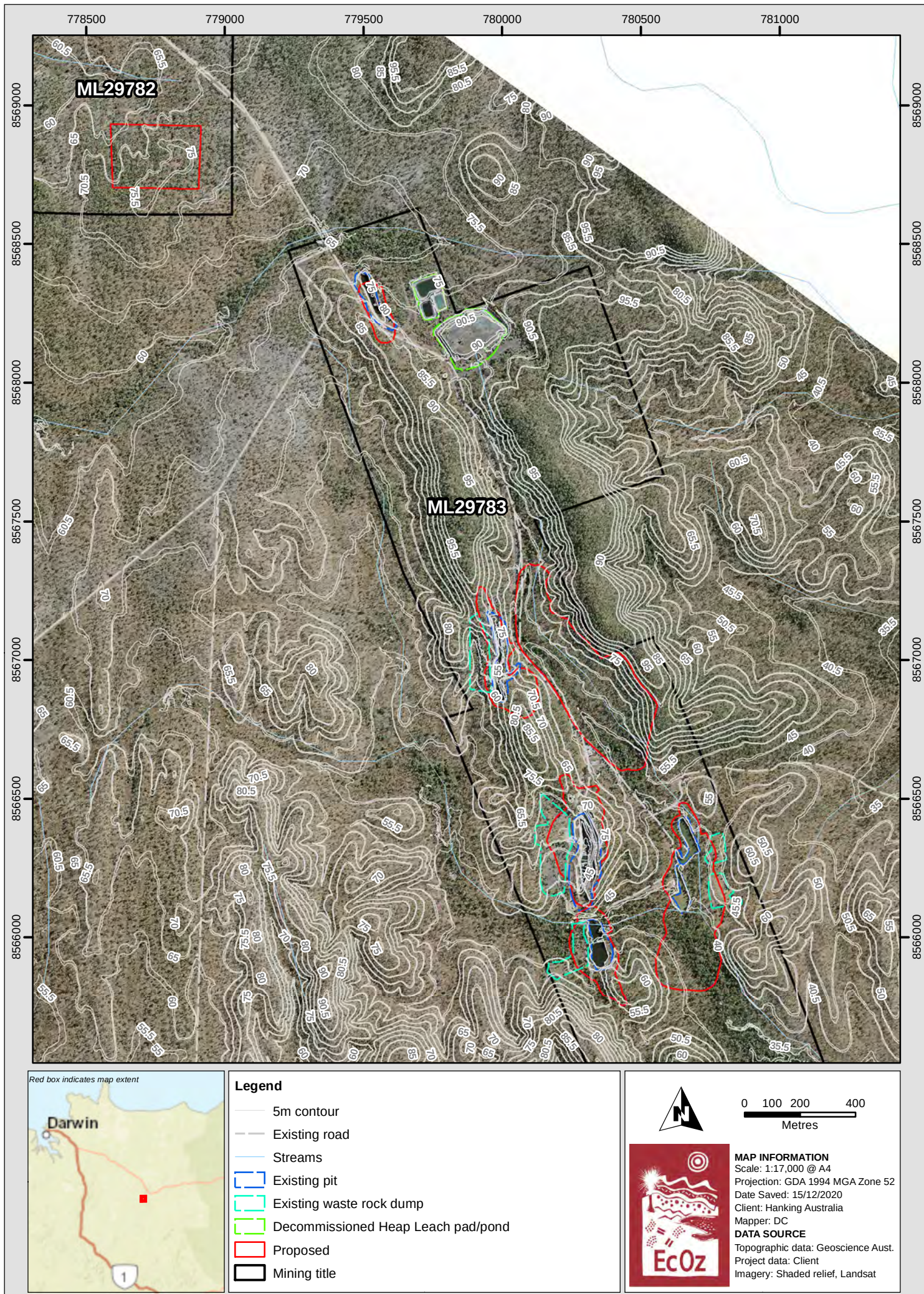
Project area	Land unit	Landform class	Landform Description	Soil	Soil description
Q29	2a	Low hills	Rugged terrain associated with siltstones and greywacke of Burrells Creek formation and Upper Proterozoic dolomites and sandstones; relief of between 10 and 80 m; with slopes >10 %; extensive surface stone outcrop.	Rudosols	Very shallow stoney lithosols
Rustlers Roost	2b	Rises	Low hills; ridges same lithologies as 2a; relief between 5 to 20 m, slope gradients between 6 -15 %, with extensive stone outcrop.	Kandolsols	Shallow stoney and gravelly lithosols
Q29	3a	Low rounded hills	Low rounded hills; some upland surfaces; well-drained (nil to low level waterlogging); slope 3 to 4 %.	Kandolsols	Shallow brown sandy loam with scattered surface gravel
Q29	6a	Creek channel	Creek channel ranging in width and depths forming large pools; poorly drained (wet season waterlogging); slope 1 to 4 %.	Hydrosol	Yellowish/brown sandy clay
Q29 & Rustlers Roost	6a1	Drainage lines	Minor creek lines and broad drainage systems; poorly drained (wet season waterlogging); slope 1 to 6 %.	Hydrosol	Soils vary between sites; reddish/brown sandy clay within creek bed at Rustlers Roost, and more skeletal on the upper bank and yellow/brown sandy clay at Quest 29 with less surface gravel.

Source: NTG NR Maps



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Figure 2-1. Map of Rustlers Roost topography



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Figure 2-2. Map of Q29 project topography

2.1.2 Flora and fauna

Ecological surveys undertaken by Low Ecological Services P/L (LES) during 2017 describe the natural vegetation of the undisturbed land and surrounding areas as savanna woodlands dominated by *Eucalyptus miniata*, *E. tetradonta*, *E. tintinnans* with a *Sarga spp.* grass understory, which is common in the region. Flora identified in highly disturbed areas are not significant or sensitive vegetation, and were identified as being highly modified in comparison to natural condition (LES 2016). Weeds are prevalent in areas that have been previously disturbed. Riparian vegetation commonly occurs along waterways downstream of the proposal area, this is an important habitat to sustain terrestrial and aquatic ecology. Two listed threatened flora species *Helicteres macrothrix* and *Stylidium ensatum* have been identified with a high likelihood of occurrence within or immediately surrounding the proposal area (Figure 4-1). Both plants are listed as endangered under the Commonwealth *Environmental Protection and Biodiversity Conservation (EPBC) Act, 1999* and endangered in the NT under the *Territory Parks and Wildlife Conservation (TPWC) Act, 1976*. Further details are discussed in section 4.2.

Due to the historic disturbance, the proposal area is considered unlikely to support any important fauna populations. The disturbance has reduced the potential food source, shelter and potential breeding sites for threatened species common in the region (LES 2016). Introduced fauna species known to occur in the area includes the water buffalo, cane toad, house mouse, pigs, cattle and horses.

2.1.3 Waterways

Rustlers Roost is predominantly located in the upper Mount Bunday Creek sub-catchment of the Mary River system. A portion of the western section of Rustlers Roost is located in the Marrakai Creek sub-catchment of the Adelaide River system.

Q29 is predominantly located in the McKinley River sub-catchment, which also flows into the Mary River system. A minor northern portion of Q29 is located in the upper Mount Bunday Creek sub-catchment of the Mary River system (Figure 2-3).

The local catchment is comprised of ridges and dissected hills that are drained by small step rivulets (CDM 2019b). Stream flows in these upper areas of the catchments are ephemeral, with flows occurring for only a few weeks-months each year throughout the wet season, in response to rainfall events.

Mount Bunday Creek – Mary River

During the wet season, drainage lines downstream of both Rustlers Roost and Q29 discharge to the north into the receiving Mount Bunday Creek, which flows into the main branch of the Mary River approximately 35 km downstream. Mount Bunday is an ephemeral creek that has limited flow and contains isolated pools during the dry season (Primary Gold 2020c). The creek flow is dependent on localised rainfall and historically the creek flows for 3-4 weeks annually (Primary Gold 2020c). The creek is utilised primarily when flowing by the Mount Bunday Station Pastoralist for livestock drinking water and supports aquatic flora and fauna at the upper and lower sections of the creek.

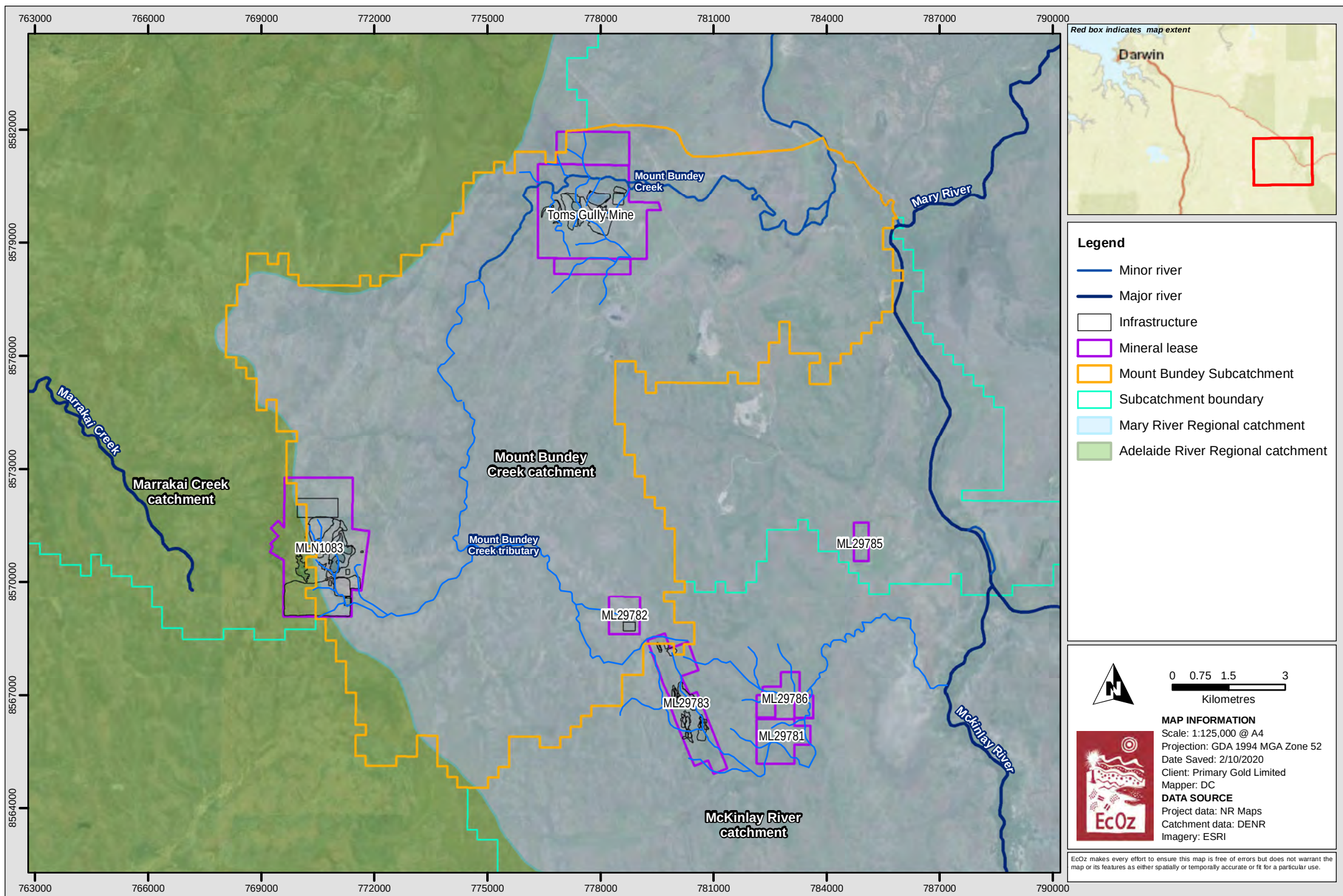
Mount Bunday Creek and the Mary River main branch are considered important watercourses, with beneficial uses declared under the *Water Act*. The declared beneficial uses for Mount Bunday Creek are for stock water supply for approximately a 7 km section at the Arnhem Highway flowing north-east (approximately 25 km downstream of the proposal areas), and aquatic ecosystems protection for the remainder (approximately 30 km downstream of the proposal areas). The declared beneficial uses and objectives for Mary River region is for environment, riparian and cultural uses. Sections of Mount Bunday Creek and the Mary River downstream of the proposal area are protected in the Mary River National Park (refer section 2.2.4).

McKinley River – Mary River

The majority of the Q29 mine site (eastern and southern parts) are located in the McKinley River catchment. Unnamed ephemeral drainage lines downstream of the site discharge to the east through floodplains towards the McKinley River main branch, which is approximately 15 km downstream of the project. From this location, the McKinley River flows north and discharges to the Mary River at a location 2 km upstream from the Arnhem Highway Mary River Bridge.

Marrakai Creek – Adelaide River

The headwaters of Marrakai Creek, a tributary of the Adelaide River, is located downstream of the western parts of the Rustlers Roost mine site. The site is approximately 37 km upstream of the Adelaide River confluence. The Adelaide River and associated floodplain system is considered environmentally significant and an overview of the system is provided in section 2.2.5.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ20143 - Rustlers Roost EIS\01 Project Files\Figure X-X. Subcatchment map.mxd

Figure 2-3. Map of proposal area hydrology

2.1.4 Groundwater

The regional groundwater system is comprised of intermediate-scale aquifers associated with unconsolidated sediments and local-scale aquifers associated with fractured and weathered rocks with minor groundwater resources (CDM Smith 2019a). This section of the region is not within a Declared Water Control District (WCD) or Management Zone. Further information regarding proposal area specific groundwater flows is provided in the section 5.4.

The majority of the proposal area lies within the declared beneficial uses and objectives area of the Mary River. The beneficial use and objectives applies to both surface water and groundwater. The beneficial uses of groundwater are for environmental, riparian and agricultural uses. The surface water is for environmental, riparian and cultural uses.

There are no groundwater dependent ecosystems (GDEs) within either of the proposal areas. The Bureau of Meteorology (BoM) GDE Atlas classifies the Mount Bunday, Marrakai Creek and Mary River system as being high potential GDE water systems. There is a low-moderate potential for terrestrial GDEs, at two locations approximately 2-3 km downstream, north-east of Rustlers Roost, and one low potential terrestrial GDE, approximately 5 km downstream, north-west of Q29 lease.

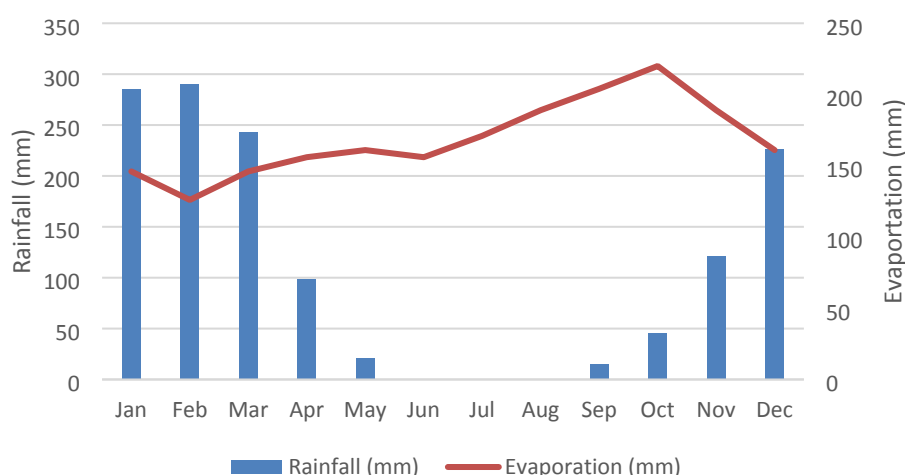
Bores identified within a 5 km radius of the proposal area leases are all associated with mining activities. The closest registered bore not associated with mining activities is RN036401, which is a pastoralist bore for the McKinlay River Station, located 6 km north-east of the Q29 lease boundary.

There is limited existing information regarding groundwater quality at the proposal area. Available information is detailed in section 4.4.

2.1.5 Climate

The tropical monsoonal climate, with a distinct Dry season (May to October) and Wet season (November to April), has implications for mining planning and operations. The annual rainfall occurs predominately in the Wet season, with rainfall intensities typically being high. During the Dry season there is no rainfall for six months or more; surface water resources gradually diminish and groundwater levels drop. Mine planning will need to take into account water availability for operations through the dry season and management of excess water during the wet season.

Climate observations are made by the Bureau of Meteorology (BoM). The Middle Point Rangers Station (Station no. 014090) is the closest BoM weather monitoring station to the proposal area, located approximately 40km south west of the Rustlers Roost. Average annual rainfall recorded at this station is 1366.5 mm (2001 to 2019) with the highest rainfall occurring in February and the lowest in July. Over 84% of annual average rainfall falls between November and March. The average annual regional evaporation is 2000 mm and exceeds the average annual rainfall. Evaporation is highest in October and lowest in February. Refer to Figure 2-4 for mean monthly rainfall and evaporation data.

Figure 2-4. Mean monthly rainfall and evaporation data (BoM, 2020)

2.1.6 Cyclones

The proposal is located in an area that experiences cyclones. These events most frequently occur in the Wet season particularly from December to March. Mine planning will need to take into consideration management requirements for increased rainfall intensity and flooding events associated with cyclones.

2.2 Significant sites or features

Important sites and features in proximity to the proposed action are summarised below and shown in Figure 2-5.

2.2.1 Communities

The proposed action is located in a remote area, where the nearest residences are the Old Mount Bunday homestead is located approximately 10 km north-north east and McKinlay River homestead – 15 km east of Rustlers Roost. In the case of Q29, the homesteads are 8.7 km north-east and 6 km north-east respectively. The homesteads are the nearest groundwater users to the proposal area. The closest residential subdivision is Marrakai, 14km north-west of the proposal area.

2.2.2 Culturally important or sacred sites

Historically there have been a number of Aboriginal Area Protection Authority (AAPA) Certificates issued over the proposal area. Most recently, PGO was issued an Authority Certificate in 2016, for the purpose of exploration activities and ongoing maintenance of the Rustlers Roost and Q29 mines (C2016/168). No recorded or registered sacred sites were identified. Prior to the commencement of the proposed action, PGO will seek a new Authority Certificate.

2.2.3 Heritage sites

An archaeological survey was undertaken at Rustlers Roost, and recorded four sites of prehistoric materials, which included background scatters (Kinhill 1993b). No archaeological surveys have been undertaken on the Q29 mining leases.

Correspondence with the NTG Heritage Branch in August 2020 determined that no nominated, provisional or declared heritage places were registered as a result of the above archaeological investigation. A number of the sites recorded were removed or disturbed as part of previous development and expansion of the mine.

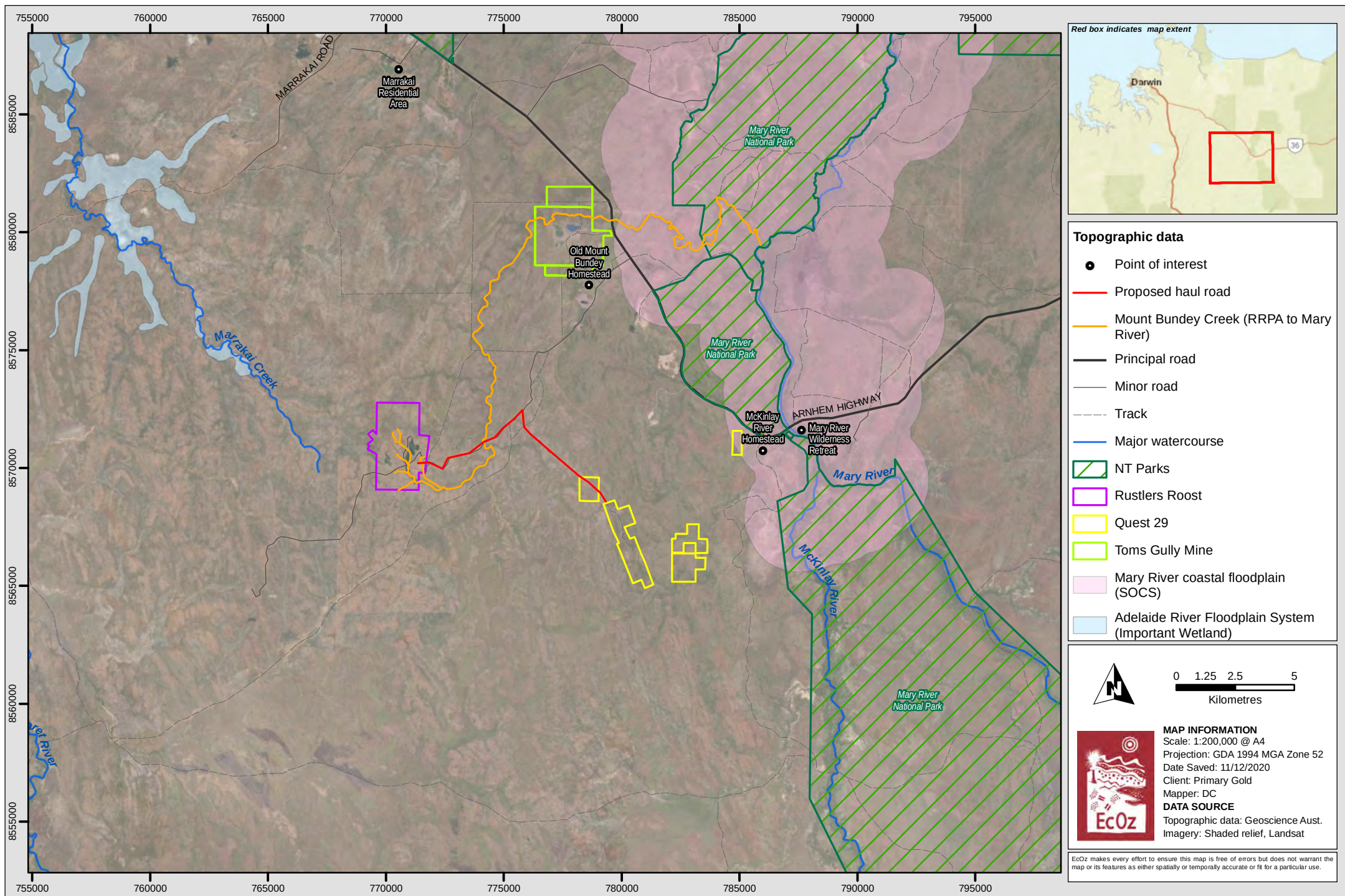
Heritage Branch did not express any heritage or archaeological concern within the proposal area, due to level of disturbance, proximity of the Arnhem Highway and previous archaeological investigation undertaken. However, the advice provided by the Branch indicates that in the event that potential archaeological sites are discovered, all works in the immediate area should cease and the Heritage Branch will be contacted for comment (see Appendix C).

2.2.4 Mary River Floodplain System & National Park

The Mary River National Park is located downstream of the proposal area, approximately 6.5 km east of the Q29 at its closest. The Mary River Floodplain System is protected within the Mary River National Park and is defined as a Site of Conservation Significance (SOCS). The Mary River National Park is managed under a Joint Management Plan between the Limilngan and Uqynmil Traditional Owners of the park (PWCNT 2015). The park contains biodiversity values of national and international significance, as it provides a complex mosaic of wet and dry habitats that supports a diverse population of waterbirds (PWCNT 2015). As well as cultural, natural, recreational and historical significance for tourism in the Top End.

2.2.5 Adelaide River Floodplain System

Located 6 km downstream (north-west) of Rustlers Roost, is the southern portion of the Adelaide River Floodplain System. Collectively the Adelaide Floodplain system is of natural and cultural importance. Floodplains are important environmental feature in the Northern Territory (NTG 2019). They provide essential ecosystem services and support a wide diversity of flora and fauna.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ20155 - Rustlers Roost & Quest29 - Bore Preparation & Installation Plan\01 Project Files\Figure 2 6. Map of surrounding.mxd

Figure 2-5. Map of surrounding significant sites and features

2.3 Demography and economy

The proposal area is located in the Mount Bunday region, and is remote from any communities. The closest major town is Humpty Doo, which is approximately 46 km north-west from the Rustlers Roost. Marrakai residential subdivision is located 14 km north-west of Rustlers Roost. The Australian Census for the nearest community, the Marrakai community, indicates a population of 517 people with a median age of 39 (ABS 2016).

The economic input of the region is predominately based on extracting civil and building material and pastoral properties utilised for cattle farming. Ranging from 3 to 9 km from Q29 are a number of quarries, owned by Allan King and Sons Construction, Austmin Development, Boral Resources, Halkitis Bros; Mousellis & Sons Pty Ltd; Ostojic Group Pty Ltd and Tomazos Group Pty Ltd which provide construction material for civil and residential buildings around the Northern Territory. The proposal area is located on pastoral land, McKinlay River and Old Mount Bunday Station, utilised for pastoral production. The closest production bore is 6 km north-east of Q29, and is associated with the McKinlay River Pastoral Lease.

The broader Mount Bunday region is surrounded by the Mary River, Mary River National Park and Wilderness retreat that is utilised for tourism and recreational purposes. Mary River Wilderness retreat is located 8.5 km north-east from Q29.

The Mount Bunday Region has an established Defence Training Area to the east of the Mary River, operated by the Commonwealth of Australia.

3 ENVIRONMENTAL FACTORS

A self-assessment of the proposed action was undertaken using the pre-referral checklist provided in the guideline '*Referring a proposed action to the NT EPA.*' For each of the NT EPA's Environmental Factors and Objectives, environmental values and sensitivities within and surrounding the Rustlers Roost and Q29 proposal areas were identified based on desktop studies and preliminary terrestrial surveys. The potential for the proposed action to impact on these values was assessed with reference to *NT EPA Environmental factors and objectives, environmental impact assessment guidance*. The environmental factors identified as having the potential to be significantly impacted by the proposed action are:

- Terrestrial environmental quality
- Terrestrial ecosystems
- Hydrological processes
- Inland water environmental quality
- Aquatic ecosystems.

Table 3-1. Environmental factors and potential impacts relevant to the proposed action

Theme	Factor and Objective	Environmental values and sensitivities	Does the proposed action have the potential to significantly impact values or sensitivities?
Land	Landforms <u>Objective:</u> Conserve the variety and integrity of distinctive physical landforms.	Mount Bunday is a distinctive landform located immediately to the north of Q29 and approximately 8 km east of Rustlers Roost. The landform is a large area of outcropping rock that forms hills up to 150 m above the surrounding floodplains of the Mary River. It supports large Ficus trees and patches of rainforest that are recognised as important refuge habitats and food resources for fauna. There are a number of established quarry operations that extract granite and other materials from Mount Bunday.	☐ Yes ☒ No ☐ Uncertain ☐ NA The proposed activities will not directly impact on Mount Bunday or any other landform.
	Terrestrial Environmental Quality <u>Objective:</u> Protect the quality and integrity of land and soils so that environmental values are supported and maintained.	- Existing mining landforms present on the sites include open pit lakes, WRD's and heap leach pads/ponds. Sampling of the waste materials and water quality has indicated that there is a low risk of contamination from the historical mining activities, which targeted only Non-Acid Forming (NAF) waste rock (CDM Smith, 2019). - The mine sites encompass areas of dissected and hilly terrain where steep slopes (>2%) are at risk of erosion, especially during the wet season when the area experiences significant rainfall events. - The ore that will be mined contains Potentially Acid Forming (PAF) materials likely to produce AMD. - Pastoral land use, aquatic ecosystems and cultural/recreational use of the watercourses downstream are sensitive to water quality impacts that can result from land and soil degradation or contamination.	☒ Yes ☐ No ☐ Uncertain ☐ NA - Mine site layout and design will need to consider erosion risks and incorporate controls. - Geochemical analysis of waste rock and ore required to inform design criteria for surface waste storage structures (WRD), TSF and materials management.

Theme	Factor and Objective	Environmental values and sensitivities	Does the proposed action have the potential to significantly impact values or sensitivities?
	Terrestrial Ecosystems <u>Objective:</u> Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	- Majority of the areas that are part of the proposed action have been previously cleared and disturbed by past mining activities. - Direct disturbance footprints are mixed woodlands of <i>Eucalyptus miniata</i>, <i>Corymbia sp.</i> and <i>Erythrophleum sp.</i> vegetation type, which is common and well represented in surrounding areas (Low Ecological, 2016). - Riparian habitats present on ML's and downstream watercourses that will receive runoff from the mine sites. - Threatened plant species, <i>Helicteres macrothrix</i> not identified during targeted surveys of suitable habitat undertaken by EcOz during September / October 2020. - Threatened plant species, <i>Stylidium ensatum</i>, presence/absence yet to be verified through field surveys of suitable habitat in June/July. Habitat surveys indicate that the habitat within the proposal area is not suitable for <i>Stylidium ensatum</i> (EcOz 2020).	☒ Yes ☐ No ☐ Uncertain ☐ NA - Further survey work required to assess threatened plant populations and determine if impacts will be significant. - Riparian habitats could be impacted by groundwater drawdown associated with dewatering of pits or if water quality deteriorates as a result of the mining activities.
Water	Hydrological Processes <u>Objective:</u> Protect the hydrological regimes of groundwater and surface water so that environmental including ecological health, land uses and the welfare and amenity of people are maintained.	There are three sub-catchments that surface water flow into; the Mount Bunday Creek, McKinley River (sub-catchments of the Mary River System) and Marrakai Creek (sub-catchment of the Adelaide River System).	☐ Yes ☐ No ☒ Uncertain ☐ NA - Operational mine site discharges could potentially alter surface water flows. - Additional groundwater monitoring bores have been installed to develop a site-specific understanding of groundwater availability, sustainable extraction limits, baseline groundwater conditions, dewatering requirements and groundwater impacts. - Dewatering may impact groundwater levels and flow in the area.

Theme	Factor and Objective	Environmental values and sensitivities	Does the proposed action have the potential to significantly impact values or sensitivities?
	Inland Water Environmental Quality <u>Objective:</u> Protect the quality of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are maintained.	• Nearest identified groundwater users are the Mount Bunday Station, approximately 8.7 km north-east, and McKinlay River homestead 6 km north-east of the proposal areas. • Beneficial use for receiving waters downstream at Mount Bunday Creek – for stock water supply and aquatic ecosystems. • Surface water - declared beneficial use area for the Mary River catchment – for environmental, riparian, cultural and stock purposes. • Groundwater - declared beneficial use for Mary River– for environmental, riparian and agriculture.	☒ Yes ☐ No ☐ Uncertain ☐ NA • Operational mine site discharges could potentially alter downstream surface water / groundwater quality. • Baseline surface water and groundwater monitoring is proposed for a minimum 6-month period to determine a site-specific model. • Refer to section 4.4 for further assessment.
	Aquatic Ecosystems <u>Objective:</u> Protect aquatic habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	• No natural permanent waterbodies located within the proposal area. • Downstream of the proposal area, Mount Bunday Creek, Marrakai Creek and Mary River water systems identified as likely of being groundwater dependant ecosystems. • Section of Mount Bunday Creek declared beneficial use for aquatic ecosystem protection.	☒ Yes ☐ No ☐ Uncertain ☐ NA • Aquatic ecosystems have the potential to be impacted by mine site water discharges. • Refer to section 4.5 for further assessment.
Sea	Coastal Processes <u>Objective:</u> Protect the geophysical and hydrological processes that shape coastal morphology so that the environmental values of the coast are maintained.	• Proposed actions are located beyond 100 km from a marine ecosystem.	☐ Yes ☐ No ☐ Uncertain ☒ NA
	Marine Environmental Quality <u>Objective:</u> Protect the quality and productivity of water, sediment and biota so that environmental values are maintained.		
	Marine Ecosystems <u>Objective:</u> Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.		

Theme	Factor and Objective	Environmental values and sensitivities	Does the proposed action have the potential to significantly impact values or sensitivities?
Air	Air Quality <u>Objective:</u> Protect air quality and minimise emissions and their impact so that environmental values are maintained.	- Closest sensitive receptors are the pastoral lease homestead, Mount Bunday Station, 8.7 km north, and McKinlay River homestead 6 km north-east. The Mary River Wilderness retreat is also approximately 8.5 north-east. - No environmentally valuable sensitivities directly encompassing the proposal area.	☐ Yes ☒ No ☐ Uncertain ☐ NA Dust emissions will be mitigated using standard measures, and will only be applicable during construction of the proposed action.
	Atmospheric Processes <u>Objective:</u> Minimise greenhouse gas emissions so as to contribute to the NT Government's aspirational target of achieving net zero greenhouse gas emissions by 2050.	The annual total emissions estimate for the proposal area is 69,228 t CO₂-e, or 0.43 % of NT emissions.	☐ Yes ☒ No ☐ Uncertain ☐ NA Proposal will not significantly contribute to NT emissions. The Australian Government's Safeguard Mechanism, applies to facilities emitting more than 100,000 t of CO₂-e per annum.
People	Communities and Economy <u>Objective:</u> Enhance communities and the economy and foster resilience to a changing climate, for the welfare, amenity and benefit of current and future generations of Territorians.	- Closest sensitive receptors are the pastoral lease homestead, Mount Bunday Outstation, 8.7 km north, and McKinlay River homestead 6 km north-east. The Mary River Wilderness retreat is also approximately 8.5 north-east. - Marrakai subdivision is 14 km north-west. - Ranging from 3 to 9 km from Q29 mining infrastructure are a number of quarries, owned by various Companies. - The Mary River region downstream of the proposal area has recreation and tourism values, which could be sensitive to any impacts to water quality in watercourses downstream of the mine sites.	☐ Yes ☒ No ☐ Uncertain ☐ NA - Due to the following, it is not expected that the proposed action will significantly impact the communities and the economy factor: - o Remote from nearest sensitive receptors. - o Onsite accommodation facilities utilised. - o Limited light vehicle traffic will utilise public roads. - o Haulage of ore is restricted to internal non-public road. - o Short mine life and past mining history.

Theme	Factor and Objective	Environmental values and sensitivities	Does the proposed action have the potential to significantly impact values or sensitivities?
	Culture and Heritage <u>Objective:</u> Protect sacred sites, culture and heritage	• Extensive historic archaeological investigation was undertaken in 1993. Four sites of prehistoric materials, including background scatters were identified. Recommendations were provided to protect the sites using fences, or request to destroy the sites were to be obtained. No further information regarding what recommendation was followed. • No nominated, provisional or declared heritage or archaeological places located within the proposal areas, according to the NTG Heritage Branch. • Heritage Branch recommended no archaeological survey required for any Mineral Leases due to high level of previous disturbance and low likelihood of significant heritage sites being present. • Numerous AAPA Certificates have been obtained for exploration activities do not identify any recorded or registered Aboriginal Sacred Sites in proposal footprint.	☐ Yes ☒ No ☐ Uncertain ☐ NA • AAPA certificate will be obtained prior to the commencement of any proposed actions to ensure sacred sites are identified and avoided. • Mine Management Plan (MMP) will incorporate conditions of the AAPA certificate. • MMP authorisation will be subject to approval and will incorporate mitigation measures in the event of a potential heritage or archaeological site is identified.
	Human Health <u>Objective:</u> Protect the health of Northern Territory population.	• No consumptive use of surface water downstream. • No residential or commercial developments within 5km of the proposal area.	☐ Yes ☒ No ☐ Uncertain ☐ NA

Factors from Table 3-1 that have identified as being potentially impacted by the proposed action are examined in the sections below.

4 POTENTIAL ENVIRONMENTAL IMPACTS

For each of the environmental factors identified above, the following sections provide details of the current condition of the receiving environment and potential environmental impacts associated with the proposal.

4.1 Terrestrial environmental quality

NTEPA Environmental Objective:

Protect the quality and integrity of land and soils so that environmental values are supported and maintained.

4.1.1 Receiving environment

The current condition of the proposal area is largely disturbed from past mining activities. Topsoil has been removed and the previously disturbed areas have not been rehabilitated. Areas that are not cleared are dominated by the presence of *Eucalyptus* sp. open and lowland woodlands, which are common of the region (LES 2017). The landscape is predominately low hilled rugged terrain with gradient slopes ranging between 5-15% (Land units 2a and 2b). Slopes greater than 2% pose a high erosion risk and require targeted management. There is evidence of localised erosion, in particular inspections have recorded erosion around the Rustler's Roost Heap Leach Pad (Primary Gold 2016).

There is no evidence of soil contamination from past land use. The key sources of contamination would be from hydrocarbon/chemical use around the old process plant site and AMD and/or other chemical contaminants leaching from the existing WRD's and Heap leach facility. Desktop and limited field geochemical assessment was undertaken at Rustlers Roost to assess the likelihood of AMD to be released from previously mined materials stored onsite (CDM 2019). Ten surface samples were collected from the WRD and Heap Leach pads and two samples from the ROM pad, which were subject to geochemical analysis. All samples were classified as NAF, which is consistent with previous geochemical assessments of the weathered materials within the geological profile.

Pastoral land use, the main land use in the surrounding area, relies on good quality soil and could be impacted by the proposed action if there was significant erosion or contamination. Downstream water quality could be impacted if the quality and integrity of soils is not adequately protected, which could subsequently impact aquatic ecosystems and cultural/recreational use of the watercourses downstream.

4.1.2 Potential impacts

Land clearing and construction of surface landforms has potential to cause erosion. The physical impacts of erosion are likely to be localised within the ML's. Erosion can lead to loss of soil structure and soil seed bank and can affect long-term integrity of constructed landforms, which can reduce the success of future rehabilitation efforts. Erosion could also lead to indirect downstream water quality impacts associated with fine sediments being washed off site by rainfall events.

Contamination of soils, and subsequent impacts to downstream water quality, are likely to occur if problematic waste materials and the landforms they are stored in are not properly designed and managed during operations and post-closure. A large portion of waste rock and all of the tailings will be stored in surface landforms, with the intent that benign NAF waste rock will be used to encapsulate all PAF waste rock.

Results of waste characterisation work undertaken by Graeme Campbell and Associates (CGA 1997) indicate that weathered material is classified as NAF and barren (majority of material mined for stage 1), transitional waste material is a mixture of NAF and PAF, and all fresh waste is classified as PAF. A multi-element composition analysis of the waste rock identified elevated arsenic concentrations up to 390 mg/kg

(GCA 1997). Waste rock and tailings disposal could impact soil quality through PAF materials, release of soluble metals and residual process chemicals including cyanide.

Historical geochemical assessments indicate a correlation of increased mining depth and the increase in PAF material quantity (CDM Smith 2019). Currently the base of the oxidation zone within Rustlers Roost is estimated as 60 m below the initial ground surface, with this referral proposing that the final pit depth for Rustler Roost will be 175 m. It is expected that further waste characterisation will confirm this correlation and that further mining will expose PAF material that will require management. However, the number of samples collected to date are not considered sufficient to fully characterise the mined and potentially mined ore and wastes. Further waste and ore geochemical characterisation and materials volumes are to be assessed in detail as part of the environmental approvals.

Storage of processing chemicals and hydrocarbons on site has the potential to result in spill and leaks, which could cause localised soil contamination. Contamination of soils, and subsequent impacts to downstream surface water and groundwater quality, could occur if processing chemicals and hydrocarbons area not adequately stored and cleaned up in the event of a spill or leak being identified.

Water quality is discussed in detail in section 4.4.

4.1.3 Mitigation

The existing ESCP for Rustlers Roost MMP will be reviewed to incorporate the proposed WRD expansion, TSF and processing facility. An operational Erosion and Sediment Control Plan (ESCP) will be developed by a suitably certified person, in accordance with the *Best Practice Erosion and Sediment Control Guidelines* (IECA, 2008).

To minimise the potential for AMD, WRD and TSF landforms will be designed by appropriately qualified engineers in accordance with accepted industry guidelines and standards. The landform designs and closure strategies will be informed by detailed waste rock and ore characterisation studies. Further confirmation of problematic materials volumes and the availability of suitable material to encapsulate the waste will occur during mine planning.

A portion of fresh waste material will be backfilled into Rustlers Roost pit and Zamu pit (Q29), minimising the volume of material being exposed for oxidation. Backfilling of pits with PAF rock and encapsulating the material is a leading mining practice strategy that results in less PAF material being exposed to oxidation and remaining on the surface. Due to the quantity of waste rock that will be produced, WRD landforms will be designed to dispose the remainder of the waste material. This waste will be managed through the development of an AMD Management Plan.

Storage facilities and handling of processing chemicals and hydrocarbons will be designed appropriately in accordance with the *Australian Standard 1940-2004 The storage and handling of flammable and combustible liquids*, the International Cyanide Management Code (ICIM 2006) and leading practice guidelines.

4.1.4 Assumptions

The key assumptions made in assessing potential impacts on terrestrial environmental quality are:

- The WRD and TSF will be designed, constructed and operated in accordance with leading practice. The management strategy for PAF material is based on there being sufficient acid neutralising materials available to encapsulate the wastes. It has been assumed that the landform designs will provide for effective long-term prevention and/or containment of AMD.
- Erosion risks associated with early or unexpected closure, would be addressed to the satisfaction of DITT through the MMP process.
- A Mine Closure Plan will be developed and implemented to make the site safe, non-polluting and mitigate long-term impacts.

- Storage and handling of processing chemicals and hydrocarbons will be in accordance with accepted standards and guidelines.

4.1.5 Relevant policy and guidance / industry standards

The relevant policy, guidance and industry standards that have been considered in relation to terrestrial environmental quality include:

- International Erosion Control Association Australia (IECA). (2008). *Best Practice Erosion and Sediment Control Guidelines* – to inform standards for ESCP management.
- International Network for Acid Prevention (INAP). (2009). *Global Acid Rock Drainage (GARD) Guide*.
- AMIRA. (2002). *International ARD Test Handbook*.
- Commonwealth of Australia. (2016). *Preventing Acid and Metalliferous Drainage*, Leading Practice Sustainable Development Program for the Mining Industry.
- Commonwealth of Australia. (2016). *Hazardous Materials Management*, Leading Practice Sustainable Development Program for the Mining Industry.
- Commonwealth of Australia. (2016). *Mine Closure*, Leading Practice Sustainable Development Program for the Mining Industry.
- Commonwealth of Australia. (2016). *Mine Rehabilitation*, Leading Practice Sustainable Development Program for the Mining Industry.
- Commonwealth of Australia. (2008). *Cyanide Management*, Leading Practice Sustainable Development Program for the Mining Industry.
- Commonwealth of Australia. (2016). *Tailings Management*, Leading Practice Sustainable Development Program for the Mining Industry.

4.1.6 Consultation

No specific consultation has been undertaken in regards to terrestrial environmental quality.

4.1.7 Cumulative impact

Cumulative impacts as a result of the proposed actions include the increased area of land disturbance, subsequent erosion risk and increase area of unsuitable land for non-mining activities. The permanence of the open pit lakes, WRDs and TSF, eliminates the potential for future non-mining land use for the MLs. Cumulative impact of AMD may result from numerous waste material landforms remaining in-situ over time.

4.1.8 Ecologically sustainable development

The precautionary principle has been considered by acknowledging the assumptions and uncertainties that exist in relation to the assessment of potential impacts and risk associated with AMD. Geochemical characterisation of recent drilling is currently being undertaken to verify assumptions and reduce uncertainty of materials characterisation and volumes of classified material to determine appropriate management of the PAF material. This will inform the landform designs and AMD Management Plan. It is planned that some backfilling of open-pit voids will progressively occur during mining where mine scheduling allows.

4.1.9 Residual impact

Localised erosion is expected to occur but subject to effective management through implementation of an ESCP and Mine Closure Plan, is not expected to impact land areas outside of the ML's.

The development footprint will be unsuitable for any future non-mining land-use due to the presence of the surface WRD's, TSF and open pit lake. As part of the Mine Closure Plan, the WRD and TSF landforms will require long-term monitoring to ensure their structural integrity is maintained, preventing the generation and release of AMD.

It is expected that that chemical and hydrocarbon contamination would not cause a significant impact to soils. Minor areas of residual chemical and hydrocarbon contamination could be present around the processing facility and operations areas.

4.2 Terrestrial ecosystems

NTEPA Environmental Objective:

Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

4.2.1 Receiving environment

Ecological surveys undertaken by Low Ecological Services P/L (LES) during 2017 describe the natural vegetation of the undisturbed land and surrounding areas as savanna woodlands dominated by *Eucalyptus miniata*, *E. tetradonta*, *E. tintinnans* with a *Sarga spp.* grass understory, which is common in the region. Riparian habitat is present within the proposal area and were assessed as part of the EcOz vegetation survey (EcOz 2020). Much of the riparian area within and to the east of Rustlers Roost were disturbed due to mining activities, but did contain some monsoonal species. Riparian areas to the west of Rustlers Roost were largely intact and weed free (EcOz 2020). Areas within the Quest 29 proposal area were classified as the riparian land unit 6a and comprised of riparian and monsoon vine species. Much of these riparian areas have been disturbed by previous clearing and stockpiling of fill material; weeds and feral animals were observed in these areas (EcOz 2020). Riparian vegetation is common in the region with riparian habitat present downstream of the proposal area in Mount Bunday Creek (GHD 2018). The riparian habitat was largely intact along Mount Bunday Creek (GHD 2018).

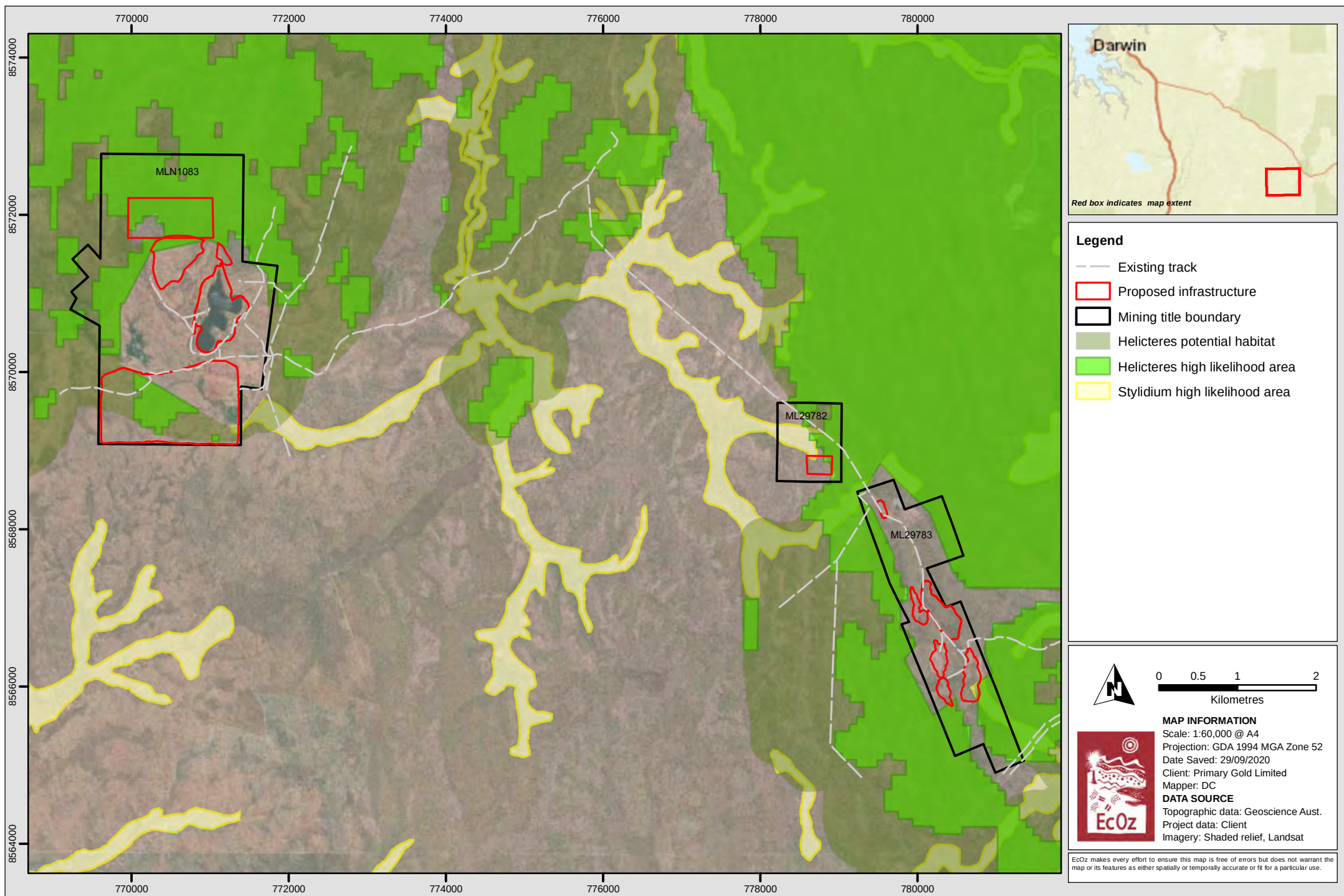
Habitat modelling prepared by NTG indicates that two threatened species, *Helicteres macrothrix* and *Stylidium ensatum* could occur in the proposal areas (refer to Figure 4-1). Flora surveys undertaken at Toms Gully, Rustlers Roost and Q29 by Low Ecological Services P/L (LES) during November 2016 and May 2017 did not identify any flora species of conservation significance. Targeted surveys of the proposal area conducted during September 2020 did not identify *Helicteres macrothrix* (see Appendix D).

Stylidium ensatum, could occur based on habitat modelling; however, due to its seasonal detectability, only habitat suitability was assessed during September 2020. Only one small (approximately 3,000 m²) patch of modelled *Stylidium ensatum* habitat was considered to be marginally-suitable habitat based on the known ecology of the plant; however, as the plant is only detectable in June/July, it is not possible to confirm presence or absence of the species at this time. Other areas modelled as potential *Stylidium ensatum* habitat within the proposal area were assessed as being unsuitable and unlikely to support this species. (EcOz 2020). LES (2017) also indicated that there is a low likelihood that *Stylidium ensatum* occurs.

Targeted surveys for this species are planned for early dry season 2021 to confirm the species presence/absence, in accordance with prescribed methodologies.

During the EcOz (2020) vegetation survey, invasive weed species incidentally observed within proposal area were recorded, with the majority established in disturbed areas, and occasionally occurring in native bushland. The declared weed species, *Hyptis (Hyptis suaveolens)* was the most abundant within the proposal area; it was recorded in high densities in Quest 29 south. Scattered Perennial Mission Grass (*Cenchrus polystachios*) and Gamba Grass (*Andropogon gayanus*) were also observed, mostly within Quest 29 south and along roadsides. Other weed species included *Sida sp.* (EcOz 2020). Gamba Grass and Perennial Mission Grass are listed as Class B weeds under the NT *Weeds Management Act*, with Gamba Grass also listed as a Weed of National Significance (WoNS). A number of NT threatened, near threatened

and data deficient fauna species were recorded during the 2016 and 2017 surveys (LES, 2017). The NT threatened species included the Merten's water monitor (*Varanus mertensi*). A total of four near threatened species recorded were the orange leaf-nosed bat (*Rhinonicterus aurantia*), Arnhem sheath-tailed bat (*Taphozous kapalgensis*), yellow-rumped manikin (*Lonchura flaviprymma*), and the bush stone-curlew (*Burhinus grallarius*). Two data deficient species recorded were the red-cheeked dunnart (*Smithopsis virginiae*) and black-spotted ridge-tailed monitor (*Varanus baritji*). No fauna species listed as migratory were recorded during either survey (LES, 2017).



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ20143 - Rustlers Roost EIS\01 Project Files\Figure X-X, Map of threatened flora.mxd

Figure 4-1. Map of modelled distribution of threatened flora species

4.2.2 Potential impacts

Clearing of vegetation will have a direct impact on vegetation and habitats inside the proposal area. Approximately 246 ha of Eucalyptus woodland will be cleared for construction of new mine site components. The vegetation is common in the region and the habitat value of the area is degraded due to previous mining activities. The impact of land clearing will be localised.

Riparian habitat downstream of the proposal area could be impacted if significant AMD contamination were to occur. The potential for AMD contamination to occur was discussed in section 4.1.2. There is potential for the post closure open pit lakes to contain Acid and Metalliferous Drainage (AMD) impacted water. Fauna will likely have access to these water sources. Potential impacts to downstream water quality and the Pit lake post closure is further discussed in section 4.4.

Fire regimes may be altered locally within the proposal area due to clearing of native vegetation and proliferation of existing weeds such as Gamba grass. Fire history from North Australia & Rangelands Fire Information (NAFI) indicate that the proposal areas are frequently burnt, having historically been burnt for 10 to 15 years within a 20-year period.

The proposal is unlikely to impact any important populations of threatened flora or fauna species. Surveys of the proposal area have verified the absence of all but one flora species, *Stylidium ensatum*, which has not yet been the subject of a targeted surveys. Habitat modelling undertaken by NTG identifies high likelihood habitat at the proposal areas for *Stylidium ensatum*. Further understanding of the *Stylidium ensatum* presence and extent will be formed once the targeted survey is undertaken during the dry season.

Dust, noise and vibrations as a result of mining activities, could cause fauna to avoid the proposal area. The extent of these impacts will be localised to the immediate surrounding area of the MLs.

4.2.3 Mitigation

Potential impacts to flora and fauna associated with land clearing, weed and fire management, noise and dust, will be mitigated by industry standard controls under an approved MMP.

In the event that *Stylidium ensatum* is identified in the proposal area, consideration will be given to avoiding the plants. If impact cannot be avoided, then an assessment will be undertaken to determine if there will be a significant impact on the population. Offsets may be required if a significant impact cannot be avoided. The survey methods to be adopted and any subsequent mitigation measures will be determined in consultation with NTG.

To minimise the potential for AMD, WRD and TSF landforms will be designed by appropriately qualified engineers in accordance with accepted industry guidelines and standards. Material characterisation, material handling, backfill placement and strategies to flood remaining existing open pits with water will minimise the likelihood of AMD affected pit water quality, thus reduce potential impacts to fauna utilising the pit water. Potential AMD impacts and mitigation is further discussed in section 4.4.

4.2.4 Assumptions

The key assumptions made in assessing potential impacts on terrestrial ecosystems are:

- The WRD and TSF landform designs and open pit lake closure designs will provide for effective long-term prevention and/or containment of AMD. Riparian ecosystems are unlikely to be impacted by the proposal if AMD is effectively prevented and/or contained.
- Rehabilitation of the mine site will occur to make the site safe and stable; however, it has been assumed that habitat values will not return to the area due to the long-term presence of the mining landforms.

4.2.5 Relevant policy and guidance / industry standards

The relevant policy, guidance and industry standards that have been considered in relation to terrestrial ecosystems include:

- Department of the Environment and Natural Resources (2019). *Land Clearing Guidelines*.
- Department of the Environment, Water, Heritage and the Arts. (2013). *Significant Impact Guidelines regarding Matters of National Environmental Significance*.
- Northern Territory Environment Protection Authority (NT EPA). (2013). *Guidelines for Assessment of Impacts on Terrestrial Biodiversity*.
- Commonwealth of Australia. (2016). *Biodiversity Management*, Leading Practice Sustainable Development Program for the Mining Industry.

4.2.6 Consultation

EcOz contacted NTG Flora and Fauna Division to ascertain whether the surveys undertaken in LES 2016 and 2017 were of an acceptable standard and breadth. The fauna component of those surveys was considered adequate and no further surveys were required. Gaps were identified in the flora component, and further survey requirements were identified for two threatened flora species – *Helicteres macrothrix* and *Stylidium ensatum*. Prior to commencement of surveys for these species, EcOz confirmed their survey methodology with the NT Herbarium.

Post-survey, samples of the *Helicteres* species were provided to NT Herbarium and subsequently confirmed to be the common *Helicteres darwinensis*, and not the threatened *Helicteres macrothrix*.

4.2.7 Cumulative impact

The proposal will contribute to cumulative loss of native vegetation in the region through land clearing. Nearby quarry activities are the other key source of vegetation/habitat loss. Because the region is dominated by pastoral land use and national park, cumulative land clearing impacts are considered unlikely to impact terrestrial ecosystems.

Increasing areas of disturbed land will increase the prevalence of weeds and subsequent fire risk.

The presence of multiple mining activities in the upper Mount Bunday Creek catchment has the potential to indirectly stress riparian vegetation in Mount Bunday Creek, from alteration of water quality associated with AMD. The cumulative impact on water quality in the Mount Bunday Creek is discussed further in section 4.4.

4.2.8 Ecologically sustainable development

The principle of evidence based decision making has been adopted by undertaking targeted threatened species surveys of the presence/absence of *Helicteres macrothrix* and *Stylidium ensatum* during mine planning.

The precautionary principle has been adopted by acknowledging the uncertainties that exist in relation to the assessment of potential indirect impacts and risks associated with AMD. To reduce uncertainty, a waste characterisation of materials and classifications of volumes will be assessed from recent drilling undertaken by PGO. This will inform the AMD Management Plan, which will detail the testing standards during operations, expected volumes of PAF material and adequate management.

4.2.9 Residual impact

Disturbance from land clearing will be localised. Rehabilitation during the mine closure may return some habitat value to the site; however, the species composition and structure will not return to pre-mining

conditions. The presence or absence of the threatened flora *Stylidium ensatum* is to be verified during a targeted survey planned early dry season 2021. Irrespective of the targeted field survey results it is considered that the proposed action is unlikely to have direct significant impact on terrestrial ecosystems, subject to effective implementation of the mitigation measures discussed above.

Weeds will invade disturbed areas and are likely to be a long-term feature of the post-mining landscape. This impact is expected to be localised to within and immediately surrounding the mine site footprint, as is the case on other mine sites in the region.

There is uncertainty about the potential for impacts downstream riparian habitats associated with cumulative impacts from alteration of water quality flowing into Mount Bunday Creek and Marrakai Creek tributaries during mining and post-closure.

4.3 Hydrological processes

NTEPA Environmental Objective:

Protect the hydrological regimes of groundwater and surface water so that environmental values are maintained.

4.3.1 Receiving environment – Surface water

The Rustlers Roost site is located on a catchment divide. The eastern portion of surface water flows drain to the Mary River catchment via Mount Bunday Creek; and the western portion of flows drain into the Adelaide River via an unnamed tributary of Marrakai Creek (CDM 2019c).

The Rustlers Roost catchment is comprised of a series of ridges and dissected hills, which are drained by small steep rivulets. These systems converge into a single creek channel in the south-east of the site. The mining area has a small external catchment area of around 2.2 km².

The Q29 proposal area is located on the boundary of two upper sub-catchments within the Mary River regional catchment. The main catchment encompasses two drainage lines flowing south through the site, converging into one drainage line that flows south-east off the tenement boundary and in an easterly direction towards the McKinlay River.

All waterways within the Proposal area are ephemeral. Flows are intermittent and occur in direct response to rainfall. Stream flows predominantly occur during the wet season months from late November (first-flush) to April (recessional flows), with sustained creek flows for approximately four months (December to March). There are no permanent pools located within the Proposal areas during the dry season; however, isolated pools remain during early dry season further downstream in the catchments. Catchment boundaries and drainage lines are shown in Figure 2-3.

Mount Bunday Creek

Surface hydrological regimes in Mount Bunday Creek are not significantly altered by any existing land use in the catchment, which is limited to pastoral grazing and the Mary River National Park. Past mining activities are unlikely to have significantly altered flows in any of the creeks downstream because those activities affect relatively small areas of land in the upper parts of the catchment that are a relatively minor contributor to stream flows.

66 % (or 4.9 km²) of Rustlers Roost MLN1083 and all of Q29 ML29782 (0.8 km² proposed camp area) sits within the headwaters of the Mount Bunday Creek catchment. Approximately 3.5% (or 0.1 km²) of Q29 MLN29783 (northern area heap leach infrastructure) drains north into Charlies Creek, a tributary of the upper Mt Bundy Creek, upstream of the Rustlers Roost Mine. The proposal area covers 3.5% (or 5.8 km²) of the total ~170 km² catchment area of the Mount Bunday Creek.

Mount Bunday Creek is currently used as stock drinking water during the wet season, and the wet season flows and dry season pools support riparian and aquatic ecosystems. The nearest permanent billabong

thought capable of providing suitable habitat for aquatic fauna is situated 12 km north-east of the Rustlers Roost. This waterbody is not connected to any watercourse that drain the Proposal areas.

Marrakai Creek

34 % (or 2.6 km²) of Rustlers Roost MLN1083 (the western portion) sits within the headwaters of the Marrakai Creek catchment. The main ephemeral drainage line that receives surface water flows from the proposal area has been dammed to create Annie's Dam, previously built as a pastoralist dam. The dam has a surface area of approximately 11 ha and without extraction, retains water throughout the dry season.

Surface water flows from this area, flow west into minor unnamed ephemeral drainage lines, which during the wet season flow into Marrakai Creek proper approximately 6 km downstream. Marrakai Creek discharges into the upper tidal reaches of the Adelaide River approximately 35 km downstream of the Proposal area.

McKinley River

The remaining 96.5% (or 2.75 km²) of Q29 MLN29783 falls within the McKinley River catchment. Unnamed ephemeral drainage lines downstream of the site discharge to the east through floodplains towards the McKinley River main branch, which is approximately 15 km downstream of the Proposal area. From this location, the McKinley River flows north and discharges to the Mary River.

Beneficial uses

The Mary River regional catchment has declared 'beneficial uses' under the *Water Act*. The Mary River beneficial uses declaration (BUD) covers Rustlers Roost (with the exception of the western catchment encompassing Annie's dam) and Q29 ML's. The declared beneficial uses for the Mary River surface water catchment are environment, riparian and cultural. These uses rely on the maintenance of stream flows and good water quality. The potential impact of mining activity on declared beneficial uses is taken into consideration by the NT Government when making decisions in relation to project approvals.

The proposal areas are not directly covered by the Mount Bunday Creek BUD, the BUD commences approximately 13 km downstream of the proposal areas. The declared beneficial uses for Mount Bunday Creek are aquatic ecosystem protection (for the upper and lower creek sections), and stock water supply for the middle 7.8 km section of the creek (downstream of Toms Gully Mine east of the Arnhem Highway).

Surface water users

The Proposal area is located on pastoral leases with existing pits and dams that may be accessed by stock and fauna for drinking water. Flows in watercourses or permanent waterholes downstream of the mine sites, may also be access by stock and fauna. There are no know direct surface water users within the 5 km radius of the Proposal areas.

4.3.2 Receiving Environment - Groundwater

Groundwater information available for the proposal area is limited to regional-scale aquifer information available from Tickell 2019 and historical site-specific information from previous operators of Rustlers Roost, Valdora (1994) and Greenbase (1997). Groundwater Enterprises (2020) was commissioned to prepare a groundwater investigation plan for the proposal area (Appendix E). A network of groundwater monitoring bores, as recommended by Groundwater Enterprises (2020), was installed during October 2020. Baseline groundwater monitoring will be undertaken on these investigation bores, which will provide site-specific data on groundwater levels, flow directions, connectivity with surface water and water quality.

Rustlers Roost

Groundwater Enterprises (2020) outlines that aquifers beneath the Rustlers Roost lease are associated with fracturing/structural permeability within the metasediments of the South Alligator Group and Burrell Creek Formation. These aquifers are mapped at a local scale (Ticknell 2019). Regional data suggests typical bore

yields in the Mount Bonnie Formation range from 0.5 – 2 L/s away from major structural features and 0.5 – 5 L/s along major faults or shear zones (Valdora, 1994).

A potentiometric surface developed using surveyed water levels in mineral holes pre-mining in 1993, indicates the regional groundwater flow direction towards the east/north-east towards the Mary River and local flow directions following the natural surface gradient (Valdora, 1994). The aquifer response from a short-term (26 hour) pumping test completed prior to mining (Valdora, 1994) showed confined to semi-confined conditions with a transmissivity range of 71 – 107 m²/day and a storativity range of 2×10^{-3} – 10^{-5} (Groundwater Enterprises 2020).

NRMaps indicates seven registered bores were drilled along the eastern boundary of MLN1083 for Valdora Mining during 1994. A bore search undertaken during 2016 could not locate any of the historical registered bores. Bore completion depths ranged from 61 to 86 m; SWL ranged between 11 to 23 mBGL and yield ranged from 1.5 L/s to 20 L/s. Desktop assessment of the groundwater by CDM Smith (2019) identified one existing groundwater sampling point (MB1), located downstream of the heap leach pad. MB1 is not a registered bore and there is no bore development report available. There are no other bores located within 5 km of the lease.

Q29

Groundwater Enterprises (2020) indicates that there is limited groundwater information available onsite or in the immediate vicinity of the lease. Regional scale mapping suggests aquifers across the lease are local scale systems in fractured and weathered rocks with expected bore yields of 1-3 L/s in the metasediments and <0.75 L/s in the Mt Bundy Granite (Ticknell, 2019). Higher permeabilities are likely associated with structural deformation within the metasediments/dolerite (Sirocco, 1999) and at local scale (Groundwater Enterprises 2020).

NRMaps records show four registered bores at Q29 ML29783 were historically drilled for mining purposes. Three of these bores (drilled in 1976) were not located during a bore audit undertaken in 2016. The fourth bore, drilled during 1999 for Sirocco Resources was located immediately north-west of the existing heap leach ponds, and is monitored as part of the Q29 groundwater monitoring program (GWB01). Bore completion depths ranged from 17 to 27 m; SWL is artesian to 10 mBGL and yield ranged from 0.25 L/s to 10 L/s. An unregistered bore (GWB02) located to the south-west of the heap leach ponds is also included in the Q29 groundwater monitoring plan.

There are five registered bores within a 5 km radius of Q29, all bores are associated with mining activities and are either historical investigation holes or monitoring sites. The closest registered bores not associated with mining is a pastoral bore (RN036401) located 6 km north-east of the lease (Groundwater Enterprises 2020).

There is no groundwater flow information available, however it is assumed to broadly reflect the topographic gradient and surface flows, flowing towards Charlies Creek in the north and the remainder of the site flowing south.

A number of shallow historic mining pits present at Q29 hold water from a combination of rainfall, surface water runoff and potentially groundwater.

Beneficial Uses

The Mary River groundwater management zone (encompassing the eastern portion of Rustlers Roost and the entirety of Q29) has declared 'beneficial uses' under the *Water Act*. The defined beneficial uses are environment, riparian and agriculture.

Groundwater users

The nearest identified groundwater users include the Old Mount Bundey Station/Quarry, Goanna Park and McKinlay River Station. All of these users are located greater than 5 km in distance from the proposal areas and are therefore their groundwater supplies are unlikely to be affected by the proposal activities.

Groundwater Dependent Ecosystems

There are no recorded GDE's within the Q29 leases. The GDE atlas (BOM 2020) maps a low-moderate potential for terrestrial GDEs at two locations on ephemeral watercourses that drain north of the lease (ML 29783) between 2 to 3 km downstream from the lease boundary (Groundwater Enterprises 2020).

There are no recorded GDE's within the Rustlers Roost leases. The GDE atlas (BOM 2020) maps a moderate potential for terrestrial GDEs along watercourses that drain north of the lease boundary (ML1083). These occur around 1 to 2 km downstream from the lease boundary (Groundwater Enterprises 2020).

4.3.3 Potential impacts

The proposal could have the following potential impacts on hydrological processes:

- Alteration of surface flows
- Flooding
- Drawdown of groundwater levels in aquifer.

The sections below consider the severity and extent of these impacts and implications for protection of environmental values.

Alteration of Surface Flow

The Rustlers Roost and Q29 sites are not likely to significantly impact surface water flows downstream in Mount Bunday Creek, Marrakai Creek or McKinley River. This is because the proposal area is located in the headwaters of upper catchment areas, where surface water inputs from the minor ephemeral drainage lines (stream one order) contribute a very small portion of the overall catchment flows. At Rustlers Roost, the proposed TSF footprint intersects a minor drainage line within the upper Mount Bunday Creek catchment and Annie's Dam intersects a minor drainage line within the upper Marrakai Creek catchment. At Q29, the most southern pits are sited over two minor drainage lines in the McKinlay River catchment.

Localised alteration of flows to the ephemeral drainage lines will occur associated with developing new mine infrastructure, dewatering of existing pit lakes and expansion of existing pits. Some of the direct rainfall into the proposal area that under natural conditions would either seep into the ground or runoff into drainage lines, will be retained in pits or other structures on site, whilst 'clean' stormwater will be captured in sediment basins and discharged. This will result in reduced runoff occurring within the immediate sub-catchment, but is not expected to have any measureable impact on surface flows in the creeks and rivers downstream.

Discharge of excess water to Mount Bunday Creek from pit dewatering is not likely to be consequential due to the downstream Mary River Floodplain receiving large volumes of water during the wet season. The water released will be a combination of intercepted surface flows, rainfall and groundwater dewatered from the open pits to allow for mining. Discharges will be controlled and timed to ensure that the volumes released do not significantly alter stream flows to a point that causes scouring or overtopping of the banks.

Flooding

Positioned in the upper headwaters, the sites are unlikely to be impacted by flooding. Surface water flow is expected to peak and subside rapidly after rainfall events.

Flooding analysis by CDM Smith (2019c) found that (with the existing infrastructure) the Rustler's Roost site is unlikely to be affected by flooding, with the undisturbed sections largely free draining, and the disturbed sections draining mostly to the pit.

Flooding modelling developed by GHD (2019b) for existing site infrastructure at Q29 indicates;

- The BHS Pit, South Koolpin and North Koolpin Pits are likely to be unaffected by flood inrush from the adjacent creeks for events up to and including the probable maximum flood (PMF) event.
- The Heap Leach Pad and Leach Ponds are also unaffected by external flooding for events up to the 0.1% AEP flood event.

- The Taipan Hill Pit and Zamu Pits are flooded from external sources for all the events analysed, having been constructed on a drainage line.
- Flow velocities are generally low around the pits, except at those locations where the pits are overtopped.

Drawdown of groundwater aquifers

Dewatering of the mine pits during operations and extraction of groundwater as a water supply, has potential to drawdown the water levels in the groundwater aquifer. Typically, these types of activities can create a drawdown cone of depression that alters groundwater flows and lowers of groundwater levels for some distance around the open pits and bores. CDM Smith (2019c) determined that the pit lake acts as a hydraulic sink for a large portion of the disturbed catchment, meaning that the pit lake water evaporates faster than the influx of water (rainfall, runoff and groundwater ingress). There is uncertainty in regards to groundwater drawdown that could occur during mining, and the time it will take for groundwater levels to recover post-mining.

Groundwater recovery post-mining will be verified by groundwater modelling. Historic survey data of the pit shell was derived at the cessation of mining in 1997 and survey level data (mRL) sourced from a CAD file, and climate (rainfall and evaporation) data sourced from SILO data was used to develop a pit lake storage curve and pit surface area curve. The data shows, from an empty pit shell in 1997, a steep increase in water level (15 m over the initial 3-4 years), contributed due to limited surface area for evaporation. A more gradual increase in water volume occurred with a larger pit lake surface area, reaching a dynamic equilibrium between 56 m AHD (3 GL) and 62 m AHD (4.5 GL).

Groundwater drawdown associated with the mining activities is unlikely to affect any other groundwater users because the closest user is 5 km away, and therefore outside the area that any drawdown would be expected to affect. Desktop studies have not identified any GDE's in proximity to the site that would be affected by groundwater drawdown. As the level of connection between groundwater and surface water flows in the area is not yet determined, the extent to which any drawdown would impact surface water flows in ephemeral drainage lines is uncertain.

The plan to install investigative and monitoring bores, as well as utilising existing bores, on the site will allow for the development of a local groundwater model. This model will allow determination of the extent and depth of any drawdown, sustainable levels of extraction from bores, expected rates of groundwater recovery and surface-groundwater connections.

Current groundwater extraction requirements are currently unknown. A site water balance will be prepared to assess suitable water supply options to meet the forecast water demand of 3.3 GL per year.

4.3.4 Mitigation

Due to the location of the ore bodies and constraints of the ML area available for development, it is not possible to avoid all of the minor drainage lines present in the proposal area. To minimise impacts, the mine site design will incorporate internal stormwater drainage and water storages that will allow for capture and controlled release of excess water during the wet season. The water management system will be designed, based on a site-specific water balance model, to avoid uncontrolled discharges.

Dewatering of pits during operations will only occur during wet season, when stream flows occur naturally. Discharges will be altered with existing creek flow regimes and tapering discharge volumes towards the end of the wet season, reducing potential impacts to natural flow regimes, riparian vegetation and aquatic communities. Wastewater discharges as required for operations will be undertaken in accordance with conditions of an approved Waste Discharge Licence (WDL).

Sustainable levels of groundwater extraction will be determined through groundwater modelling, and any measures required to protect surface and groundwater flows, will be addressed in the Mining Management Plan (MMP). The proposed activities are not located within a Water Control District (WCD) established

under the *Water Act*. As a result, the proposed surface water extraction from Annie's Dam and groundwater bores to supply the mine sites, does not require a licence.

A groundwater and aquatic monitoring program will be developed for implementation during mining to detect changes in groundwater levels and monitor impacts to riparian vegetation and aquatic communities. The monitoring program will allow for adaptive management and/or rehabilitation of damage.

In summary, the following detailed mitigation and monitoring measures will be included for further environmental approvals and the subsequent MMP:

- Site-specific groundwater modelling report including groundwater drawdown contours and assessment of potential impacts to watercourses
- Water Management Plan detailing a groundwater, surface water and aquatic monitoring program, and a Trigger Action Response Plan (TARP).

4.3.5 Assumptions

The key assumptions made in assessing potential impacts on hydrological processes are:

- The zone of potential impact from groundwater drawdown, while currently uncertain, is assumed to be contained mainly within the mining tenements. This is based on the groundwater modelling outcomes of the nearby Tom's Gully mine:
 - o Will not extend to impact other bores, which are located more than 5 km away.
 - o Will not affect any potential GDE's identified in the desktop review. The closest potential GDE is located 1-2 km downstream of Rustlers Roost. If the groundwater modelling determines this area is within the zone of potential impact associated with groundwater drawdown, then ground-truthing will be required to determine if a GDE is present and likely impacts.
- Due to the location at the headwaters of the catchment, any reduction in flows in ephemeral watercourses would be localised and would not affect the higher order watercourses downstream i.e. Mount Bunday Creek, Marrakai Creek and McKinley River.

4.3.6 Relevant policy and guidance / industry standards

- NTG (2020). *NT Water Allocation Planning Framework*.
- ANCOLD (2012). *Guidelines on the Consequence Categories for Dams*.
- *Water Act 1992*.
- Commonwealth of Australia. (2016). *Water Stewardship*, Leading Practice Sustainable Development Program for the Mining Industry.

4.3.7 Consultation

No consultation has been undertaken to date with regard to hydrological processes, directly associated with this proposal.

4.3.8 Cumulative impact

Cumulative discharges from Rustlers Roost and the downstream Toms Gully Mine is not likely to impact the hydrological processes as discharges will be proportional to flows occurring in the Mount Bunday Creek Catchment. Mount Bunday Creek is a higher stream order, has intact riparian vegetation and able to withstand high flows throughout the wet season, and is expected very little erosion beyond natural occurrence will occur (Aquatic Ecology Services 2019).

4.3.9 Ecologically sustainable development

The precautionary principle has been adopted by acknowledging assumptions and uncertainties that exist in relation to understanding of groundwater hydrogeology and how this will be impacted by the proposal. To verify assumptions and reduce uncertainty, a network of investigation bores has recently been installed and a groundwater model will be developed that will enable prediction of potential drawdown impacts to nearby watercourses and understand potential pit dewatering requirements during operations.

The principle of sustainable use has been considered by incorporating water reuse into the mine site design. Process water from the TSF will be returned to the processing facility and water dewatered from the mine pits will be used for dust suppression. This will reduce the overall requirement for raw water extraction from groundwater bores.

4.3.10 Residual impact

Localised reduction of surface water flows will occur along short sections of stream lines located within and downstream of the ML's as a result of water being retained within the mine sites and Annie's Dam and/or associated with reduce groundwater expression into surface water courses. The reduction in flow is expected to be minor and localised due to the location in the upper catchment and therefore, relatively small contribution of the ephemeral drainage lines to downstream flows. The availability of water for use by cattle, riparian vegetation and aquatic ecosystems is unlikely to be impacted. Groundwater levels will be lowered around the pits during mining. The extent of the drawdown cone is to be determined by groundwater modelling undertaken during mine planning. It is not expected that there will be any impact to other consumptive users of groundwater due to their distance away from the proposal areas. If there is a connection between the groundwater and surface water systems (to be determined by the groundwater modelling), drawdown could reduce flows in surface water courses; however, the vegetation types present along the drainages do not indicate groundwater dependence and therefore riparian and aquatic habitats are unlikely to be affected.

4.4 Inland water environment quality

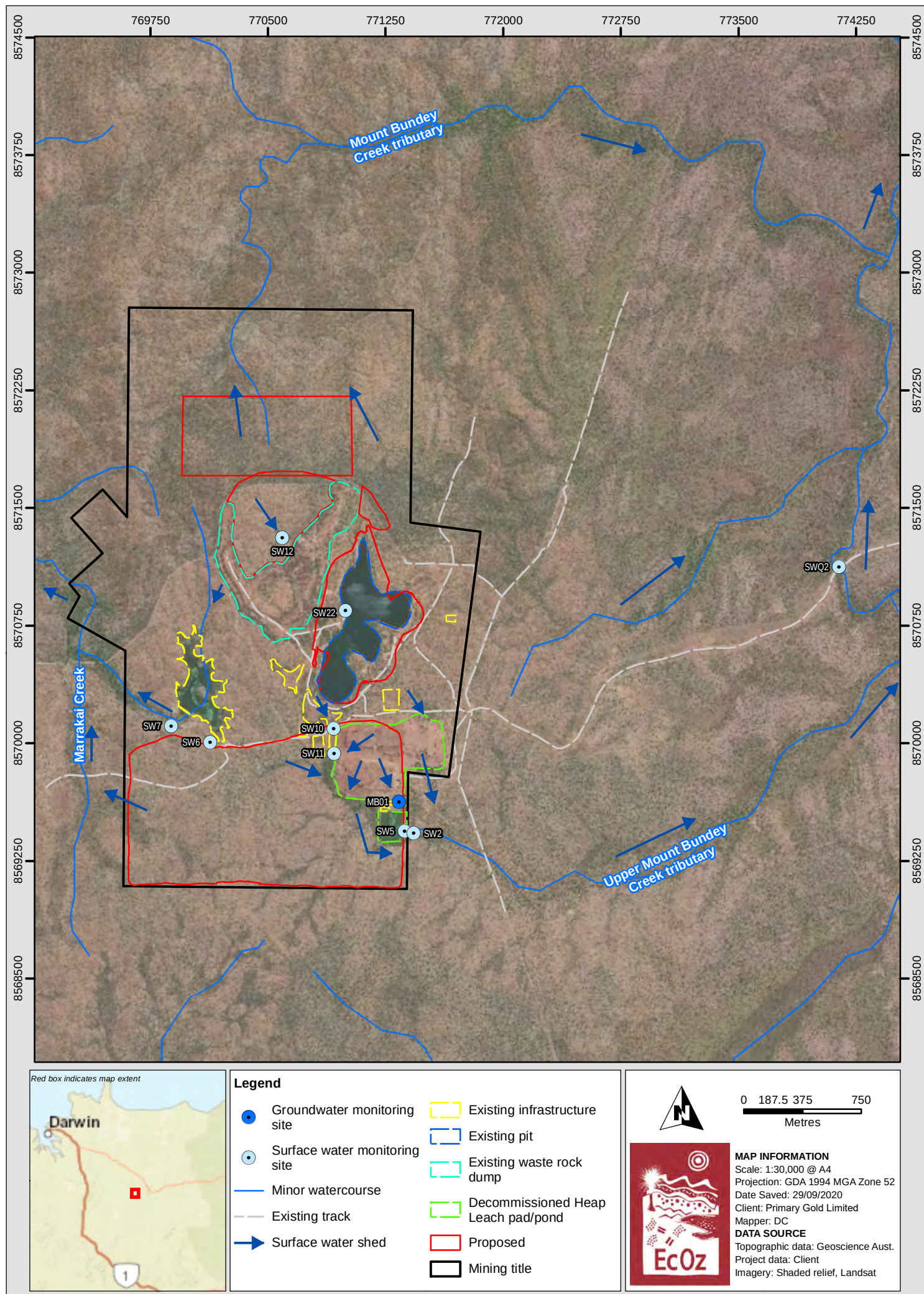
NTEPA Environmental Objective:

Protect the quality of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are maintained.

4.4.1 Receiving environment

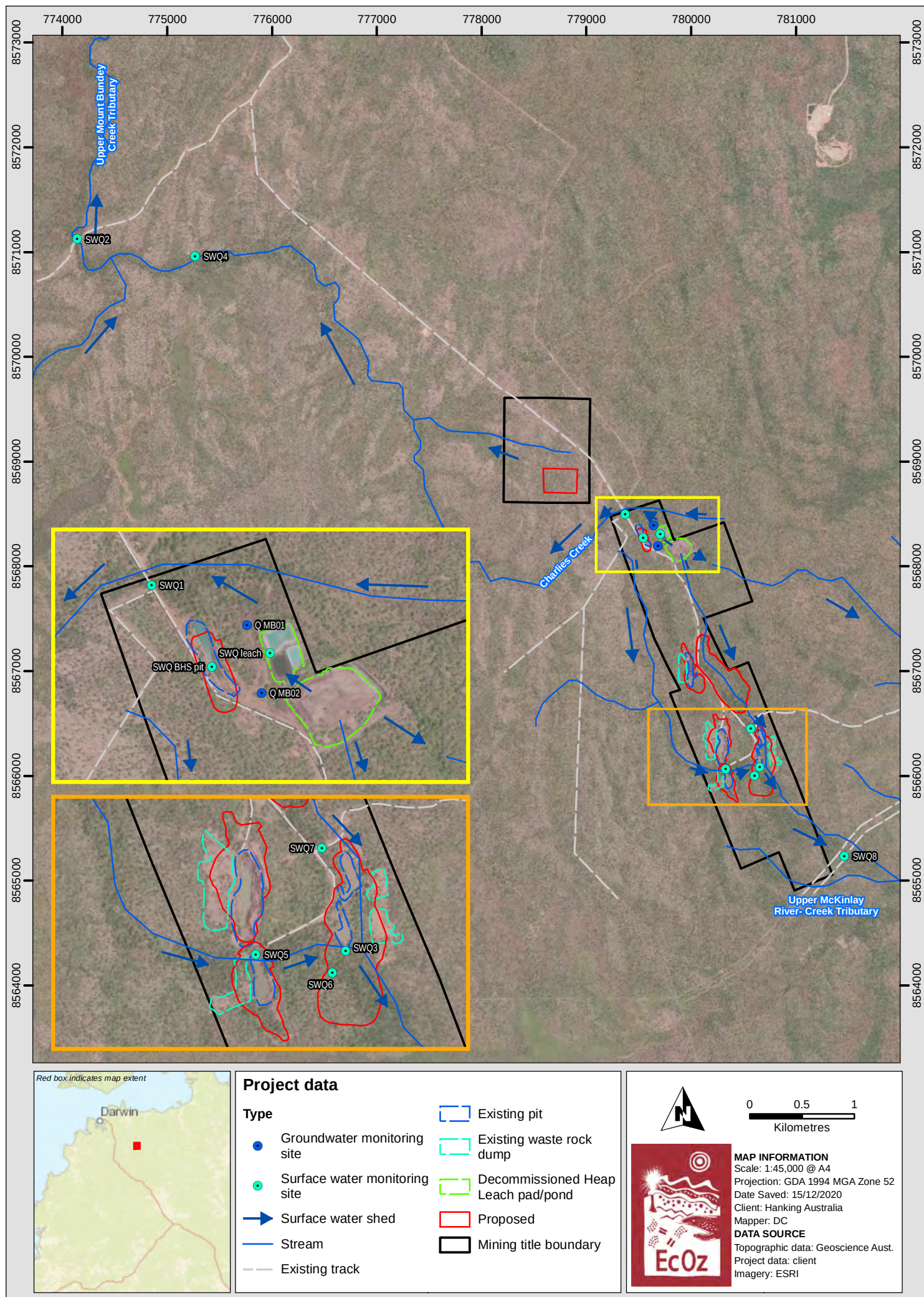
Figure 4-2 and Figure 4-3 provides an overview of the existing surface water and groundwater monitoring locations at Rustlers Roost and Q29 respectively. This monitoring program includes site-specific guideline values (SGVs) developed based on the Australian and New Zealand Environmental Conservation Council (ANZECC) Ecosystem protection guideline values (95%) (Ecosystem protection GVs), Livestock Drinking Water Guidelines (SWG) and the 2018 CSIRO Review of Site-Specific Trigger Values (SSTV) for the Tom's Gully Mine (CSIRO 2018). SSTVs for physical parameters (i.e., pH, EC, TSS and turbidity) are based on the 80th percentile of reference site monitoring data.

Water quality of the main water bodies and downstream sites within each receiving catchment are summarised below. Water quality database is presented in of Appendix F and Appendix G.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ20155 - Rustlers Roost & Quest29 - Bore Preparation & Installation Plan\01 Project Files\Map five.mxd

Figure 4-2. Map of Rustlers Roost existing surface water and groundwater monitoring sites



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ20155 - Rustlers Roost & Quest29 - Bore Preparation & Installation Plan\01 Project Files\Map two.mxd

Figure 4-3. Map of Quest 29 existing water quality monitoring sites

Mount Bunday Creek - Mary River

The ANZECC & ARMCANZ (2000) Guidelines for fresh and marine water quality set varying GV levels of ecosystem protection derived from local reference data that should aim to:

- Maintain the existing ecosystem condition; and/or
- Enhance the modified ecosystem (by targeting the most appropriate condition level).

The Mount Bunday catchment ecosystem condition is a highly disturbed environment. Modification of water quality is due to the long history of anthropogenic activities and typical tropical ecosystem characteristics, such as the wet-dry climate. The catchment is classified as 'tropical lowland rivers and streams' and aquatic ecosystem protection is the dominant environmental value (CSIRO 2018). The ANZECC (2000) freshwater ecosystem protection guideline value of 95% has been implemented to assess water quality within and downstream of the proposal area with SSTV's derived for the Tom's Gully Mine (CSIRO 2018) for physical parameters (i.e., pH, EC, TSS and turbidity), based on the 80th percentile of reference site monitoring data within the Mount Bunday Creek.

The surface water quality downstream of Rustlers Roost mining infrastructure is impacted with exceedances of ecosystem protection GVs of some metals and varies from slightly acidic to neutral pH.

Rustlers Roost Pit lake water quality (SW22) is considered "clean" water, with a pH range 6.4 to 7.1 and Electrical Conductivity (EC) range 21 to 27 $\mu\text{S}/\text{cm}$. All dissolved metals were within ecosystem protection GVs with the exception of slight exceedances in Zn (0.018 mg/L) compared to the ecosystem protection GVs of 0.008 mg/L; however, is within the CSIRO SSTV of 0.031 mg/L.

SW2 is located on Rustlers Roost (MLN1083) south-eastern tenement boundary downstream of the decommissioned heap leach pads and ponds. pH ranges from slightly acidic (6.4) to neutral (7.4) and EC remaining below the ecosystem protection GV of 250 $\mu\text{S}/\text{cm}$. On occasion, there were elevations in dissolved metals outside the ecosystem protection GVs including Al, As, Fe and Ni.

SWQ2 is located downstream of Rustlers Roost and Q29 ML29783 and ML29782 within the unnamed tributary of the Mount Bunday Creek. pH ranges from slightly acidic (6.3) to neutral (7.3) and EC remaining well below the ecosystem protection GVs of 250 $\mu\text{S}/\text{cm}$ with a maximum of 43 $\mu\text{S}/\text{cm}$. All dissolved metal parameters are within the ecosystem protection GVs apart from Al on all sampling occasions and Cu and Zn on one and two sampling occasion respectively.

SWQ1 is located on the Q29 ML29783 northern tenement boundary, within Charlies Creek, a tributary of the Mount Bunday Creek. SWQ1 is immediately downstream of the Q29 decommissioned heap leach pad and ponds and BHS pit. pH ranges from slightly acidic (6.3) to neutral (7.4) and EC range of 78 to 456 $\mu\text{S}/\text{cm}$ exceeding the ecosystem protection GVs of 250 $\mu\text{S}/\text{cm}$. There were multiple exceedances in ecosystem protection GVs of Al, Cu and Zn and on one sampling occasion for Pb.

SWQ4 is located downstream of Q29 ML29783 and ML29782, downstream of SWQ1 within Charles Creek. pH ranges from slightly acidic (6.1) to neutral (7.0) and EC range of 12 to 44 $\mu\text{S}/\text{cm}$. All dissolved metal parameters are within the ecosystem protection GVs, SWGs and SSTV with the exception of Al and on one sampling occasion for Pb.

Marrakai Creek– Adelaide River

The water quality at the Annie's dam spillway (SW6) and downstream of the spillway within an unnamed tributary of the Marrakai Creek (SW7) is slightly acidic with a mean pH of 5.88, and a range of 4.3 to 6.3; and low EC average of 20 $\mu\text{S}/\text{cm}$ and a range of 10 to 49 $\mu\text{S}/\text{cm}$. The acidic pH value of 4.3 was recorded during December 2016 and may be attributed to a first flush event. There were also the occasional exceedance of the ecosystem protection GVs for dissolved metals (Al, Mn, Ni and Zn). This indicates that water quality may be influenced by past mining activities.

McKinley River- Mary River

The receiving unnamed ephemeral drainages within Q29, flows into the McKinley River discharge into the Mary River. The BUD objectives for Mary River surface waters are aquatic ecosystem protection specified the Australian Water Quality Guidelines for Fresh and Marine Waters (ecosystem protection GVs).

SWQ8 is located in an unnamed creek tributary of the McKinlay River catchment downstream of the existing four open-cut pits and WRDs in the south of ML29783. Water quality, based on limited sampling occasions (two) indicate water quality within the ecosystem protection GVs, is slightly acidic (6.39 to 6.6), with an EC range of 20 to 34 $\mu\text{S}/\text{cm}$ and no exceedances of dissolved metals. Based on the limited data the water quality is stable with minimal changes in quality, however the water quality data is not sufficient to determine if this is a constant.

Groundwater quality

Due to the lack of existing groundwater monitoring bores at the proposal areas, knowledge of existing groundwater quality is deficient. There is currently one groundwater monitoring site (MB01) at Rustlers Roost and two bores at Q29 (Q29MB01 and Q29MB02). These bores are located within proximity to the heap leach facilities. The water quality results indicate that this groundwater has been impacted by historical mining activities.

Background groundwater quality at Rustlers Roost from historical bore reports with available water quality data (five bores drilled in 1994 and one bore drilled in 1985), indicate fresh water quality with an average pH of 6.8 and EC of 114 $\mu\text{S}/\text{cm}$. MB01 at Rustlers Roost is located between the heap leach pad and ponds. Water quality from two sampling occasions indicate pH values are slightly acidic, ranging between 5.9 to 6.2, EC is low (110 to 140 $\mu\text{S}/\text{cm}$) and exceedance of the ecosystem protection GVs of Zn and Ni.

Background groundwater quality at Q29 from historical bore reports with available water quality data (one bores drilled in 1999 and two bores drilled in 1976), indicates that groundwater is fresh and good quality, with an average pH of 7.06 and an EC of 262 $\mu\text{S}/\text{cm}$.

The bore Q29MB01 (RN32317) is located in the north-west of the heap leach ponds at Q29. Recent monitoring results show elevated EC and dissolved metals indicative of mining influence, likely seepage from the heap leach ponds. pH values range between 6.09 to 7.33, and elevated EC, well above the ecosystem protection GVs of 250 $\mu\text{S}/\text{cm}$ (ranging from 210 to 1213 $\mu\text{S}/\text{cm}$) and exceedance of the ecosystem protection GVs of Al, As, Cd, Cr, Cu and Zn.

Q29MB02 located west of the heap leach ponds and pad at Q29, has had elevated EC and occasional exceedances of the ecosystem protection GVs of As, Cd, Cr, Cu, Pb and Zn. pH values range from acidic (6.49) to neutral (7.6), and elevated EC, above the ecosystem protection GVs of 250 $\mu\text{S}/\text{cm}$ (ranging from 210 to 336 $\mu\text{S}/\text{cm}$). Indicating that groundwater is influenced by mining activities.

4.4.2 Potential impacts

The proposal could have the following potential impacts on inland water environmental quality:

- Increased turbidity in downstream watercourses from erosion and sedimentation.
- Contamination of surface water and groundwater aquifer by acid and metalliferous drainage (AMD).
- Bacterial contamination due to leaks from onsite wastewater management systems
- Hydrocarbon and other chemical contamination due to leaks and spills.

The sections below consider the severity and extent of these impacts to groundwater and surface water and the implications to ecological health, land use and the welfare and amenity of people.

Increased turbidity in downstream watercourses from erosion and sedimentation

Turbidity in the watercourses downstream of the proposal area (Mount Bunday, McKinlay and Marrakai catchments) could be increased through erosion of exposed surfaces from land clearing, erosion of land forms and dewatering and discharge of mine water off site. The existing heap leach pads are heavily eroded

landforms as they have been previously crushed and processed materials, and localised erosion and sedimentation is evident. During operations, it is expected that surface water run-off within the proposal areas will contain increased levels of suspended sediments without appropriate controls.

Contamination of surface water and groundwater by AMD

Water quality in minor streams discharging to the Mount Bunday, McKinlay and Marrakai catchments could be impacted by poor quality mine drainage. Groundwater underlying the area could also be impacted by poor quality seepage from the WRD expansion and TSF, and historic heap leach infrastructure. The risk of AMD, NMD and SD associated with the proposed action is currently uncertain and will depend on the volumes and characteristics of PAF materials and how these materials are managed on site. Further geochemical characterisation of waste rock and ore will determine material types and anticipated volumes, and the landform designs and AMD Management Plan will be informed by this data. To prevent contamination of surface water and groundwater, the mine site design will need to provide for long-term prevention and/or containment of AMD.

If AMD is released from the site, then the surface water in Mount Bunday Creek and Marrakai Creek could be contaminated with metals, making the water unsuitable for stock and impacting aquatic ecosystems. Groundwater could be contaminated, making it unsuitable for future use as a stock water supply or for other land uses. Impacts to the regional Mary River and Adelaide River catchments is unlikely due to the large volumes of water shed and dilution within the regional catchment.

The Rustlers Roost pit lake post-closure, left, as a void may potentially become impacted by AMD as the pit void recharges with surface water catchment and groundwater inflows. The predicted pit water quality at post closure is currently unknown and will be determined by the results of the geochemical characterisation program and geochemical modelling. Whether the pit acts as a terminal sink or groundwater recharge will determine the likely extent of impacts to groundwater quality.

Bacterial contamination due to leaks from onsite wastewater management systems

There is potential for minor exceedances of water quality criteria caused by leaks from the wastewater management systems into groundwater. Given the relatively small scale of the wastewater disposal systems and absence of other water users, any impact would be minor.

Hydrocarbon and other chemical contamination due to leaks and spills

Hydrocarbon contamination of surface water or groundwater could be caused by leaks and spills from bulk diesel fuel storages or run-off from workshop/parking areas. Diesel powered machinery and equipment will be primarily utilised in the dewatering and mining processes. The risks of hydrocarbon contamination to land and soils were discussed in detail in section 4.1, which concluded that there is a potential for soil contamination on a localised level if chemicals and hydrocarbons are not adequately stored and cleaned up in the event of a spill or leak being identified.

Chemical contamination due to the types of chemicals required for processing activities (such as cyanide), and quantities required to be used on site, pose a higher risk to surface water and groundwater. Chemicals to be stored on site are listed in section 1.5.15.

4.4.3 Mitigation

Increased turbidity in downstream watercourses from erosion and sedimentation

The potential for erosion within the mine site will be minimised by adopting appropriate design criteria for expansion components (i.e., TSF, processing plant, WRD expansions, Pit expansions, camp facilities and haul route). Details of the construction operation erosion control measures and maintenance of existing controls will be provided in an Erosion and Sediment Control Plan (ESCP) developed in accordance with the *Best Practice Erosion and Sediment Control Guidelines* (IECA, 2008).

Rustlers Roost pit dewatering during operations will occur with in-pit sumps directly into a turkey's nest to be used for dust suppression. Excess water will be directed to the proposed raw water dam (Annies Dam) to be used for process water and excess water discharged under an approved operational WDL in accordance with the WDL conditions. The MMP and associated Water Management Plan will specify routine control measures that will provide for detection of turbidity impacts and corrective actions to mitigate potential impacts.

Approval to discharge Rustlers Roost pit lake prior to operations is currently being sought independently to this referral through a MMP amendment under the *Mining Management Act*, and a Waste Discharge Licence (WDL) under the *Water Act*. Discharge of water will be managed in accordance with an approved WDL conditions, discharge plan, and construction and maintenance of erosion and sediment control measures.

Contamination of surface water and groundwater by AMD

The key mitigation measure to avoid the potential for AMD is limiting exposure of PAF material to atmospheric oxygen and water. Designing the TSF and WRD to adequately contain PAF material is a key mitigation measure. Key design measures include lining the TSF underdrainage, placement of benign NAF material on the outer annulus, slopes and batters of the WRDs, encapsulating the PAF in the central areas of the WRD and backfilling PAF within pits, covering with oxide material or water at depth. Materials characterisation testing will be undertaken on the 2018 Rustlers Roost drilling programme and the August 2020 drilling programme at Rustlers Roost and Q29. The program will target oxide, transitional and fresh material, and various lithologies of both waste and ore. Characterisation of the waste will identify any problematic material (PAF), allow AMD block models of the resource to be developed, and provide an estimate of anticipated volumes of problematic material, which will all be used to develop management strategies for that material within the WRD and/or backfilled within the pit. Geochemical classification of the ore material will provide an indication of the tailings characteristics and identify the requirements for tailing dam design, tailings management during operations and closure.

As part of the approvals process, surface water and groundwater baseline monitoring will be undertaken for a minimum of 6-months to establish a baseline understanding of the proposal specific characteristics in terms of inland water environmental quality. Groundwater Enterprises (2020) conducted a review of the existing groundwater desktop assessment (CDM Smith 2019a), available information and proposed mining infrastructure, and provided a recommendation for seven monitoring bores to be installed at each site. Water quality monitoring will be on going throughout operations for early detection for potential AMD issues; during closure to ensure remediation is undertaken; and post-closure to monitor rehabilitation successful.

Geochemical modelling of the Rustlers Roost pit lake post closure, will be undertaken to predict the water quality of the pit lake. Results of the geochemical characterisation program and groundwater model will be used to assess this. In the event the geochemical modelling determines AMD impact, options to manage the risk such as water treatment, rapid flooding and/or further re-handling of waste material to partially backfill the exposed PAF walls of the pit and subsequent flooding, will be investigated.

MMP and associated water management plan and AMD management plan will specify routine control measures that will provide detection of water quality impacts and corrective actions to mitigate potential impacts.

Bacterial contamination due to leaks from onsite wastewater management system at Rustlers Roost camp facility.

The wastewater system type and design will be based on maximum number of staff onsite during construction / operations and will be installed by a licenced plumber in accordance with the *NT Code of Practice for Onsite Wastewater Management*. The location and design of the system will also be subject to a wastewater works design approval by the NT Department of Health pursuant to the *Public and Environmental Health Act*.

Hydrocarbon and other chemical contamination due to leaks and spills.

All hydrocarbons and chemicals will be stored in accordance with Australian Standard 1940:2017, the NT *Dangerous Goods Act 1998*, the NT *Work Health and Safety (National Uniform Legislation) Act 2011* and to the *Leading Practice Handbook for Sustainable Mining - Cyanide Management*. During closure all hydrocarbons and chemicals will be removed from site. MMP and associated Hazardous materials storage management plan and Emergency Response Plan will specify routine control measures, spill response, early detection of leaks and spills and corrective actions to mitigate potential impacts.

4.4.4 Assumptions

The key assumptions made in assessing potential impacts on inland water quality are:

- The WRD and TSF design and construction strategies will provide for effective long-term prevention and/or containment of AMD.
- Erosion risks associated with early or unexpected closure, would be addressed to the satisfaction of DITT through the MMP process.
- A Mine Closure Plan will be developed and implemented to make the site safe, non-polluting and mitigate long-term impacts.
- Storage and handling of processing chemicals and hydrocarbons will be in accordance with accepted standards and guidelines.

4.4.5 Relevant policy and guidance / industry standards

- AS/NZS 1547:2012 - *On-site domestic wastewater management*.
- AS/NZS 1940:2017 – *The storage and handling of flammable and combustible liquids*.
- Australia and New Zealand Governments (2011), *Guidelines for Fresh and Marine Water Quality*
- International Erosion Control Association Australia (IECA). (2008). *Best Practice Erosion and Sediment Control Guidelines* – to inform standards for ESCP management.
- Land Capability Guidelines. (2014). *Land Capability Assessment for Onsite Wastewater Management Guidelines*.
- Natural Resources, Environment, the Arts and Sports (2010) - *Water Quality Objective for Darwin Harbour Region*.
- International Network for Acid Prevention (INAP). (2009). *Global Acid Rock Drainage (GARD) Guide*.
- Commonwealth of Australia. (2016). *Preventing Acid and Metalliferous Drainage*, Leading Practice Sustainable Development Program for the Mining Industry.
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- Commonwealth of Australia. (2016). *Water Stewardship*, Leading Practice Sustainable Development Program for the Mining Industry,

4.4.6 Consultation

The Mount Bunday Station pastoralist was consulted regarding the installation of bores.

4.4.7 Cumulative impact

There is potential for cumulative impacts to water quality within Mount Bunday Creek associated with discharges from the Rustlers Roost and Q29 sites, combined with the discharges from the Toms Gully mine site downstream. Indirect stresses on the receiving aquatic ecosystems, riparian habitat and GDE's could occur as a result of multiple mining activities in Mount Bunday Creek catchment. Further groundwater and surface water studies are in progress to determine discharge water quality and to establish Site Specific Trigger Values for discharges that will protect the downstream receiving environment.

4.4.8 Ecologically sustainable development

Decision-making in relation to management of water quality will be informed by the results of baseline studies of surface water, groundwater and water accumulated in the open pit, and geochemical assessments of the waste rock and tailings. It is acknowledged that the WRD and TSF are potential sources of AMD and further work is required to inform land form designs and management strategies that will provide a greater level of certainty that AMD will be avoided and/or contained in the short-term (during mining) and long-term (post-closure). The results of the water and geochemistry studies that are underway will inform an evidence-based approach to decision making about final landform designs and closure requirements.

The intergenerational and intragenerational equity principle will be considered in the mine closure planning. The closure and rehabilitation of Rustlers Roost and Q29 involves the removal of all hydrocarbons, chemicals, wastewater infrastructure and designing of the WRD and TSF to adequately contain problematic waste rock and rehabilitating with native vegetation. The mine closure planning process will need to provide certainty that the mine site will be safe, stable and non-polluting, and does not leave a legacy of pollution.

Consistent with the improved valuation, pricing and incentive mechanisms principle, under the *Mining Management Act*, PGO will be required to pay a security deposit, which is an incentive to achieving mine closure.

4.4.9 Residual impact

The proposed action could result in short-term water quality impacts during construction and mining operations, associated with increased turbidity during the wet season. Subject to successful closure/rehabilitation of the site to stabilise the landforms, there should be no long-term increase in turbidity in downstream watercourses.

Residual impacts to water quality from AMD and/or processing chemicals, will depend on the effectiveness of the mitigation measures proposed to avoid AMD generation and/or contain/treat contaminated water on site prior to release. If AMD or chemicals are released off site, then there is potential for significant long-term impacts to water quality. The measures that will be put in place to avoid these types of water quality impacts will be further defined through mine planning in response to baseline data collected through the geochemical and water quality studies.

4.5 Aquatic ecosystems

NTEPA Environmental Objective:

Protect aquatic habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

4.5.1 Receiving environment

Aquatic habitat values in the ML's are limited by the ephemeral nature of flows in the higher order watercourses that drain the sites. These watercourses are unlikely to support any important or sensitive aquatic habitats.

Downstream of the mine sites, in Mount Bundey Creek, Marrakai Creek and McKinley River, there are areas that experience more extended periods of flow and support semi-permanent to permanent pools. The closest area that potentially supports semi-permanent pools is approximately 5.5 km downstream of Rustlers Roost in an unnamed tributary to Marrakai Creek. These areas are more likely to support aquatic ecosystems. The nearest surveys undertaken to the proposal area, are those undertaken upstream of the Toms Gully mine site (approximately 10 km downstream from Rustlers Roost and 11 km from Q29 mining area). This survey described Mount Bundey Creek as a high order stream characterised with flora and fauna commonly found in highly disturbed intermittent streams. The presence of reptiles such as turtles and monitors, indicates that refugial pools are likely to persist along the watercourse and well into the dry season. No submerged aquatic plants were identified growing (Aquatic Ecology Services 2019). Indicating that the water flows are not consistent.

There is evidence of poor water quality, habitat availability and macroinvertebrate community variation from past mining land use in Mount Bundy Creek, adjacent and directly downstream of Toms Gully Mine (Aquatic Ecology Services 2019). The key sources of contamination would likely be from water connectivity between the stored tailings, groundwater and surface water flows from Toms Gully Mine. Aquatic surveys have been undertaken at Mount Bundey Creek to assess the potential impact of mining activities on aquatic ecology in 2015, 2017, 2018, 2019 and 2020. Elevated conductivity and concentrations of some metals have been recorded over a number of monitoring events in comparison to background water quality. The aquatic flora and fauna were characterised as species commonly found in highly disturbed intermittent streams (Aquatic Ecology Services 2019).

There are no groundwater dependant ecosystems (GDEs) in the proposal area. However, the presence of GDEs downstream of the proposal area is uncertain, with Mount Bundey and Marrakai Creek and the McKinlay and Mary River all identified as having high potential aquatic GDEs (BoM 2020). The implementation of more groundwater bores and a consistent monitoring program will provide a better understanding of the groundwater influences of aquatic ecosystems surrounding the proposal area.

4.5.2 Potential impacts

In the event that the mining activities alter the water quality in Mount Bundey Creek, Marrakai Creek or McKinley River, there is potential for indirect impacts to aquatic ecosystems supported by these watercourses. Evidence of the impacts of water quality on aquatic ecosystems have been recorded directly adjacent and downstream of Toms Gully Mine (Aquatic Ecological Services 2019).

Indirect impacts to aquatic ecosystems could occur due to impacts to off-site water quality associated with erosion and off-site movement of sediments, pit water discharges and/or AMD. Section 4.4 of this referral assesses these risks and outlines the mitigation measures and monitoring that will be undertaken to minimise water quality impacts.

Reduced habitat quality and biodiversity due to alteration of surface and groundwater water quality.

Indirect impact to downstream aquatic ecosystems in the surrounding watercourses could occur due to alteration of off-site surface water and groundwater quality, from AMD and discharge of poor quality water. Existing evidence from Toms Gully Mine that areas adjacent to landforms that have the potential for AMD (i.e., tailing storages and waste rock dumps) have resulted in declines in ecological health of the aquatic community. Sites further downstream did not show the same type of variability in the community and were considered similar to those upstream of Tom Gully Mine.

4.5.3 Mitigation

The key measure proposed to avoid impacts to aquatic ecosystems, is to ensure that contaminant levels in water released from the mine site are sufficiently low that there is no measurable impact to water quality outside of the ML boundaries. Measures are detailed in Section 4.4.3 and will include the use of sediment basins and flocculants to remove sediments from water prior to discharge and only discharging when baseline creek flows will provide for mixing and dilution of mine-affected waters. Further groundwater and surface water studies are in progress to determine discharge water quality and to establish Site Specific Trigger Values (SSTVs) for discharges that will protect the downstream receiving environment. SSTVs have been established at Toms Gully Mine based on water quality upstream in Mount Bunday Creek, and have been designed to protect the receiving environment from changes to water quality associated with mine water discharge. Discharges will be authorised through an approved operational WDL and will be subject to monitoring and reporting in accordance with the licence conditions.

4.5.4 Assumptions

The key assumptions made in assessing potential impacts on aquatic ecosystems are:

- Potential impacts to aquatic ecosystems are inherently linked to hydrological processes (flows) and water quality. The potential impacts to these factors are assessed in Sections 4.3 and 4.4.
- Section 4.3 states that the proposal is unlikely to significantly affect surface water flows and therefore we have assumed that there is unlikely to be any significant impact to aquatic ecosystems.
- Section 4.4 identifies potential for the proposal to impact downstream water quality. We have assumed that there will be short-term increases in turbidity downstream during mining. We have also assumed that measures to avoid generation and/or release of AMD and processing chemicals will be developed and implemented, and these will be effective in protecting downstream water quality from mine related impacts.

4.5.5 Relevant policy and guidance / industry standards

- Australia and New Zealand Environment and Conservation Council (ANZECC). (2018). *Guidelines for Fresh and Marine Water Quality* (95%).
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- Commonwealth of Australia. (2016). *Water Stewardship*, Leading Practice Sustainable Development Program for the Mining Industry.

4.5.6 Consultation

No consultation has been undertaken to date with regard to aquatic ecosystems, directly associated with this proposal.

4.5.7 Cumulative impact

There is potential for cumulative impacts to water quality within Mount Bunday Creek associated with discharges from the Rustlers Roost and Q29 sites, combined with the discharges from the Toms Gully mine site downstream. Cumulative water quality impacts, increase the likelihood that aquatic communities downstream of the mine sites could be affected.

4.5.8 Ecologically sustainable development

The precautionary principle has been adopted by acknowledging assumptions and uncertainties that exist in relation to the assessment of potential impacts and risks to aquatic ecosystems and committing to undertaking further water quality assessments to address this uncertainty. It is acknowledged that the WRD, TSF and pit walls are potential sources of AMD and further work is required to inform land form designs and management strategies that will provide a greater level of certainty that AMD will be avoided and/or contained in the short-term (during mining) and long-term (post-closure). The results of the water and geochemistry studies that are underway will inform an evidence-based approach to decision making about final landform designs and closure requirements.

To verify assumptions and reduce uncertainty, PGO has made commitments to implement a surface water and groundwater monitoring program that will provide for early detection of impacts to water quality and hydrology, so that contingency measures can be implemented to avoid impacts to aquatic ecosystems. The baseline surface water and groundwater data will inform the development of a site-specific water management plan.

The principle of conservation of biodiversity and ecological integrity has been considered in the assessment of potential impacts to aquatic ecosystems. Whilst there is some uncertainty about the potential impacts to aquatic ecology associated with changes to water quality and availability, it is a reasonable assumption that if these impacts were to occur, they would be localised and not at a scale that would result in impacts to biological diversity and ecological integrity in the Mary River and Adelaide River catchments. A biological monitoring program will address this.

4.5.9 Residual impact

Aquatic ecosystems in the ephemeral streams downstream of Rustlers Roost and Q29 could be indirectly impacted by poor water quality resulting from mine site discharges. It is expected that these ephemeral streams in the immediate proposal areas do not have enough consistent water flows to support aquatic ecosystems until much further downstream in more well-defined receiving waterways. There is some uncertainty surrounding all of these potential impacts.

5 COMMONWEALTH GOVERNMENT APPROVALS

The proposed activities do not require approval from the Commonwealth Government under the *EPBC Act* for matters of national environmental significance (MNES). PGO is not proposing to submit an EPBC referral.

There are nine matters of national environmental significance (MNES) protected under the *EPBC Act*:

- World heritage properties
- National heritage places
- Wetlands of international importance (listed under the RAMSAR convention)
- Listed threatened species and ecological communities
- Migratory species protected under international agreements
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mines)
- A water resource, in relation to coal seam gas development and large coal mining development.

The purpose of this section of the referral is to determine the likelihood that the proposed project will have a significant impact on any MNES. An EPBC Protected Matters Search (PMST) for 20 kms was generated on 8 October 2020 for the Pine Creek bioregion (the bioregion in which the Proposal area occurs). This report identified two MNES may occur within the Proposal area – listed threatened species and migratory species protected under international agreements (see Appendix H).

5.1 Listed threatened species

Threatened species listed under the *EPBC Act* were previously considered in Section 4.2 of this referral. The PMST identified a total of 25 listed threatened species and 18 migratory species. These are addressed below.

5.1.1 Threatened flora

Three Commonwealth-listed threatened species, *Goodenia quadrifida*, *Helicteres macrothrix* and *Stylidium ensatum* were identified in the PMST report. *Helicteres macrothrix* and *Stylidium ensatum* have a high likelihood of occurring within the Proposal based on habitat modelling.

Targeted surveys conducted during (LES 2016 and 2017 and EcOz 2020) for *Helicteres macrothrix* identified that the endangered plant was not present within the proposal area and that the presence of *Stylidium ensatum* is unlikely to be present based on the habitat assessment EcOz (2020).

5.1.2 Threatened fauna

22 listed threatened fauna species were identified in the PMST, all species identified were listed on the PMST generated to determine the on-ground target surveys undertaken by LES (2016 and 2017). No *EPBC Act* listed fauna species were identified during targeted surveys (LES 2016 and 2017).

Consultation between EcOz and NTG Flora and Fauna Division determined that the 2016 and 2017 LES surveys and report were considered adequate in determining the presence and absence of threatened fauna in the proposal area. No further surveys were required.

5.2 Listed migratory species

18 listed migratory species are identified in the PMST. All species identified were listed on the PMST generated to determine the on-ground target surveys undertaken by LES (2016 and 2017). No *EPBC Act* listed migratory species were recorded during the surveys (LES 2016 and 2017).

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Appendix A DRAFT TERMS OF REFERENCE



Draft Terms of Reference for preparation of an Environmental Impact Statement

PROPOSAL NAME:	Rustlers Roost & Quest 29 Open-cut Mine Redevelopment
LOCATION:	Mount Bunday Locality, Arnhem Highway, NT
PROPONENT:	Primary Gold Limited

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ACRONYMS

AAPA	Aboriginal Areas Protection Authority
ABA	Acid base accounting
AMD	Acid mine drainage
ANZECC & ARMCANZ	Australia and New Zealand Environment and Conservation Council & Agriculture and Resources Management Council of Australia and New Zealand
ARI	Average recurrence interval
CSM	Conceptual site model
DENR	Department of Environment and Natural Resources (Northern Territory) – now DEPWS
DEPWS	Department of Environment, Parks and Water Security – formerly DENR
DITT	Department of Industry, Tourism and Trade – formerly DPIR
DPIR	Department of Primary Industry and Resources – now DITT
DoH	Department of Health
EIA	Environmental impact assessment
EIS	Environmental impact statement
EMP	Environment management plan
<i>EPBC Act</i>	<i>Environment Protection and Biodiversity Conservation Act (1999) (Commonwealth)</i>
ESCP	Erosion and sediment control plan
ESD	Ecologically sustainable development as defined by Part 1 Division 1 of the <i>Environment Protection Act 2019</i>
GDE	Groundwater dependant ecosystems
GHG	Greenhouse gas
LOM	Life of mine
MCP	Mine closure plan
ML	Mineral leas
MMP	Mining management plan (pursuant to the <i>Mining Act</i>)
MNES	Matters of national environmental significance
NAF	Non-acid forming
NMD	Neutral metalliferous drainage
NORM	Naturally occurring radioactive material
NT	Northern Territory
NVIS	National vegetation information system
PAF	Potentially acid-forming
ROM	Run of mine
SD	Sustainable development
SGVs	Site-specific guideline values (water quality guideline values derived by using reference-site data as advised by ANZECC & ARMCANZ)
SOR	Statement of reason
SWGs	Livestock Drinking Water Guidelines
TARP	Trigger action response plan
TOR	Terms of reference
<i>TPWC Act</i>	<i>Territory Parks and Wildlife Conservation Act (Northern Territory)</i>
TSF	Tailings storage facility
WMP	Water management plan
WRD	Waste rock dump

1 INTRODUCTION

1.1 Overview

Primary Gold Limited (PGO)¹ has submitted a proponent initiated Environmental Impact Statement (EIS) Referral for its proposed redevelopment of the Rustlers Roost and Quest 29 open-cut mines (the Proposal) to be assessed under the *Environment Protection Act 2019 (EP Act)*. These Terms of Reference (TOR) set out the environmental matters that PGO proposes be addressed in an EIS for this Proposal. The EIS will also need to address all requirements in the *NT EPA General Guideline for Preparing a proponent initiated EIS referral* (NT EPA 2020).

1.2 Background

The Proposal is to redevelop and expand a former open pit gold mining operation in the Mount Bunday locality, 100 km south-east of Darwin. The Proposal involves open cut mining of ore from a number of pits located across two separate mineral lease areas, referred to as Rustlers Roost and Quest 29. Ore from both areas will be processed at a central processing facility to produce gold bullion. The forecast life of mine is approximately seven years, after which PGO will rehabilitate the site. Full details of the Proposal are provided in the referral document submitted with this TOR.

In accordance with the *Environment Protection Regulation 48*, the referral documentation submitted by PGO includes a Draft TOR (this document) and a Statement of reasons that details why assessment by EIS is required and why these draft TOR are appropriate. If the NT Environment Protection Authority (NT EPA) decides that EIS is the appropriate method of assessment, these draft TOR will be finalised by the NT EPA after taking into account the submissions made during the public and government authority consultation period.

1.3 Assessment under Environment Protection and Biodiversity Conservation Act 1999

This proposal has not been referred under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* because the activities do not have potential for a significant impact on any Matters of National Environmental Significance (MNES) protected under Part 3 of the Act.

1.4 Assessment timeline

An indicative assessment timeline is outlined in Table 1-1 based on the timeframes for key assessment milestones specified by the *EP Act*.

Table 1-1. Indicative assessment timeline

Key assessment milestones	Completion date
Submission of proponent initiated EIS Referral	Start to Mid-February 2021
NT EPA acceptance of proponent initiated EIS Referral (15 business days)	Start March 2021
Referral consultation period including draft Terms of Reference (30 business days)	Start April 2021
NT EPA Decision on accepted referral (35 business days)	End May 2021
NT EPA approves TOR	End May 2021
Draft EIS submitted to the NT EPA (proponent timeframe)	January 2022
Public and government authority consultation period (30-60 business days)	March 2022
Direction to prepare supplement issued (25 business days)	Start May 2022

¹ PGO is a fully owned subsidiary of Hanking Australia Investment Pty Ltd.

Key assessment milestones	Completion date
Supplement submitted (proponent timeframe)	Start July 2022
Public and government authority consultation period (15 business days)	July 2022
Assessment report and draft environmental approval provided to Minister (45 business days)	Mid-September 2022
NT Ministers approval decision (30 business days)	End October 2022

2 MATTERS TO BE ADDRESSED IN DRAFT EIS

This section describes the information requirements specific to this Proposal and the surrounding environment, that should be addressed in the draft EIS.

2.1 Summary

A summary of the draft EIS should be written as a stand-alone document, able to be provided on request to interested parties who may not wish to read the whole EIS. The summary should provide the following at a minimum:

- Explanation of the approvals process and the function of the EIS.
- Clear and concise overview of the proposal, including key components and activities, lifespan, rehabilitation and closure outcomes and intended future use of the site.
- Details of the benefits of the proposal to the Territory.
- Details of consultation undertaken and outcomes.
- Summary of environmental impacts of the potential significant environmental impacts and proposed measures to avoid, mitigate or offset those impacts.

2.2 Introduction

The introduction to the EIS should include the following:

- Brief proposal overview.
- Background, rationale and key objectives of the proposal.
- Proponent details and background.
- Details of the benefits of the Proposal to the local region and the Northern Territory and the measures that will be implemented to maximise these.
- Summary of the approvals process, including key stages, timeframes and function of the draft EIS.
- Table of the environmental factors and objectives addressed in the draft EIS.
- Table cross-referencing matters in the TOR and how each matter has been addressed.

2.3 Stakeholder engagement

Provide details of any stakeholder engagement and consultation undertaken by the proponent to meet the requirements of section 43 of the *EP Act* and future engagement activities that will be undertaken throughout assessment and post-approval, including during construction and operation of the proposal.

2.4 Alternatives

For each key component of the proposal, provide details of the alternatives considered or currently under consideration, including alternative locations, timing and design options.

Provide a comparison of the potential significant environmental impacts, across all relevant environmental factors associated with each alternative, and clearly explain if and how the preferred option(s) assist in avoiding or minimising major potential environmental impacts associated with the proposal.

The information provided is required to demonstrate that the planning and design phase of the proposal has included:

- Identification of local/regional environmental values and application of the mitigation hierarchy to avoid or minimise potentially significant environmental impacts where possible.

- Consideration of the potential for less environmentally damaging alternative approaches, methodologies or technologies, consistent with section 42(c) of the *EP Act*.

2.5 Proposal description

The EIS must include a detailed description of the all aspects of the proposal illustrated using maps and figures. The information provided should cover all phases, including design, construction, operation, rehabilitation and closure of the proposed mining operation. Specific information requirements are outlined in Table 2-1.

Table 2-1. Information to be provided in project description

Topic	Information requirements
Key components	A summary table listing the key components and significant environmental aspects of the proposal, including (but not limited to): • Expanded pit footprints • Processing facilities • Tailings storage facilities (TSF) • Waste rock dumps (WRD) • Temporary stockpiles • Buildings, structures and laydown areas • Water supply, water storage, stormwater and drainage infrastructure • Haul routes and access roads • Services infrastructure (i.e. water and power supply) • Hazardous materials and waste storage facilities • Explosive and fuel storages • Other components.
Site location and layout maps	• Current land tenure and ownership of the land covered by the proposal. • Location and boundaries of proposal area clearly identified (i.e. mineral titles and development envelope) in relation to surrounding land tenure, land use, environmental values and sensitive receptors. • Details of land use history, including extent and nature of previous activities that may have caused soil, surface water and/or groundwater contamination or degradation. • Location and approximate dimensions of areas to be disturbed and key proposal components (i.e. the direct disturbance footprint).
Design	• Design details, diagrams and schematics for each of the key proposal components prepared by suitably qualified engineers. • Details of the design criteria, consequence and risk assessments undertaken to inform the design requirements for the TSF, WRD, dams, storages and any other mine component that poses a significant risk to the environment in the event of failure. • Reference to accepted engineering and design standards and leading practice guidelines that have been used to inform design. • Geochemical characterisation investigations undertaken to determine the physical and chemical characteristics of materials to be mined and processed (e.g. ore/tailings and waste rock) consistent with the Global Acid Rock Drainage Guidelines. As a minimum testing should include: - o static testing of waste and ore, including acid base accounting (ABA) on all samples; sulphur speciation and total carbon analysis - o kinetic testing of waste and ore to inform the rate of oxidation of the materials and composition of leachates - o sampling frequency and methodology to be undertaken in accordance with relevant guidelines, including the GARD guide and the Preventing Acid and Metalliferous Drainage – Leading Practice Sustainable Development Program guidelines. Each lithology, material type to be adequately characterised - o naturally occurring radioactive material (NORM). • Outcomes of the geochemical characterisation investigation will; - o identify occurrence and risks of AMD from proposed infrastructure - o demonstrate how future development of AMD will be prevented by design - o enable development of a geological waste block model

Topic	Information requirements
	- o enable development an AMD Management Plan that incorporates site-wide management of potentially acid-forming (PAF) material. • Outcomes of investigations undertaken to determine the suitability of site derived and/or off site materials for use in construction and/or rehabilitation. The investigation will demonstrate that sufficient quantities of suitable-standard clays, benign and non-acid forming (NAF) material, are available to fulfil construction requirements for all proposed infrastructure builds and upgrades. • Outcomes of investigations undertaken to assess soil quality (contamination) and integrity (stability/erosion) in existing mine landforms and other areas disturbed by previous mining activities, including the WRD's, heap leach pads and ponds. • Design options considered, reasons for selection of the preferred option and how the proposed design avoids and/or mitigates potential impacts and risks to the surrounding environment.
Construction	• Stages of mine development and timeframes. • Seasonal considerations for mine development, including timing of land clearing and site preparation, availability of water and dewatering requirements. • Methods used for vegetation clearing, topsoil stripping and details of how excess materials will be stored, reused, recycled or disposed. • Construction materials required for each mine site component – including details of major types, quantities, specifications for different purposes such as lining and capping, sources (both on and off lease), storage requirements and potential hazards. • Any new ancillary infrastructure and upgrades required to service the Proposal, including supply of electricity, water, sewerage and road access. • Construction power and water supply.
Mine operations	• Mining methods and equipment. • Timeframes, proposal staging and ramp-up of production and progressive rehabilitation activities. • Volumes of ore and waste rock to be mined annually. • Types / categories, quantities and characterisation of materials to be mined (e.g. ore and waste rock etc.). • Location, characteristics and quantities of any mined materials that could pose an environmental risk, including AMD or saline drainage, sodic or dispersive material, erosive material, material with other chemical/physical properties that will affect rehabilitation outcomes, fibrous minerals and naturally occurring radioactive material (NORM). • Details of methods for handling, treatment, storage or disposal of these potentially problematic materials.
Processing	• Overview of ore processing methods, major components and processing circuits. • Process flow diagram showing all processing circuit inputs and outputs. • Water requirements and management (treatment, sources and storages). • Details of additives used, including physical and chemical properties, Safety Data Sheets, storage, handling and disposal requirements. • Details of processing outputs, including types and volumes of rejects, tailings, product, and details of handling, treatment, transport and disposal requirements.
Tailings management	• Quantities of tailings to be produced and managed. • Physical and geochemical characterisation of tailings, indicating potential to contaminate surface water and groundwater. • Methods of disposal and management of tailings. • Analysis of potential complexing of tails, such as with cyanide, and of physiochemical mobility of contaminants under expected environmental conditions. • Potential for reprocessing of tailings and details of how this will be managed. • A draft Tailings Management Plan developed according to leading practice guidance <i>Tailings Management Leading Practice Sustainable Development Program for the Mining Industry</i> (Commonwealth of Australia, 2016)
Water Use and Management	• Water management system schematic and water balance for each proposal phase, based on the <i>Minerals Council of Australia Water Accounting Framework (MCA 2014)</i>. The water account should be prepared for low, average and high rainfall years. • Forecast water demand for all mine site activities, including dust suppression, processing, wash-down, potable water and ablutions and other uses. • Water sources and available volumes, including surface water, groundwater and mine dewatering (including details of seasonal variations). • Systems for recycling and reuse of water, details of any treatment requirements and estimated volumes of water to be sourced from these systems.

Topic	Information requirements
	- Pit dewatering volumes and rates including quantification of the anticipated peak dewatering requirements. - Discharge volumes, quality, treatment requirements timing and proposed locations.
Energy Use	- Energy requirements and sources. - Considerations of renewable energy sources and justification of selected options. - Estimate of greenhouse gas (GHG) emissions (scope 1 and scope 2) for each year of the project. - Measures and/or initiatives to maximise energy efficiency and avoid and/or reduce GHG emissions, specifically relating to source and consumption of energy, and consistent with the NT Governments aspirational target of achieving net zero GHG emissions by 2050 (NT Government 2019).
Transport and traffic	Describe the traffic and transport activities during construction and operation. Include as a minimum: Machinery and vehicle type, number, traffic volume, hours of operation and haulage routes.
Waste and Hazardous Materials Management	- Expected waste streams and volumes for both industrial and domestic wastes at the mine and accommodation facilities. - Information on potentially hazardous materials (including fuel) that will be used or produced (waste) and methods for storage, transport, handling, containment, disposal and emergency management of these materials. - Legislation, guidelines and standards relevant to the types and volumes of waste and hazardous materials associated with the activities. - Management strategies proposed for each waste stream that demonstrate consideration of the waste management hierarchy in accordance with the <i>EP Act 2019 Clause 27</i>.
Workforce and procurement	Provide a summary of the following for each phase of the proposal: - Estimated number of people to be employed. - Skills base required and likely sources of workforce (local, regional, international). - Details of workforce accommodation and transport requirements. - Goods and services required to support project delivery and where these will be procured. - Strategies proposed for maximising local employment and procurement.
Rehabilitation and closure	A draft Mine Closure Plan (MCP) developed according to leading practice guidance (e.g. DIIS 2016; DMO & EPA 2015; ICMM 2019) and the principles of the International Council of Mining (ICMM 2015). As recommended by the ICCM (2015 and 2019), planning for mine rehabilitation and closure should be an integral part of early mining planning. Provide details of proposed rehabilitation and closure planning for the Proposal, including; - Proposal specific closure objectives, standards and criteria and future land tenure and land-use arrangements. - Geochemical analysis of waste rock and ore required to inform design criteria for surface waste storage structures (WRD), TSF and materials management. - Landform designs (TSF, WRD and Annies dam wall upgrade) by appropriately qualified professionals in accordance with accepted industry guidelines and standards to ensuring it is a non-polluting and structurally stable. - Predicted post closure pit lake water quality assessment. Detail the impacts and risks of the final mine pit lake with focus on appropriate monitoring programs, risk avoidance measures and mitigation actions, in consideration of the Western Australia Guidelines for Preparing Mine Closure Plans (Interim guidance on pit lake assessment through a risk-based approach). - Predicted post closure water balance, including density driven exchange between pit lake and the surrounding groundwater. - Material sources, characterisation and indicative volumes available for site rehabilitation. - Closure implementation, including; rehabilitation techniques, staging and timing of rehabilitation and closure, removal of all infrastructure, methods of stabilisation, an outline of final rehabilitation, revegetation and closure plans for all key components. - Financial provisions for closure (both planned and unexpected), including protocols for securing a safe, stable and non-polluting mine-site.

2.6 Statutory framework

The draft EIS must provide information on the statutory framework including a description of any permits, consents, or other approvals that will be required from Northern Territory or Commonwealth agencies and/or authorities.

2.7 Key environmental factors

The proponent has identified the five preliminary key environmental factors that may be significantly impacted by the proposal Table 2-2. These TOR focus on the information required to provide certainty with respect to the significance of impacts to each of these factors.

Table 2-2. Preliminary key environmental factors that will be addressed in the Draft EIS

Theme	Factor	Environmental Objective
Land	Terrestrial Environmental Quality	Protect the quality and integrity of land and soils so that environmental values are supported and maintained.
	Terrestrial Ecosystems	Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.
Water	Hydrological Processes	Protect the hydrological regimes of groundwater and surface water so that environmental including ecological health, land uses and the welfare and amenity of people are maintained.
	Inland Water Environmental Quality	Protect the quality of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are maintained.
	Aquatic Ecosystems	Protect aquatic habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

The Draft EIS will provide background information and an assessment of each environmental factors listed in Table 2-2 and an assessment of how the environmental objectives listed above would be met, as outlined in the *NT EPA's General Guidance for Preparing a proponent initiated EIS* referral (NT EPA 2020). A proposal footprint (direct disturbance footprint) and zone of influence (indirect disturbance footprint) are to be established to identify the components of the environment (under each environmental factor) and their specific values that could be impacted by implementation of the proposal.

Sections 2.7.1 to 2.7.5 outline the information to be addressed for each preliminary key environmental factor. If additional potential environmental impacts are identified through the EIA process, they will be included in the Draft EIS in addition to those identified in Section 3.1.

2.7.1 Terrestrial environmental quality

The Referral identified that erosion and sedimentation, contamination by hazardous materials and acid metalliferous / mine drainage (AMD) have the potential to cause land and soil degradation that could indirectly impact surface water and groundwater quality. Table 2-3 outlines the minimum information required in the EIS for assessment of these impacts to Terrestrial Environmental Quality. The EIS must also discuss any other impacts identified during stakeholder engagement, or that emerge during the assessment process.

Table 2-3. Minimum information required for assessment of terrestrial environment quality

Aspect	Specific information required
NT EPA objective: Protect the quality and integrity of land and soils so that environmental values are supported and maintained.	
Environmental values	- Describe and map of the soil types and land unit(s) within the proposal area and surrounding areas that could experience impacts, and the environmental values and current land use that are supported. - Location, characteristics and quantities of any contaminated soils present. - Location and extent of any existing erosion and assessment of erosion risk by land/soil type.
Potential impacts and risks	- Detail potential impacts, risks and benefits to land and soils associated with each phase of the Proposal, including: - Direct and indirect disturbances of existing mining landforms and contaminated soil. - Erosion and sedimentation of existing and proposed mining landforms and indirect impacts to receiving waterways - Soil and land contamination from AMD and hazardous materials. - Erosion of mining land forms during mining and post-closure. - Use the outcomes of field studies, modelling and other evidence to determine the area of land and soils that could feasibly experience impacts (zone of impact and zone of influence) and to assess the consequence (significance) of impacts. - Identify environmental values that could experience indirect impacts associated with land and soil disturbance and provide details of where these impacts are assessed in the EIS. Include consideration of indirect impacts to the following: - Watercourses associated with release of contaminants, increased turbidity and sedimentation. - Groundwater aquifers associated with release of contaminants from soil. - Surrounding land-uses that could be affected by erosion and/or contamination of surface water or groundwater.
Avoidance, mitigation and management	- Describe the measures that will be implemented to avoid or mitigate potentially significant environmental impacts to land and soils, with consideration of section 26 (environmental decision-making hierarchy) and section 27 (waste management hierarchy) of the <i>EP Act</i>. - Describe the measures that will be implemented to enhance or restore environmental quality during operations through rehabilitation of previously disturbed areas and/or post closure. - Provide an AMD management plan that demonstrates adoption of best-practice approach to prevention and management of AMD in accordance with the GARD guide and the Preventing Acid and Metalliferous Drainage – Leading Practice Sustainable Development Program guidelines. The AMD management plan will: - Provide an analysis and interpretation of geochemical characterisation programs and outline further material characterisation requirements throughout each phase. - Identify occurrence and risks of AMD from proposed infrastructure. - Demonstrate how AMD will be prevented by design. - Detail a geological waste block model. - Incorporate site-wide management of potentially acid-forming (PAF) material. - Provide a primary erosion and sediment control plan (ESCP) developed by a suitably certified person, in accordance with the <i>Best Practice Erosion and Sediment Control Guidelines</i> (IECA, 2008). - Provide a draft Mine Closure Plan (MCP) in accordance with the Western Australia Guidelines for Preparing Mine Closure Plans and the Mine Closure - Leading Practice Sustainable Development Program. - All mitigation measures should be substantiated and in accordance with best practice guidelines and advice from relevant Northern Territory Government agencies.
Monitoring and reporting	- Describe the monitoring and reporting of potential impacts and risks to land and soils for each project phase, including: - Waste rock testing and placement - Mining landform stability - Visual assessment of erosion around the mine site and in receiving watercourses

Aspect	Specific information required
	- o Surface and groundwater monitoring to provide early warning of AMD and erosion/sedimentation impacts. • All monitoring activities should be substantiated and in accordance with best practice guidelines and advice from relevant Northern Territory Government agencies.
Residual impact	• Assess the significance of any residual impact or risk of the proposal to identified values.
Offsets	• If any significant residual impact may remain after applying the environmental decision-making hierarchy, identify offsets and described how any proposed offset is consistent with the <i>NT Offset Policy</i>.

2.7.2 Terrestrial ecosystems

The Referral identified that threatened plant species, *Helicteres macrothrix* and *Stylidium ensatum* may be present in the proposal area based on habitat modelling prepared by NTG and therefore targeted surveys are required to confirm the species presence/absence. Surveys conducted for *Helicteres macrothrix* did not identify the species to be present in the proposal area (EcOz 2020). Multiple flora and fauna surveys undertaken in the area over time (LES 2016 and 2017) have not identified any other threatened species that are likely to be impacted by the proposal. If *Stylidium ensatum* is present, to be determined by field surveys in June/July 2021, the EIS will need to assess potential impacts to this species associated with land clearing and/or changes to hydrological processes.

Riparian vegetation communities and fauna could be indirectly impacted if there are downstream impacts to water quality from AMD or poor pit water quality post closure. These impacts are addressed in the Inland Water Quality section of this TOR (Section 2.7.4). If the assessment identifies there will be impacts to water quality, then the EIS will need to consider the indirect impacts to riparian vegetation and fauna.

Table 2-4 outlines the minimum information required in the EIS for assessment of these impacts to Terrestrial Ecosystems. The EIS must also discuss any other potential impacts identified during stakeholder engagement, or that emerge during the assessment process.

Table 2-4. Minimum information required for assessment of terrestrial ecosystems

Aspect	Specific information required
NT EPA objective: Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	
Environmental values	• Describe and map the extent and current condition of the following values in the proposal area and surrounding areas that could experience impacts: - o Vegetation communities and habitats present using the National Vegetation Information System (NVIS) database. - o Riparian vegetation and any other significant vegetation types. - o Introduced and invasive species including weed species declared under the <i>Weeds Management Act</i>. • Provide an assessment of NT and /or EPBC listed threatened species (both flora and fauna) presence, or likely occurrence, based on the results field studies. • Detail the outcomes of targeted surveys undertaken for the threatened plant species <i>Helicteres macrothrix</i> and <i>Stylidium ensatum</i>. • Provide details of survey program timing, locations and methodology to demonstrate appropriate and statistically sufficient survey designs. • Surveys are to be undertaken at an appropriate time of year by a suitably qualified person that has demonstrated experience in surveying for and the identification of threatened species in the Northern Territory. • If targeted surveys find <i>S. ensatum</i>, potential impacts should be evaluated and consideration given to referral under the <i>EPBC Act</i>.
Potential impacts and risks	• Detail potential impacts, risks and benefits to flora and fauna associated with each phase of the proposal, including: - o Land clearing impacts to threatened species and significant vegetation communities. - o Indirect impacts to riparian vegetation as a results of groundwater drawdown associated with dewatering of pits and water quality deterioration due to the mining activities. - o Altered fire regimes from land clearing and potential proliferation of weeds.

Aspect	Specific information required
	- o Indirect impacts to fauna from exposure to mine impacted water in downstream waterways and in the pit lakes. • Use the outcomes of field studies, modelling and other evidence to determine the area within which flora and fauna could feasibly experience impacts (zone of impact and zone of influence) and to assess the consequence (significance) of impacts. The assessment should include: - o Groundwater modelling and baseline water quality assessments to predict the extent to which groundwater drawdown and seepage or discharge of mine affected water could impact riparian vegetation health over time. - o Prediction of post-closure discharge and pit lake water quality and thresholds for impacts to fauna. - o Consideration of potential cumulative impacts to riparian vegetation associated with existing land uses and other mining/extractives activities in the region.
Avoidance, mitigation and management	• Describe the measures that will be implemented to avoid or mitigate potentially significant environmental impacts to flora and fauna, with consideration of section 26 (environmental decision-making hierarchy) and section 27 (waste management hierarchy) of the <i>EP Act</i>. • Describe any measures that will be implemented to restore impacted areas of vegetation and habitat post-closure. Provide details of closure-objectives and rehabilitation methods in the Mine Closure Plan. • Where the presence of <i>Helicteres macrothrix</i> or <i>Stylidium ensatum</i> or cannot be ruled out, provide an evaluation of the potential direct, indirect, off site and cumulative impacts prepared in accordance with the <i>Significant Impact Guidelines 1.1</i> under the <i>Environment Protection and Biodiversity Conservation Act 1999</i>. - o The evaluation of the potential impacts must be supported by a risk assessment and appropriate measures that would be implemented to avoid, mitigate and/or offset potential impacts, including referral to the Australian Government Department of Agriculture, Water and the Environment. - o The Department of Environment, Parks and Water Security (DEPWS) Flora and Fauna Division should be consulted on the proposed approach to manage potential impacts, and the results. • All mitigation measures should be substantiated and in accordance with best practice guidelines and advice from relevant Northern Territory Government agencies.
Monitoring and reporting	• Describe the monitoring and reporting of potential impacts and risks to flora and fauna for each project phase, including: - o Monitoring of groundwater drawdown and riparian vegetation condition during mining and post-closure. - o Monitoring of surface water quality during mining and post-closure as an early warning of potential impacts to riparian habitats and fauna. - o Weed surveys and reporting. • Include monitoring methods, effective controls and clear thresholds to inform remedial action and early identification of potential negative impact. • All monitoring activities should be substantiated and in accordance with best practice guidelines and advice from relevant Northern Territory Government agencies.
Residual impact	• Assess the significance of any residual impact of the proposal to identified values.
Offsets	• If any significant residual impact may remain after applying the environmental decision-making hierarchy, identify offsets and described how any proposed offset is consistent with the <i>NT Offset Policy</i>.

2.7.3 Hydrological processes

The Referral identified that the proposal could cause drawdown of groundwater levels associated with pit dewatering during mining activities and further investigations are required to understand the groundwater flow regimes potential impacts. Impacts to surface water flows are unlikely to be significant as the mine site is located at the upper limits of a large catchment and discharges will occur only during the wet season and will be managed in accordance with a Waste Discharge Licence under the *Water Act*.

Table 2-5 outlines the minimum information required in the EIS for assessment of impacts to groundwater and surface water flow regimes. The EIS must also discuss any other potential impacts identified during stakeholder engagement, or that emerge during the assessment process.

Table 2-5. Minimum information required for assessment of hydrological processes

Aspect	Specific information required
NT EPA objective: Protect the hydrological regimes of groundwater and surface water so that environmental including ecological health, land uses and the welfare and amenity of people are maintained.	
Environmental values	- Describe the surface water flow regimes of the receiving waterways that may be impacted by the Proposal, including Mount Bunday Creek and Marrakai Creek and associated tributaries. Include descriptions and maps of the following: - Surface water catchments. - Major and minor waterways, drainage lines and water bodies (natural and artificial). - Direction of flow and flow conditions. - Water control districts and water allocation plans. - Declared beneficial uses, existing users and environmental values. - Describe the existing groundwater conditions using baseline data collected from a network of groundwater bores and a site-specific groundwater model. Include descriptions and maps of the following: - Groundwater flows direction, volumes and yield. - Recharge zones and expressions. - Recharge rates. - Water table depth, including temporal variation. - Surface and groundwater connectivity. - Water control districts and water allocation plans. - Declared beneficial uses, existing users, and environmental values.
Potential impacts and risks	- Detail potential impacts, risks and benefits to hydrological processes associated with each phase of the proposal, including: - Alteration of surface water flows associated with mine site discharges/surface water extraction. - Groundwater drawdown associated with dewatering of the pit during mining and groundwater extraction. - Groundwater mounding associated with seepage from the WRD, TSF and dams/water storages. - Density driven flow and impacts to surrounding groundwater. - Flooding associated with dam overflows, dam wall failure etc. - Use the outcomes of field studies, modelling and other evidence to determine the area within which surface water and groundwater regimes could feasibly experience impacts (zone of impact and zone of influence) and to assess the consequence (significance) of those impacts. The assessment should include: - Details of modelled discharge volumes and timing (derived from the site water balance model referred to in Section 2.5), and an assessment of how discharges could alter the flow regimes in receiving watercourses. - Modelling and mapping of groundwater drawdown during operations and predicted post-closure recovery of groundwater levels in the pit lakes, including hydrological classification in accordance with the WA closure guidelines. - Assessment of potential impacts to surface water courses, GDE's, beneficial uses and surrounding users associated with lowered groundwater levels. Include details on how the model was calibrated, validated and the key assumptions used. - Quantification of sustainable groundwater extraction limits and any approval or allocation required under the <i>Water Act 1992</i>. - Results of flood risk assessments and associated design criteria adopted for dams and storages to minimise downstream flooding. Identification of any sensitive receptors that could be impacted by unexpected failure.
Avoidance, mitigation and management	- Describe the measures that will be implemented to avoid or mitigate potentially significant impacts to hydrological processes, with consideration of section 26 (environmental decision-making hierarchy) and section 27 (waste management hierarchy) of the <i>EP Act</i>. - Provide a Water Management Plan (WMP). The WMP should outline how impacts to surface and groundwater hydrology would be managed for all proposal stages and seasons, including (but not limited to): - Details of the site water management system and water balance used to inform mine site water management. - Measures to minimise water use and discharge, consistent with the environmental decision-making hierarchy and the waste management hierarchy. - Details of modelled discharge volumes and timing (derived from the site water balance model referred to in Section 2.5) and how these will be managed to minimise changes to hydrological regimes and protect environmental values. - The Mine Closure Plan required in Section 2.5 (Rehabilitation & Closure) should identify the final structures (developed by a suitably qualified engineer) that are designed to divert, capture, retain and/or treat surface runoff and to prevent discharge of contaminated water from the site.

Aspect	Specific information required
	All mitigation measures should be substantiated and in accordance with best practice advice from relevant Northern Territory Government agencies.
Monitoring and reporting	- Provide a detailed monitoring program in the WMP that provides for early warning of impacts to surface water and groundwater hydrological regimes so that they are detected before there is any significant impact to environmental values or other users. The program will include as a minimum: - A network of groundwater monitoring bores established under the guidance of a suitably qualified expert to detect impacts from key components of the mine site, including open pits, WRD and TSF. - Groundwater, surface water and aquatic monitoring program, including details of monitoring methods, frequency and timing. - Discharge monitoring sites, including point of discharge and compliance points proposed for inclusion in a Waste Discharge Licence. Measures proposed for recording and reporting discharge volumes and timing. - Measures to quantify, record and report volumes of water extracted from surface and groundwater. - Trigger action response plan (TARP) that includes proposed thresholds/triggers and corrective actions. - All monitoring activities should be substantiated and in accordance with best practice guidelines and advice from relevant Northern Territory Government agencies.
Residual impact	Assess the significance of any residual impact of the proposal to identified values.
Offsets	If any significant residual impact may remain after applying the environmental decision-making hierarchy, identify offsets and described how any proposed offset is consistent with the <i>NT Offset Policy</i>.

2.7.4 Inland water environmental quality

The Referral identifies mine site discharges (from sediment basins and controlled discharge of excess water) and release/seepage of contaminated water/AMD from the WRD and TSF, as the key source of potential impacts to surface water and groundwater quality during operations. Post-closure the open pit lakes, WRD's and TSF could be a source of AMD that could impact surface water and groundwater quality.

Table 2-6 outlines the minimum information required in the EIS for assessment of impacts to groundwater and surface quality. The EIS must also discuss any other potential impacts to water quality identified during stakeholder engagement, or that emerge during the assessment process.

Table 2-6. Minimum information required for assessment of inland water environmental quality

Aspect	Specific information required
NT EPA objective: Protect the quality of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are maintained.	
Environmental values	- Describe and map surface water courses and groundwater aquifers present within the proposal area and surrounds in accordance with the minimum information requirements in Table 2-5. - Detail the chemical and physical characteristics (quality) of surface waters and groundwater within the area that may be affected by the proposal, through the collection of an appropriate baseline dataset. Identify any water quality standards and guidelines that would be used to describe the ecological values and health of surface water environments - Describe and map the environmental values and beneficial uses supported in the proposal area and surrounding areas that could experience impacts.
Potential impacts and risks	- Detail potential impacts, risks and benefits to water quality associated with each phase of the proposal, including: - Increased turbidity in downstream watercourses from erosion and sedimentation. - Contamination of surface water and groundwater aquifer by mine site discharges and/or AMD. - Hydrocarbon and other chemical contamination due to leaks and spills. - Develop a site conceptual site model (CSM) by an appropriately qualified and experienced person for the proposal describing; - Sources of potential contaminants and mechanisms of their release. - Pathways for transport,

Aspect	Specific information required
	- o Receptors (including potential for human and ecological exposure) - o Fate of any contaminated waters, and products, from the Proposal, and Proposal components and zone of influence. • The minimum data required to support the CSM should include, but not be limited to: - o Laboratory and field results from the geochemical characterisation program. - o Hydrogeological characterisation and flow modelling. - o Physicochemical mobility of contaminants. - o Baseline surface and groundwater quality. - o Contaminant transport modelling of current and future seepage plumes. - o Biological receptors, vectors and their habitats. - o Identification of preferential flow pathways. • Use the outcomes of field studies, modelling and other evidence to determine the area within which surface water and groundwater quality could feasibly experience impacts (zone of impact and zone of influence) and to assess the consequence (significance) of those impacts. The assessment should include consideration of impacts on water quality and associated beneficial uses and ecological values associated with: - o Controlled and uncontrolled discharges. - o Seepage from the WRD and TSF. - o AMD and other contamination risks during operations and post-closure. - o Seepage or overflows from the pit lakes post-closure, including a risk and impact assessment to demonstrate that the proposed closure strategy avoids or minimises impacts to surface water and groundwater values in perpetuity. - o Post-closure landform stability and potential for erosion and sedimentation to occur over time. - o Cumulative impacts to Mount Bunday Creek and Mary River associated with discharges from multiple mining and extractives activities in the catchment
Avoidance, mitigation and management	• Describe the measures that will be implemented to avoid or mitigate potentially significant impacts to water quality, with consideration of section 26 (environmental decision-making hierarchy) and section 27 (waste management hierarchy) of the <i>EP Act</i>. • The Water Management Plan prepared for the proposal must detail how impacts to surface and groundwater quality would be managed for all proposal stages and seasons. The WMP should demonstrate how water would be managed and treated to achieve a quality that provides for protection of at least 95% of aquatic ecosystem species. The WMP should include: - o Erosion and sediment control measures, including a Primary ESCP - o Details of discharge management measures, including treatment, discharge locations and timing. - o Measures to minimise discharges and seepage from the WRD and TSF, including a Tailings Management Plan and AMD Management Plan. - o Storage and handling of hazardous materials. • A Tailings Management Plan as outlined in section 2.5 (Tailings management) that includes details of how the tailings will be managed over the life of the mining operations to avoid or minimise discharge or seepage. • A Mine Closure Plan as outlined Section 2.5 (Rehabilitation & Closure) should address: - o Predicted post closure water balance, including density driven exchange between pit lake and the surrounding groundwater - o Post closure pit lake water quality - o Surface and groundwater quality in accordance with site-specific guideline values (SGVs) to meet final land use criteria. • All mitigation measures should be substantiated and in accordance with best practice advice from relevant Northern Territory Government agencies.
Monitoring and reporting	• Provide a detailed surface water and groundwater monitoring program in the WMP to monitor the potential impacts identified from the proposal. The program will include as a minimum: - o Groundwater, surface water and aquatic monitoring program, including details of site selection and justification, frequency, analyte suite, sampling methodology, QA/QC protocols, including suitable maps. - o A summary of results and interpretation of baseline data, relevant ANZECC & ARMCANZ (2000) aquatic protection guidelines and SGVs. - o Trigger action response plan (TARP) to ensure early identification of potential negative impacts and subsequent management/remedial action. Identify effective control sites and clear thresholds. • All monitoring activities should be substantiated and in accordance with best practice guidelines and advice from relevant Northern Territory Government agencies.
Residual impact	• Assess the significance of any residual impact or risk of the proposal to identified values.

Aspect	Specific information required
Offsets	If any significant residual impact may remain after applying the environmental decision-making hierarchy, identify offsets and described how any proposed offset is consistent with the <i>NT Offset Policy</i>.

2.7.5 Aquatic ecosystems

The Proponent has identified that aquatic ecosystems have the potential to be impacted if there is a significant impact on water quality in downstream watercourses. The information required to assess the significance of potential impacts to water quality associated with the proposal are outlined in section 2.7.4.

Table 2-7 outlines the minimum information required in the EIS for assessment of impacts to aquatic ecosystems. The EIS must also discuss any other potential impacts to water quality identified during stakeholder engagement, or that emerge during the assessment process.

Table 2-7. Minimum information required for assessment of aquatic ecosystems

Aspect	Specific information required
NT EPA objective: Protect aquatic habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	
Environmental values	- Describe and map the aquatic habitats and species supported by those habitats within the proposal area and areas downstream that may be impacted by changes to water quality associated with the proposal. Include details of: - Permanent pools within surface water courses - Wetlands - GDE's.
Potential impacts and risks	- Detail potential impacts and risks to aquatic ecosystems associated with each phase of the proposal, including: - Loss of habitat or species as a result of alteration of off-site surface water and groundwater quality, from AMD and discharge of poor quality water, and alteration of flows from mining activities. - Cumulative impacts to Mount Bunday Creek and Mary River associated with discharges from multiple mining and extractives activities in the catchment - Use the outcomes of field studies, modelling and other evidence to determine the area within which surface water and groundwater quality could feasibly experience impacts (zone of impact and zone of influence) and to assess the consequence (significance) of those impacts.
Avoidance, mitigation and management	- Describe the measures that will be implemented to avoid or mitigate potentially significant impacts to aquatic ecosystems, with consideration of section 26 (environmental decision-making hierarchy) and section 27 (waste management hierarchy) of the <i>EP Act</i>. - Discuss as mitigation and management measures as outlined in Section 2.7.3 and 2.7.4 - All mitigation measures should be substantiated and in accordance with best practice advice from relevant Northern Territory Government agencies.
Monitoring and reporting	- If potentially significant impacts to aquatic ecosystems are identified, provide an aquatic monitoring program in the Water Management Plan. - All monitoring activities should be substantiated and in accordance with best practice guidelines and advice from relevant Northern Territory Government agencies.
Residual impact	Assess the significance of any residual impact or risk of the proposal to identified values.
Offsets	If any significant residual impact may remain after applying the environmental decision-making hierarchy, identify offsets and described how any proposed offset is consistent with the <i>NT Offset Policy</i>.

3 OTHER REQUIREMENTS

3.1 Other environmental factors and matters

Where the environmental impact assessment process identifies potentially significant impacts to other environmental factors not specifically included in this TOR, the draft EIS must provide an assessment of these impacts.

3.2 Stakeholder engagement and consultation

The Proponent is required under section 43 of the *EP Act* to engage and consult with stakeholders and other interested parties that may be affected by a proposal, to assist community understanding of the proposed action and its potential impact. The proponent will refer to the *NT EPA Environment impact assessment guidance for proponents - Stakeholder engagement and consultation* (NT EPA 2021a). The proponent must document the following in the EIS:

- Identified stakeholders
- Consultation undertaken, decision-making and outcomes
- Alterations to the proposal as a result of stakeholder engagement
- Future plans for consultation
- Agencies or authorities specific regulatory approvals.

3.3 Public consultation requirements

The public consultation requirements for the EIS are outlined in Part 5 Division 6 of the Environment Protection Regulations 2020. Additional specific details are provided below.

3.3.1 Submission period

The NT EPA proposes a period (usually between 30 and 60 business days) for consultation on the draft EIS. The duration of the period will be confirmed during the draft EIS pre-lodgement phase.

3.3.2 Public consultation locations

The draft EIS should be provided to and be made available for public comment at the following locations:

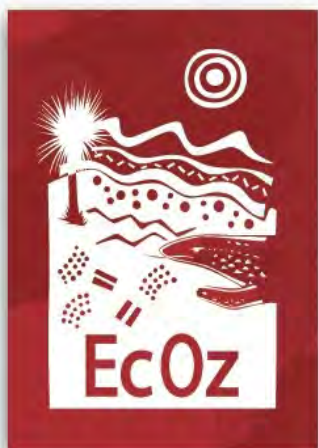
- NT EPA, Level 1, Arnhemica House, 16 Parap Road, Parap
- Taminmin Community Library, Challoner Cct, Humpty Doo NT 0836
- A nearby Government office to be determined, such as the Electoral Division of Goyder, Legislative Assembly member's office at Coolalinga (Shop 4, Coolalinga (Woolworths Shopping Centre), Stuart Highway, NT 0835. E:mail: electorate.goyder@nt.gov.au)
- Northern Territory Library, Parliament House, Darwin
- Environment Centre Northern Territory, Unit 3, 98 Woods Street, Darwin
- Mines and Energy Information Centre, Department of Industry, Tourism and Trade, 3rd Floor, Paspalis Centrepoint, 48 Smith Street Mall, Darwin
- Northern Land Council, 45 Mitchell Street, Darwin.

Attachment A – Relevant Guidance Material

As outlined in Attachment A of the NT EPA Draft Guidance of Preparing a Proponent initiated EIS referral the proponent is to refer to the guidance material considered relevant to the proposal. A list of such material is provided below but is not exhaustive. The most up-to-date and relevant evidence-based information has been referenced by the proponent.

- ANCOLD 2012. Guidelines on the Consequence Categories for Dams.
- 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/anzguidelines.
- APEC 2018. Mine Closure Checklists for Governments, Asia-Pacific Economic Cooperation.
- Austroads, 2016. Guide to Traffic Management Part 12: Traffic Impacts Development.
- Barnett B., Townley L.R., Post V., Evans R. E., Hunt R. J., Peeters L., Richardson S., Werner A. D., Knapton A. and Boronkay A., 2012. Australian Groundwater Modelling Guidelines, Waterlines Report. National Water Commission, Canberra.
- Commonwealth of Australia, 2016. Preventing Acid and Metalliferous Drainage – Leading Practice Sustainable Development Program for the Mining Industry.
- Commonwealth of Australia, 2013. Significant Impact Guidelines 1.1 – Matters of National Environmental Significance.
- Commonwealth of Australia, 2012. Aquatic ecosystems toolkit. Department of Sustainability, Environment, Water, Population and Communities.
- Commonwealth of Australia. 2016. Water Stewardship, Leading Practice Sustainable Development Program for the Mining Industry.
- Commonwealth of Australia. 2016. Mine Closure, Leading Practice Sustainable Development Program for the Mining Industry.
- Commonwealth of Australia. 2016. Mine Rehabilitation, Leading Practice Sustainable Development Program for the Mining Industry.
- Commonwealth of Australia. 2016. Hazardous Materials Management, Leading Practice Sustainable Development Program for the Mining Industry.
- Commonwealth of Australia. 2008. Cyanide Management, Leading Practice Sustainable Development Program for the Mining Industry.
- Commonwealth of Australia. 2016. Tailings Management, Leading Practice Sustainable Development Program for the Mining Industry.
- Commonwealth of Australia. (2016). Biodiversity Management, Leading Practice Sustainable Development Program for the Mining Industry.
- Commonwealth of Australia, 2010 – 2014. Survey Guidelines for Nationally Threatened Species, available at <http://www.environment.gov.au/epbc/policystatements>
- Department of Environment and Natural Resources' NT Flora and Fauna Atlases at <http://www.lrm.nt.gov.au/nrmapsnt>.
- Department of Mines and Petroleum and Environmental Protection Authority, 2015. Guidelines for Preparing Mine Closure Plans. Government of Western Australia.
- DoH, 2018. Health requirements for mining and construction. Department of Health, Environmental Health Branch. Available at: <https://www.nt.gov.au/property/buildingand-development/health-and-safety/health-requirements-mining-constructionprojects>. Last updated 1 March 2018.
- DoH, 2014. Code of practice for on-site wastewater management. Department of Health, Northern Territory Government.
- DoH, 2005. Guidelines for preventing mosquito breeding sites associated with mining sites. Medical Entomology, Department of Health. Northern Territory Government.
- IECA 2008. Best Practice Erosion and Sediment Control Guidelines. Picton NSW: International Erosion Control Association.

- INAP, 2009. The Global Acid Rock Drainage Guide (incorporating best practices and technology to address acid and metalliferous drainage issues). International Network for Acid Prevention.
- MCA, 2014. Water accounting framework for the minerals industry – User guide. Minerals Council of Australia.
- NT EPA, 2020. Draft environment impact assessment guidance for proponents - Preparing a proponent initiated EIS referral. Northern Territory Environment Protection Authority, Darwin.
- NT EPA, 2021a. Environment impact assessment guidance for proponents - – Stakeholder engagement and consultation. Northern Territory Environment Protection Authority, Darwin.
- NT EPA, 2021b. Environment impact assessment, General technical guidance – NT EPA Environmental factors and objectives. Northern Territory Environmental Protection Authority.
- NT EPA, 2018b. Guidance on adaptive management. Northern Territory Environment Protection Authority.
- NT EPA, 2018c. Opportunities and timeframes for community engagement in the environmental impact assessment process: Information for proponents and the public. Northern Territory Environment Protection Authority.
- NT EPA, 2013a. Environmental Assessment Guidelines on Acid and Metalliferous Drainage (AMD). Northern Territory Environment Protection Authority.
- NT EPA, 2013b. Guidelines for Assessment of Impacts on Terrestrial Biodiversity. Northern Territory Environment Protection Authority.
- NT EPA, 2013c. Guideline on Conceptual Site Models. Northern Territory Environment Protection Authority.
- NT EPA, 2013d. Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the NT. Northern Territory Environment Protection Authority.



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Appendix B STATEMENT OF REASON



Rustlers Roost and Quest 29 Open-Cut Mine Redevelopment

Statement of Reasons

Prepared pursuant to the Environment Protection Act 2019

February 2021

DOCUMENT INFORMATION

Job	EZ20143
Document ID	196807-11
Author(s)	Kylie Welch

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Rev	Reviewed by	Approved by	Issued to	Date
1	Suzanne Barber	Kylie Welch	Primary Gold	2/2/2021
2	Primary Gold – Charles Hastie	Kylie Welch	NT EPA	3/2/2021

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1 Introduction

Primary Gold (PGO) has submitted a proponent initiated Environmental Impact Statement (EIS) Referral for their Rustlers Roost & Quest 29 mine redevelopment proposal (the Proposal) to be assessed under the *Environment Protection Act 2019* (EP Act). In accordance with the NT Environmental Protection Authority (NT EPA) guidance, the Referral includes a referral form, referral report, Terms of Reference (TOR) and Statement of Reasons (SOR) (this document).

This Statement of Reasons (SOR) addresses the requirements of the *Environment Protection Regulations 2020* (Section 43) to provide a statement of reasons why assessment by EIS is required and why the draft TOR (submitted with the referral) are appropriate.

2 Proposal

PGO are proposing to redevelop and expand a former open pit gold mining operation in the Mount Bunday locality, 100 km south-east of Darwin. The Proposal involves open cut mining of ore from a number of pits located across two separate mineral lease areas, referred to as Rustlers Roost and Quest 29. Ore from both areas will be processed at a central processing facility to produce gold bullion. The forecast life of mine is approximately seven years, after which PGO will rehabilitate the site. Full details of the Proposal are provided in the referral document submitted with this Statement of Reasons.

3 Justification

Primary Gold has assessed the Proposal against the requirements of the *Environment Protection Act 2019* and has determined that the action has the potential to significantly impact environmental values associated with the following 5 environmental factors:

Theme	Factor and Objective	Potentially significant impacts/uncertainties
Land	Terrestrial Environmental Quality Objective: Protect the quality and integrity of land and soils so that environmental values are supported and maintained.	Soil quality and integrity may be significantly impacted within the mining lease through erosion of mining landforms; disturbance of existing contamination; leaks/spills of hazardous materials and acid metalliferous / mine drainage (AMD). To provide certainty regarding the significance of potential impacts associated with AMD, further geochemical analysis of waste rock and ore is required to inform design criteria for surface waste storage structures, materials management and closure requirements.
	Terrestrial Ecosystems Objective: Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	- Riparian habitats could be impacted through poor water quality associated with mine site discharges and groundwater drawdown from pit dewatering. To provide certainty regarding the significance of potential impacts, further assessment of impacts to hydrological processes and inland water quality is required - The threatened plant species <i>Helicteres macrothrix</i> and <i>Stylidium ensatum</i> have been identified as potentially occurring in the proposal area and if present could be significantly impacted by land clearing and habitat disturbance. To provide certainty regarding the significance of potential impacts to threatened species, field surveys are required to confirm the presence/absence of these species.
Water	Hydrological Processes Objective: Protect the hydrological regimes of groundwater and surface water so that environmental including ecological health, land uses and the welfare and amenity of people are maintained.	Groundwater hydrology will be altered by drawdown associated with mine dewatering. To provide certainty regarding the significance of potential impacts, groundwater modelling is required to determine the zone of impact (drawdown) and surface/groundwater connections.

Theme	Factor and Objective	Potentially significant impacts/uncertainties
	Inland Water Environmental Quality Objective: Protect the quality of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are maintained.	• Surface water and groundwater quality may be significantly impacted by mine site discharges (from sediment basins and controlled discharge of excess water) and AMD. To provide certainty regarding the significance of potential impacts, further assessment is required to determine water quality objectives and demonstrate these can be met during operations and post-closure.
	Aquatic Ecosystems Objective: Protect aquatic habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	• Aquatic ecosystems may be impacted through poor water quality associated with mine site discharges. To provide certainty regarding the significance of potential impacts to aquatic ecosystems, further assessment of impacts to inland water quality is required.

The draft TOR provided with the referral documentation details the information requirements to provide certainty regarding the significance of potential impacts to each of these factors.

The Referral Report submitted by PGO considered potential impacts to each of the other 9 environmental factors and objectives covered by the *Guide to NT EPA environmental factors and objectives*. Impacts to those factors are not considered to be significant and can be avoided and mitigated through routine management measures documented in the Mining Management Plan (MMP) required to obtain a Mining Authorisation under the *Mining Management Act*. As a result the draft TOR does not include any further information requirements for these factors.

A standard assessment by EIS is considered appropriate to address the requirements of section 42 and section 43 of the *EP Act*. PGO have undertaken a range of studies and assessments as part of developing the mine plan that is documented in the referral made under the Act. However, it is acknowledged that there are information gaps that need to be addressed to ensure that the mine is designed, planned, constructed, operated and rehabilitated/closed, in a manner that does not have an unacceptable impact on the environment. The EIS process will allow PGO to demonstrate to the NT EPA and stakeholders that the mine has been planned and will be carried out taking into account the following:

- principles of ecologically sustainable development
- environmental decision-making hierarchy
- waste management hierarchy
- ecosystem-based management
- impacts of a changing climate.

The EIS process will also allow PGO to meet its obligations to ensure that the community is provided information about the proposal and is consulted in relation to potential impacts and how they should be avoided or mitigated.

4 Conclusion

PGO considers that the proposal has the potential to have a significant impact on Terrestrial Environmental Quality, Terrestrial Ecosystems, Hydrological Processes, Inland Water Quality and Aquatic Ecosystems. Further studies and assessments are required to inform mine planning and closure requirements, and to provide certainty with respect to the significance of potential environmental impacts to each of these factors. The proposed EIS process will allow impacts, management and mitigation measures to be developed taking into consideration the information provided by additional studies and stakeholder engagement.



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Appendix C NTG HERITAGE BRANCH CORRESPONDENCE

From: [Dianne Bensley](#)
To: [Britanny Crescentino](#)
Subject: RE: Heritage query - old mining leases
Date: Tuesday, August 11, 2020 10:31:53 AM

Good morning Brittany,

I have conducted a search of my maps and databases for the areas included in your search request. I can confirm that there are no nominated, provisional or declared heritage places located within any of the tenements. You are right in that MLN1083 has been previously surveyed and subject to extensive mining disturbance. The sites that were recorded there many years ago were part of the Rustlers Roost Mine and quite a few were removed or disturbed as part of the development and expansion of that mine. I won't recommend any further surveys of that MLN1083 area. ML29782 and ML29783 do not have any previously recorded Aboriginal archaeological sites recorded within them but I can tell that they too have been subject to various levels of disturbance and the archaeological potential of those areas has been reduced. ML29781 and ML29786 have likely never been subject to archaeological surveys, but I won't recommend any surveys for those two areas either, given that they are quite small. I will recommend though that care be taken during works within those two tenements and if any archaeological sites are discovered then all works in the immediate area cease and Heritage Branch is contacted for comment.

ML29785 appears to be located fairly close to the road and also appears to have been previously cleared to some extent, so I won't recommend any surveys for that tenement either.

Overall, there are no heritage or archaeological concerns with any of these mining leases.

Kind regards,

Di

Dianne Bensley
Senior Heritage Officer

Heritage, Libraries and Sport Division
Department of Tourism, Sport and Culture
Northern Territory Government

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From: Britanny Crescentino <Britanny.Crescentino@ecoz.com.au>
Sent: Friday, 7 August 2020 10:08 AM
To: Dianne Bensley <Dianne.Bensley@nt.gov.au>
Subject: Heritage query - old mining leases

Good morning Di,

EcOz are undertaking some approval work on behalf of a mining company in the Mount Bunday region, and I am wondering if you could please conduct a search for any registered or declared NT Heritage sites or archaeological sites that may be in the area within and surrounding Mineral Leases N1083, 29781, 29782, 29783, 29786, 29785. These Mineral leases are within NT Portion 4937 and 3938 (3500 and 3670 Arnhem Highway, Mount Bunday). Hopefully this is enough information for you to find the areas. I have also outlined them on a map.

These mineral leases have a bit of history to them that is worth mentioning. MLN 1083 and ML29783 have been subject to mining disturbance as they are historically old gold mines, processing facilities and waste disposal areas.

Mineral Lease N 1083 was subjected to an archaeological investigation back in 1993. This investigation identified 4 prehistoric archaeological sites and a number of scatters. The entire lease was extensively surveyed. We do have a copy of this investigation and the recommendations, but I assume they would have been provided to Heritage Branch at the time they were undertaken but this was a long time ago.

EcOz are required as part of our scope of works to undertake desktop assessment of the leases and part of that is liaising with Heritage Branch.

Please advise if you believe additional surveys are required for MLN1083 or for any of the other leases. Also if you require any further information or clarification on anything please do not hesitate to contact me.

Thank you,

Appendix D ECOLOGY REPORT



Vegetation survey report for Rustlers Roost & Quest 29

Primary Gold



DOCUMENT CONTROL RECORD

Job	EZ20181
Document ID	194680-55
Authors	Clare Millen and Nicole Clark

DOCUMENT HISTORY

Rev	Reviewed by	Approved by	Issued to	Date
1	Glen Ewers	Glen Ewers	Charles Hastie	28 October 2020
2	Charles Hastie	Glen Ewers	Charles Hastie	2 December 2020

Recipients are responsible for eliminating all superseded documents in their possession.

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Appendices

APPENDIX A LAND UNIT SURVEY SITES AND RESULTS

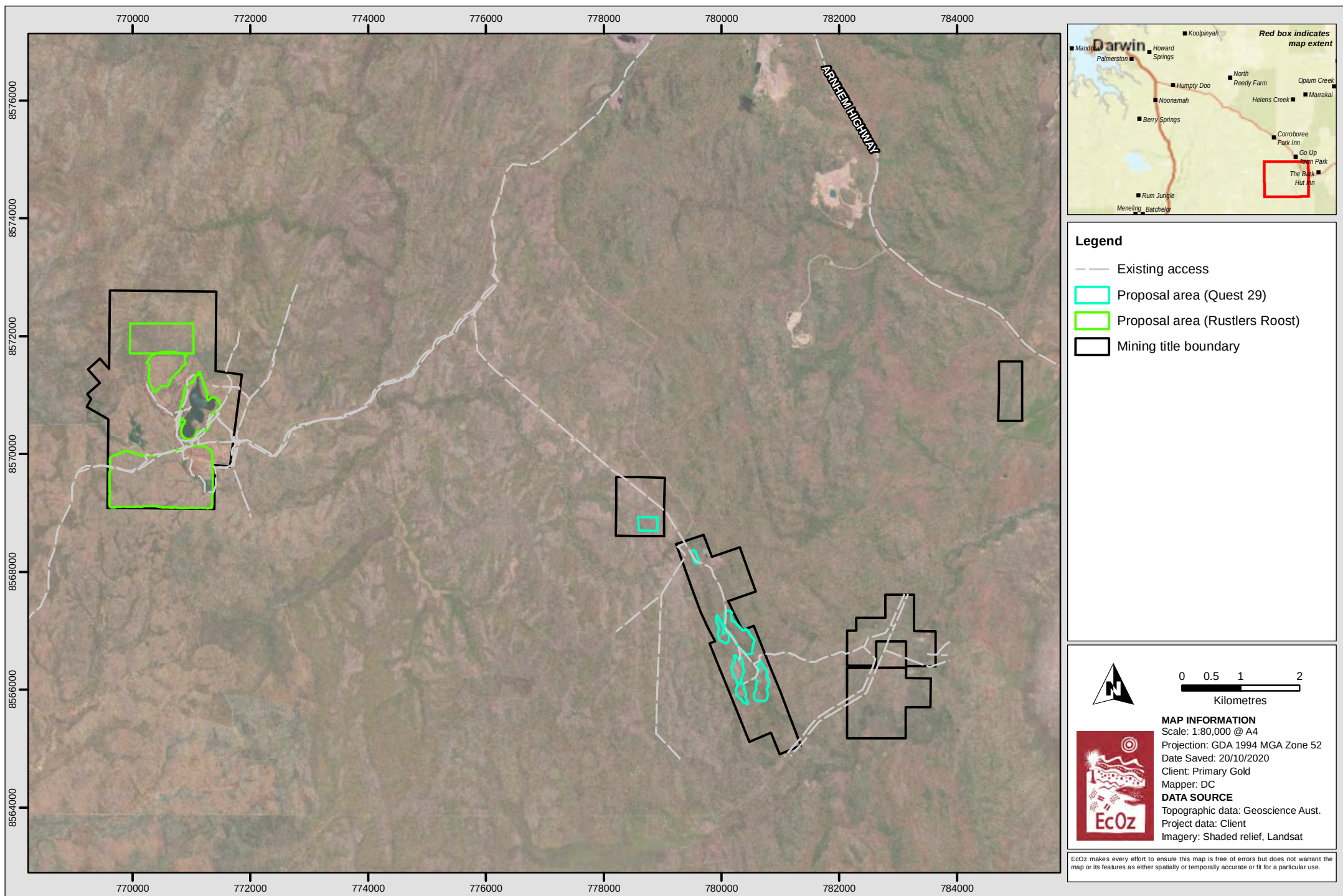
1 INTRODUCTION

The Rustlers Roost and Quest 29 (here-in referred to as the *proposal area*) is a brownfields site with a history of gold mining activity on mineral leases located in the Mount Bunday locality, approximately 100 km south-east of Darwin (Figure 1-1). Primary Gold Limited is proposing to redevelop the proposal area, expanding open-cut gold mining operations. The action is being referred to the NT EPA for consideration under section 48 of the *Environmental Protection Act*.

Flora and fauna values in the broader mining leases have previously been assessed and surveyed by Low Ecological in 2016 and 2017. The Flora and Fauna Division at the Department of Environment and Natural Resources (DENR) advised that this survey effort for fauna was adequate, but that further flora surveys were required. EcOz were engaged to undertake vegetation surveys to address the outstanding information gaps for the proposal area. The purpose of these surveys is to:

- Verify available land unit mapping within the proposal area.
- Document riparian habitat value and current condition within, and adjacent to, the proposal area.
- Survey for the Endangered sub-shrub *Helicteres macrothrix* where there is suitable habitat within the proposal area.
- Assess habitat suitability for the Endangered trigger plant *Stylidium ensatum*.

This report presents the methodology and results of the above surveys which were conducted in September and October 2020. *Stylidium ensatum* detection surveys can only be conducted in June and July when flowering and fruiting occurs, therefore only a habitat suitability assessment was possible at this time.



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Figure 1. Map of project location and proposal area

2 VEGETATION SURVEYS

2.1 Land unit mapping

2.1.1 Methods

This survey focused on 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).

Existing land unit mapping of the region is outlined in the *Report of the land units of the Western Section of Annaburroo Station, Northern Territory* (Fett & Hall 1983) at a scale of 1:25,000. The report mapped five land units as occurring within the proposal area.

The aim of this survey was to verify that the existing land units assigned to the proposal area were correct in areas that have not been previously surveyed by Low Ecology (LES 2017). The proposal area was visited between 28 September – 1 October by botanist Nicole Clark and ecologist Clare Millen to ground-truth the existing land units.

In preparation for the field visit, proposed vegetation assessment sites (VS) and photo sites (PS) were plotted on a geo-rectified map, using a combination of land unit mapping and aerial imagery. Sites were placed in the centre of each land unit, and/or where aerial imagery showed a potential change in land units (Figure 2, Figure 3). The following information was collected for each site:

- Landform – indicating topography of the land, aspect and slope (%)
- Soil and landform types based on surface characteristics (i.e. presence of surface gravel/rock outcrops or inundation areas) and digital photos of surface soils.
- Drainage potential (rapid, well or poor).
- Broad vegetation description for characterisation to a standard equivalent to Level V of the National Vegetation Information System, in line with the NT Guidelines and Field Methodology (Brocklehurst et al. 2007). Within each stratum (upper, mid and ground), the three dominant species were recorded and general structure was noted.
- Disturbance – presence of weeds, fire history and signs of feral animals.

2.1.2 Results

Five land units were recorded in the proposal area; these are summarised in Table 1, and displayed in Figure 2 and Figure 3. Vegetation and soils were generally consistent with existing land unit descriptions, with only some minor corrections made. It is noted that 25% of the proposal area has been disturbed due to mining activities. This has been demarcated in the corrected land unit mapping. See Appendix A for a detailed description of each land unit.

Land unit 2b – occurring in Rustlers Roost only

This was the overall dominant land unit accounting for 60% of the total proposal area, but only occurred within Rustlers Roost (Figure 2). The landform was rises and ridges with some deep gullies (ranging between 4 – 6 m) and slopes between 6 – 15 %, with extensive surface stone outcrops. The vegetation in the upper strata comprised of *Corymbia polysciada*, *Eucalyptus miniata*, *Corymbia dichromophloia* and occasional *Eucalyptus tintinnans* low to mid high open woodland; lower woodland occurred on the slopes. It was not uncommon for *Erythrophleum chlorostachys* to grow as tall as the upper strata species. The mid strata comprised of *Erythrophleum chlorostachys*, *Corymbia dichromophloia* and *Gardenia megasperma* mid-high open shrubland to shrubland. Other common shrubs recorded at photo point assessment sites

included *Livistona humilis*, *Grevillea decurrens*, *Buchanania obovata* and *Acacia* sp. The understorey (ground cover) was dominated by patchy grasses, although these were poorly represented at the time of survey due to the dry conditions. The most commonly encountered species in the ground cover were *Eriachne* sp., *Heteropogon triticeus* and *Triodia bitextura* low to mid high open tussock grassland.

Soils were brown sandy loam with high surface gravels (small pebbles) on the lateritic upland plateaux and yellow/brown sandy clay loam on the hills/ridges with greater amount of siltstones and sandstones.

There was one slight variation in landform, and thus vegetation/soil composition, within land unit 2b – the presence of upland plateaux with more lateritic surface gravels (often smaller pebbles than those recorded throughout remaining of land unit 2b). Vegetation comprised of *Eucalyptus tetradonta* and minor *Eucalyptus miniata*, with a mid-stratum of *Eucalyptus* saplings, *Erythrophleum chlorostachys*, *Livistona humilis* open shrubland, over a ground cover of *Petalostigma quadriculare* and mixed grasses. The trees were taller (to ~14m) in these areas. An additional vegetation assessment site was undertaken to capture this variation.

There was one minor open depression/drainage system within Rustlers Roost north. The vegetation comprised of tussock grassland dominated by *Eriachne* sp., *Themeda triandra* with isolated trees which were mostly wet-indicator species; *Corymbia polycarpa*, *Xanthostemon paradoxus*, *Syzygium eucalyptoides*, and *Eucalyptus bigalerita*.

Land unit 2b was the main land unit occurring within Rustlers Roost – in the southern portion species composition and surface soils were similar to the northern section; however, the landform was more undulating, with more minor open depressions and less gullies present.

Land unit 2a – occurring in Quest 29 only

Land unit 2a was found to be largely consistent with existing land unit mapping; however, the existing land unit area was corrected to capture a drainage system which is an extension of land unit 6a (Figure 3). The landform was hills and ridges with some steep slopes. The vegetation in the upper strata was comprised of *Eucalyptus miniata*, *Corymbia polycarpa*, *Corymbia dichromophloia* and occasional *Corymbia clavigera* low to mid high open woodland, with an *Erythrophleum chlorostachys* and *Corymbia dichromophloia* open shrubland, over *Eriachne* sp. and *Triodia bitextura* tussock grassland. The weed *Hyptis suaveolens* was a common ground cover within Quest 29. This land unit had skeletal soils made up of greyish/brown sandy clay loam.

Land unit 3a – occurring in Quest 29 only

Land unit 3a was generally consistent with existing land units in terms of landform – low rounded hills with some upland surfaces and erosion potential; however, the species present were slightly different – *Eucalyptus miniata* was one of the dominant species recorded during field investigations, a species which is not recorded within the existing land unit vegetation description. The vegetation in the upper strata comprised of *Eucalyptus miniata*, *Corymbia* sp., *Corymbia clavigera* mid-high woodland with an *Erythrophleum chlorostachys*, *Acacia auriculiformis* and *Calytrix exstipulata* shrubland, over dense leaf litter and sparse tussock grassland. Soils were shallow brown sandy loam with scattered surface gravel.

Land unit 6a – occurring in Quest 29 only

Some key characteristics (landform, soil and vegetation) within the existing land unit 6a (located south of Quest 29) remains intact, but field investigations found a portion was disturbed. The landform was defined as a creek channel ranging in width and depths forming large pools in places. Vegetation comprised of riparian and monsoon vine species, with an upper stratum of *Corymbia bella* and *Corymbia polycarpa*, *Ficus racemosa* and occasional *Melaleuca leucadendra*, *Alstonia actinophylla*, *Barringtonia acutangula* and Banyan trees mid high woodland to open forest, over *Erythrophleum chlorostachys*, *Terminalia* sp., and *Acacia auriculiformis* open shrubland and occasional *Planchonia careya* over *Aristida* sp., and *Hyptis suaveolens* mid high open tussock grassland. Soils were yellowish/brown sandy clay.

Land unit 6a1 – occurring in both Rustlers Roost and Quest 29

Land unit 6a1 occurred in the south of Rustlers Roost, and in a minor section in Quest 29 north (Figure 2 and Figure 3) and was consistent with the existing land unit description – i.e. associated with minor creek lines and broad drainage systems. The vegetation in the upper strata comprised of mixed *Corymbia* species; *Corymbia bella*, *Corymbia polycarpa* and *Corymbia grandiflora* mid high (10 to 15 m tall) and occasional *Eucalypt bigalerita* woodland over shrubland of mixed species over *Eriachne sp* and *Mnesithea sp.* sparse tussock grassland. Soils varied between the sites. At Rustlers Roost there was reddish/brown sandy clay within creek bed, with more skeletal soils on the upper bank. At Quest 29, soils were yellow/brown sandy clay with less surface gravel present.

Disturbed areas

Several areas within the proposal area at both Rustlers Roost and Quest 29 had been previously cleared and were highly modified and/or disturbed, and so were classed as 'disturbance areas' rather than as a land unit (see Figure 2 and Figure 3). These areas contained establishing native flora species such as Acacias and Eucalypts; weeds were commonly recorded within these areas.

2.1.3 Weeds and other disturbance

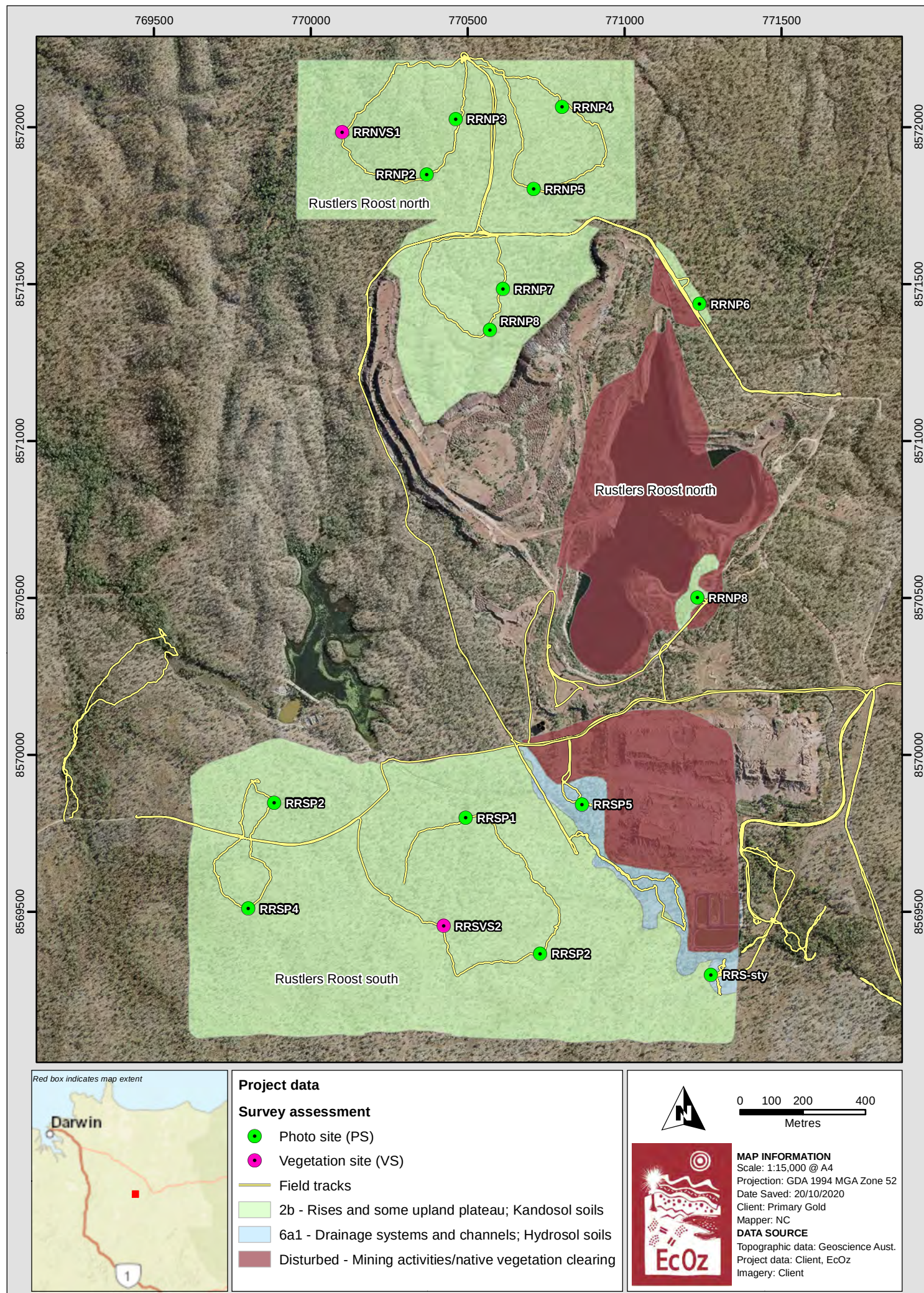
Invasive weed species incidentally observed within proposal area were recorded, with the majority established in disturbed areas, and occasionally occurring in native bushland. The declared weed species, Hyptis (*Hyptis suaveolens*) was the most abundant within the proposal area; it was recorded in high densities in Quest 29 south. Scattered Perennial Mission Grass (*Cenchrus polystachios*) and Gamba Grass (*Andropogon gayanus*) were also observed, mostly within Quest 29 south and along roadsides. Other weed species included *Sida sp.* Detailed weed data are presented in Appendix A.

Gamba Grass and Perennial Mission Grass are listed as Class B weeds under the NT *Weeds Management Act*, with Gamba Grass also listed as a Weed of National Significance (WoNS).

Pigs and cattle were commonly observed in the proposal areas, mainly located around drainage channels and remaining pools at Quest 29.

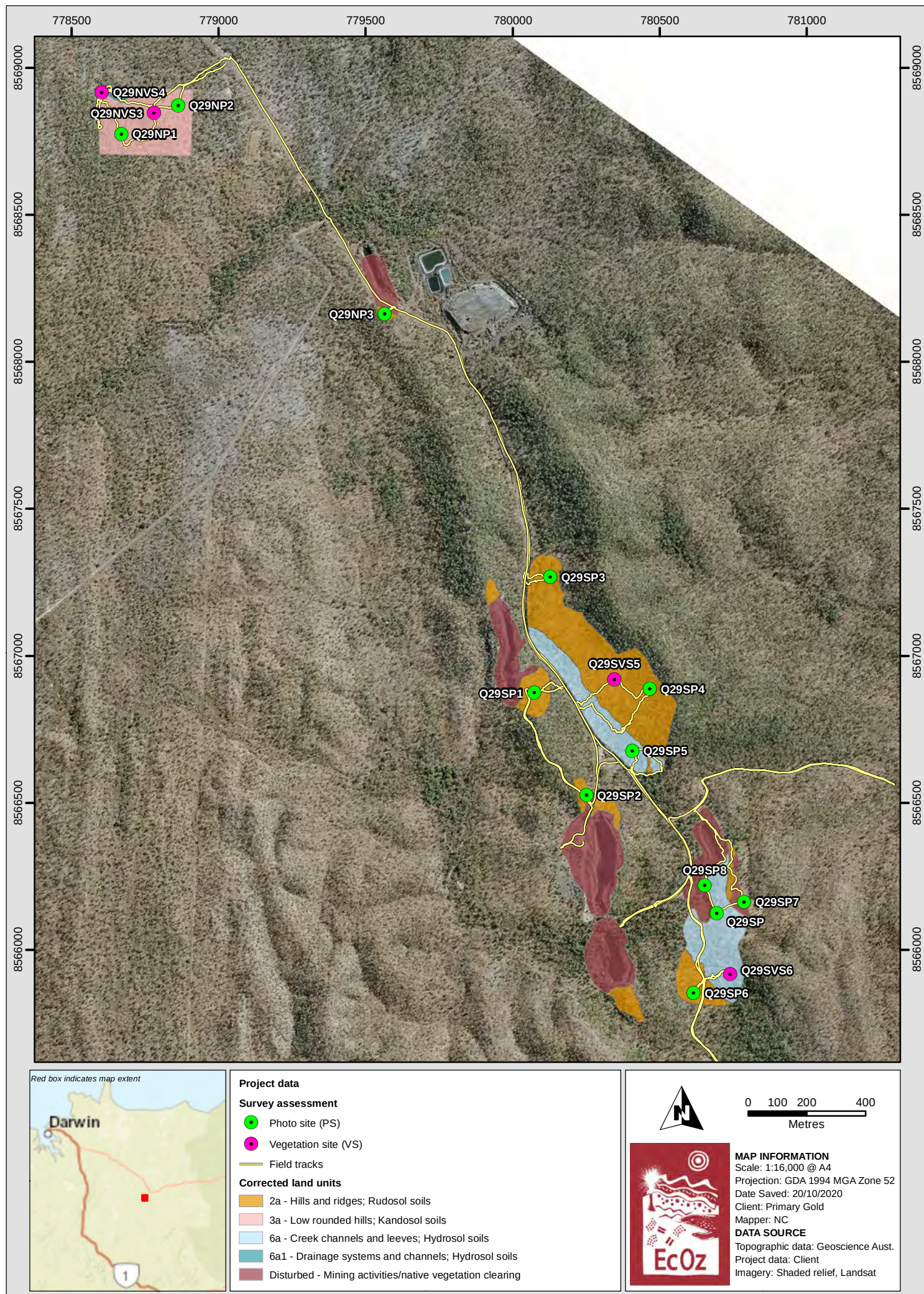
Table 1. Land units within the proposal area

Land unit	Survey sites	Landform	Soil	Vegetation	Area (ha)
2b	RRNVS1, RRSVS2, RRNP2, RRNP3, RRNP4, RRNP5, RRNP6, RRNP7, RRNP8, RRNP8, RRSP1, RRSP2, RRSP2, RRSP4, RRSP5	Rises and ridges; some upland plateaus; Well drained (nil to low level waterlogging); slope 6 to 15 %	Kandosol; mix of lateritic soils; brown sandy loam with high surface gravels (small pebbles) and siltstones and sandstones (larger in size); yellow/brown sandy clay loam	Rises and ridges: <i>Corymbia polysciada</i> , <i>Eucalyptus miniata</i> , <i>Corymbia dichromophloia</i> (V1) and occasional <i>Eucalyptus tintinnans</i> low to mid high open woodland, over <i>Erythrophleum chlorostachys</i> , <i>Corymbia dichromophloia</i> and <i>Gardenia megasperma</i> mid high open shrubland to shrubland, over <i>Eriachne</i> sp., <i>Heteropogon triticeus</i> and <i>Triodia bitextura</i> low to mid high open tussock grassland. Upland plateau: <i>Eucalyptus tetrodonta/miniata</i> woodland over Eucalypt saplings, <i>Erythrophleum chlorostachys</i> , <i>Livistona humilis</i> open shrubland and a ground cover of <i>Petalostigma quadriloculare</i> , and mixed grasses.	214.5
2a	Q29SVS5, Q29NP3, Q29SP1, Q29SP2, Q29SP3, Q29SP4, Q29SP5, Q29SP6, Q29SP7	Hills and ridges with some steep slopes; very well drained; slope >10%	Rudosol; Skeletal soils; greyish/brown sandy clay loam.	<i>Eucalyptus miniata</i> , <i>Corymbia polysciada</i> , <i>Corymbia dichromophloia</i> and <i>Corymbia clavigera</i> low to mid high open woodland, over <i>Erythrophleum chlorostachys</i> , <i>Corymbia dichromophloia</i> open shrubland, over <i>Eriachne</i> sp., and <i>Triodia bitextura</i> tussock grassland.	18.3
3a	Q29NVS3, Q29NP1, Q29NP2	Low rounded hills; some upland surfaces; well drained (nil to low level waterlogging); slope 3 to 4 %.	Kandosol; Brown sandy loam, shallow soils; scattered surface gravel present	<i>Eucalyptus miniata</i> , <i>Corymbia</i> sp., <i>Corymbia clavigera</i> mid high woodland over <i>Erythrophleum chlorostachys</i> , <i>Acacia auriculiformis</i> , <i>Calytrix exstipulata</i> shrubland, over leaf litter and <i>Eriachne</i> sp. sparse tussock grassland	13.9
6a	Q29SVS6, Q29SP, Q29SP8	Creek channel ranging in width and depths forming large pools; poorly drained (wet season waterlogging); slope 1 to 4 %.	Hydrosol; Yellowish/brown sandy clay	<i>Corymbia bella</i> , <i>Corymbia polycarpa</i> , <i>Ficus racemosa</i> and occasional <i>Melaleuca leucadendra</i> , <i>Alstonia actinophylla</i> , <i>Barringtonia acutangula</i> and Banyan trees mid high woodland to open forest, over <i>Erythrophleum chlorostachys</i> , <i>Terminalia</i> sp., and <i>Acacia auriculiformis</i> and occasional <i>Planchonia careya</i> open shrubland, over <i>Aristida</i> sp., and <i>Hyptis</i> mid high open tussock grassland.	9.9
6a1	Q29NVS4, RRS-sty	Minor creek lines and broad drainage systems; poorly drained (wet season waterlogging); slope 1 to 6 %	Hydrosol; Soils vary between sites; reddish/brown sandy clay within creek bed at Rustlers Roost, and more skeletal on the upper bank and yellow/brown sandy clay at Quest 29 with less surface gravel	Mixed <i>Corymbia</i> species; <i>Corymbia bella</i> , <i>Corymbia polycarpa</i> and <i>Corymbia grandiflora</i> mid high (10 -15 m tall) and occasional <i>Eucalypt bigalerita</i> and <i>Eucalyptus tectifica</i> woodland over shrubland of mixed species over <i>Eriachne</i> sp. and <i>Mnesithea</i> sp. sparse tussock grassland.	9.1



Path: Z:\01 EcoZ_Documents\04 EcoZ Vantage GIS\EZ20181 - Rustlers Roost and Quest29 Ecology Report\01 Project Files\Figure 2. Map of corrected land units within Rustlers Roost proposal area.mxd

Figure 2. Map of corrected land unit within Rustlers Roost proposal area



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Figure 3. Map of corrected land units within Quest 29 proposal area

2.2 Riparian habitat assessment

Riparian vegetation is defined as native vegetation surrounding a waterway and plays a critical role in protecting wetland systems, providing habitat, shade and food resources for native fauna, maintaining nutrient levels in waterways, and providing bank stabilisation (DENR 2020). The aim of the riparian habitat assessment was to collect baseline information about community structure, and assess the riparian habitat value and current condition of riparian areas both upstream and downstream of the proposal area.

2.2.1 Methods

Riparian surveys were undertaken on 31 October 2020. In preparation, potential riparian areas were plotted on a geo-rectified map, using a combination of aerial imagery and surface water drainage mapping. Riparian areas within the proposal areas had been surveyed as part of the land unit mapping surveys and these results are also discussed below.

2.2.2 Results

Rustlers Roost

Four riparian areas within and adjacent to Rustlers Roost were visited – two to the west of the Rustlers Roost proposal area, one to the east, and one within the proposal area on the eastern edge (Figure 9). The proposal area at Rustlers Roost south sits at the top of two catchments; the riparian survey sites were located to capture both catchments. All were downstream of the proposal area; due to its position in the catchments, there is no upstream riparian habitat at Rustlers Roost.

Eastern side

Generally, the riparian vegetation in the eastern riparian areas was comprised of mixed Eucalypts (*Corymbia polycarpa*, *Eucalyptus bigalerita*, *Eucalyptus tectifica*) and occasional *Melaleuca viridiflora* mid-high woodland in the upper strata, over *Alphitonia excelsa*, *Erythrophleum chlorostachys*, *Terminalia* sp., *Acacia auriculiformis*, *Xanthostemon paradoxus* shrubland. Ground cover was relatively sparse in the creek bed with some *Pandanus spiralis* and mixed tussock grasses including *Themeda triandra*, *Aristida* sp. and *Sorghum* sp. occurring on the upper banks (Figure 4).



Figure 4. Photographs of riparian vegetation on the eastern side of Rustlers Roost south

There was one open forest patch recorded at site *RP8-DS* (Figure 9). In this patch, the species composition was similar to other downstream sites, with additional monsoon species; *Maranthes corymbosa* and some large Milkwood trees were recorded.

The main channel ranged between 2 – 10 m, with a few small pools, and the flow path was draining to the east. Much of the riparian area was disturbed due to mining activities adjacent to the main channel. Weeds were common along the banks (*Hyptis suaveolens* and *Sida* sp.). Some clearing of vegetation near tracks and stockpiling of fill material from mining activities was observed. Pigs and cattle were common through this area and observed on numerous occasions during field investigations.



Figure 5. Photographs of open forest patch at Rustlers Roost (site RP8-DS)

Western side

The riparian vegetation on the western side was more intact and the survey sites were free of weeds. The vegetation at site RP7-US was fringed by *Corymbia polycarpa* (8 – 10 m tall) open woodland in the upper strata, over *Melaleuca* sp and *Pandanus spiralis* woodland to open forest (6 – 8 m) tall, over *Themeda triandra* on the upper banks.

The vegetation recorded at site RP6-US was most representative of undisturbed riparian vegetation and was classified as a closed forest patch (Figure 6). The vegetation comprised of *Corymbia polycarpa* and *Erythrophleum chlorostachys* mid-high closed forest (18 – 20 m tall trees) over *Terminalia* sp, *Lophostemon lactifluus*, and *Alstonia actinophylla* shrubland.

The vegetation was edging a meandering 4 m wide channel, 1 m deep. Water was clear, trickling to the north-west. Ferns and Native Olive Hymenachne (*Hymenachne acutigluma*) were present in the water. There was evidence of groundwater seepage adjacent to the stream (Figure 7).



Figure 6. Photographs of riparian vegetation along channel at site RP6-US



Figure 7. Photographs of groundwater seepage at site RP6-US

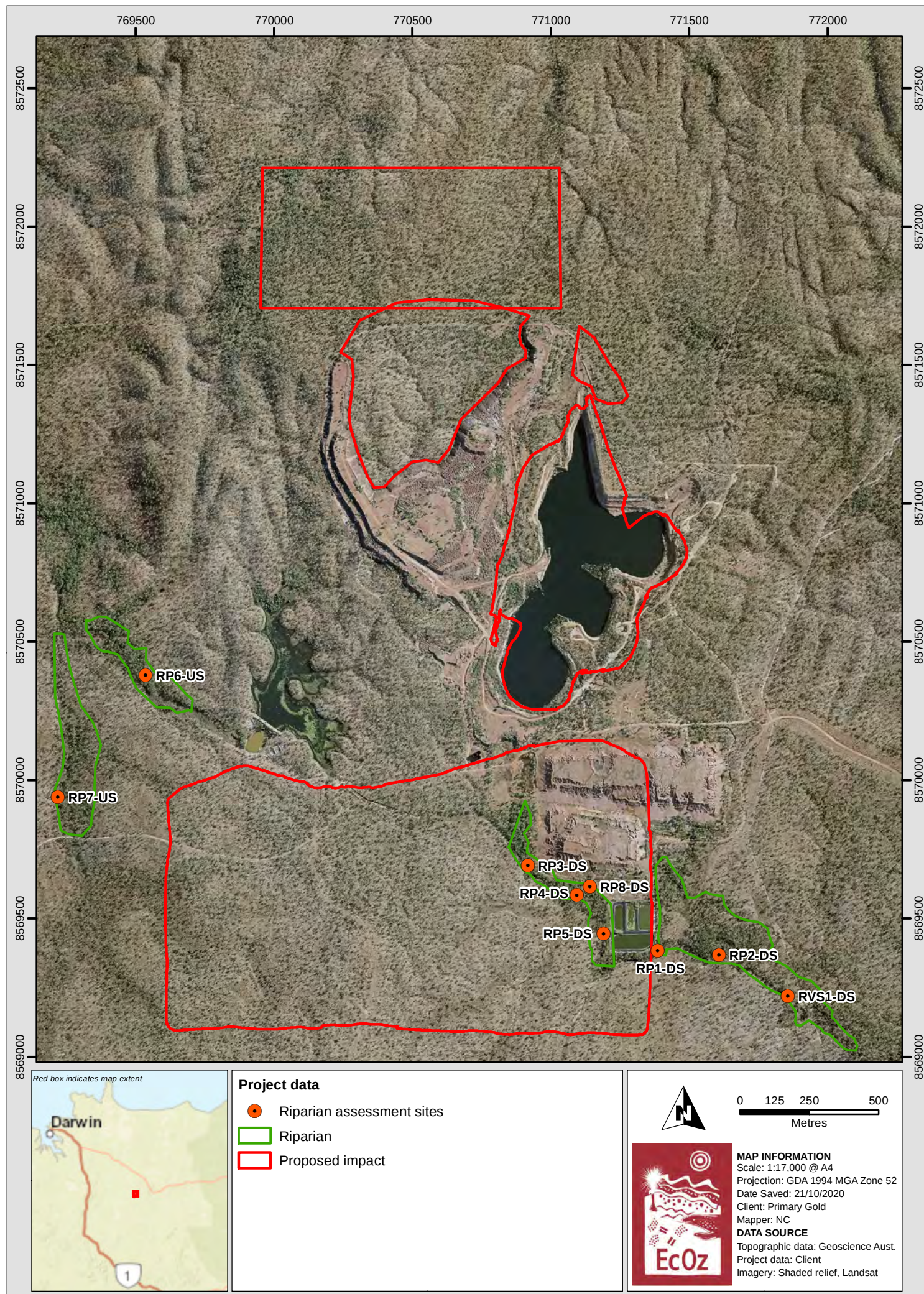
Quest 29

Like Rustlers Roost, because of its position in the catchment there is no riparian habitat upstream of Quest 29. Riparian areas within Quest 29 were surveyed as part of the land unit mapping surveys (Figure 3) and were attributed to land unit 6a.

Much of the riparian vegetation within Quest 29 proposal area had been disturbed, with original native vegetation already cleared and large stockpiles of fill material present adjacent to the riparian zones (Figure 8). The riparian vegetation at Quest 29 was patches of open forest to closed forest along the channel associated with land unit 6a (refer Figure 3). See Appendix A for vegetation/soil descriptions.



Figure 8. Photographs of riparian habitat at sites Q29SP5 (right) and Q29SVS6 (left)



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ20181 - Rustlers Roost and Quest29 Ecology Report\01 Project Files\Figure 4. Map of Riparian survey areas within Rustlers Roost and outside of proposal area.mxd

Figure 9. Map of riparian survey areas within and adjacent to Rustlers Roost

2.3 *Helicteres macrothrix* survey

This section presents the methodology and results of a targeted survey for *H. macrothrix* conducted in September and October 2020 as part of the ecological assessment for the proposal area.

2.3.1 Status and ecology

Helicteres macrothrix is a multi-stemmed subshrub, one of approximately 13 species of the genus *Helicteres* from the Northern Territory (Cowie 2011). *H. macrothrix* is endemic to the Northern Territory and is listed as Endangered under both the *Territory Parks and Wildlife Conservation Act* and the *Commonwealth Environment Protection and Biodiversity Conservation Act*.

The species grows to 50 cm tall with ascending to erect branches, pink to purple flowers, and fruits, leaves and branches that are green and woolly-hairy. The aerial parts of the plant are annual, with perennial root stock. The plant is known to re-sprout from root stock, often vigorously, after fire. The species has been recorded from three populations – near Mt Bundey, near Batchelor and in the Lake Bennett area. The known extent of occurrence for this species is 915 km². *H. macrothrix* flowers from November to March and fruits from January to March (DENR 2012).

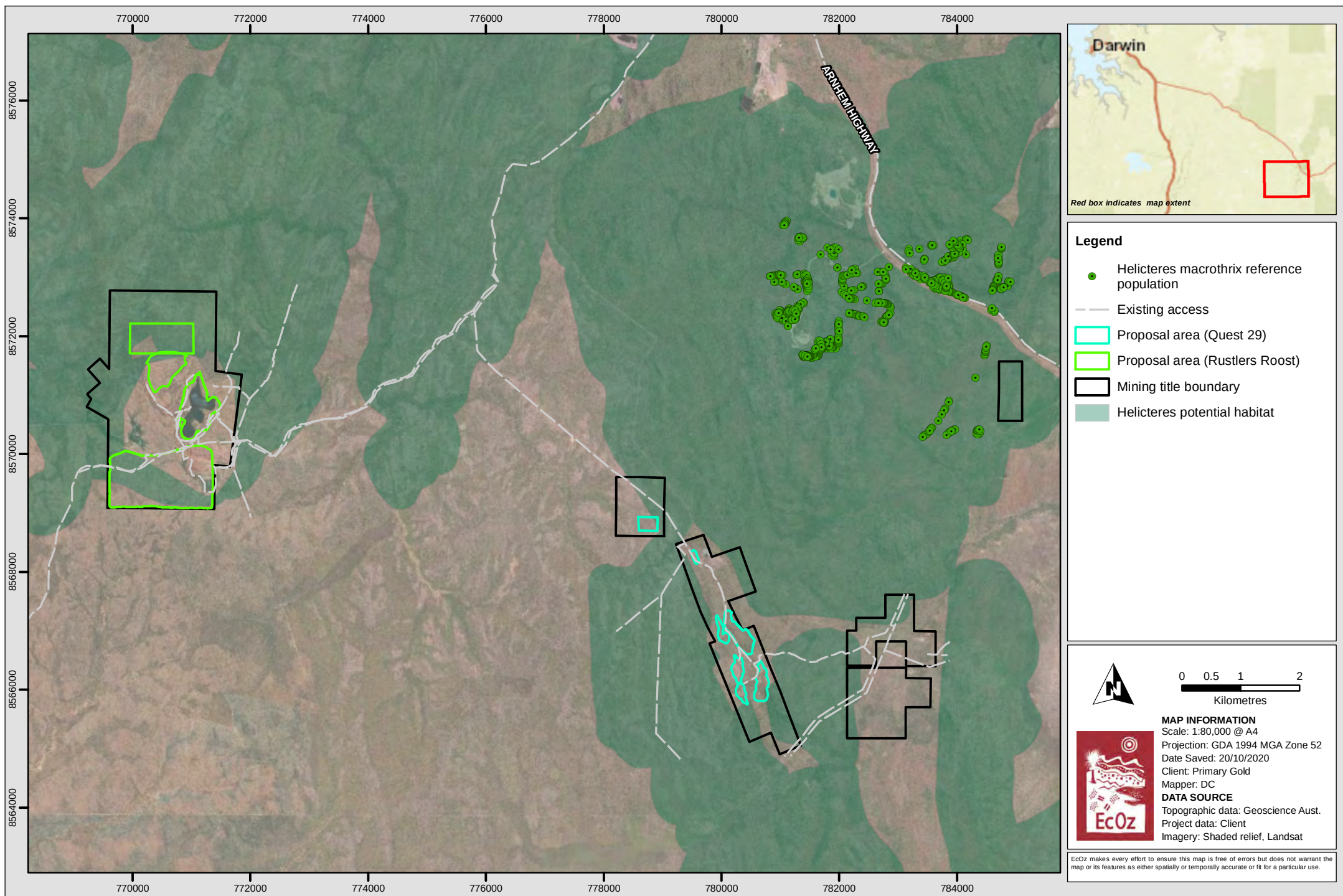
This species is associated with *Eucalyptus tectifica*, *E. miniata* and/or *E. tetradonta* woodland on clayey soils derived from siltstone or sandier soils derived from the granite-like rock syenite.



Figure 10. Photographs of *Helicteres macrothrix* leaves and flowers. Images I. D. Cowie

2.3.2 Known extent of occurrence

The NT Government has mapped the extent of occurrence of *H. macrothrix* based on known recorded locations (DLRM 2016a). Potential habitat for the species has been modelled from historical land resource information that includes existing land unit, vegetation and geological mapping. This model serves as a guide to identify areas where the species may be present (DLRM 2016a). While the species has not previously been recorded from the Rustlers Roost or Quest 29 mining lease area, the model identified approximately 133 ha of potential *H. macrothrix* habitat within the proposed area at both the Rustlers Roost and Quest 29 sites (Figure 11).



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Figure 11. Map of *Helicteres macrothrix* modelled habitat and reference population at Mt Bunday

2.3.3 Methods

The field surveys were led by ecologists Clare Millen and Nicole Clark, who have extensive experience in undertaking vegetation surveys in the Top End, including surveys for and identification of threatened flora. They were assisted by Cameron Jones.

Pre-survey preparation

Advice was sought from DENR regarding best practice field methods to detect *Helicteres macrothrix*. Prior to the field survey, surveyors visited the NT Herbarium to inspect the diagnostic features of the plant in the available reference material, to assist with identification in the field. Other species within the genus including *H. darwinensis*, *H. cana* and *H. angustifolia* can be similar in appearance; these species were also examined at the NT Herbarium for comparison.

A reference site at McKinlay Quarry in Mt Bunday – approximately 5 km north-east of Quest 29 and 12 km east of Rustlers Roost – with a known *H. macrothrix* population was visited at the time of the field surveys to confirm the presence, habitat, phenological state and detectability of the species in the general area.

Although the above ground parts of the plants at the reference site were senesced and the leaves were in poor condition, they were readily detectable in unburnt habitat by meandering through the area.

In burnt areas at the reference site, where a late season burn had been recorded in August 2020 (NAFI 2020) the plant was not detected. Although the plant has been observed to re-sprout vigorously after a fire, the intensity of a late season burn – and the particularly dry conditions at the time of survey – may have delayed re-sprouting.

The field methodology assumes that any *H. macrothrix* plants in unburnt habitat within the proposal area would be in a comparable phenological state and have similar detectability to plants observed at the reference site.

Field survey

The *H. macrothrix* field surveys were undertaken over four days between 15 and 17 September, and on 1 October 2020. As advised by DENR, areas of modelled potential habitat within the proposed area were searched on foot by multiple observers following transects spaced 25 m apart which were pre-loaded onto hand held GPS units. Transects were placed perpendicular to the general direction of contours to ensure good coverage of topography, maximising the chance of detecting sub-populations.

In the two small survey areas in the southern portion of Quest 29, a meander technique was utilised due to the very small size of these areas, and the steep topography in places being unsuitable for transects.

GPS track log data was saved to record the survey range and effort. The differing habitat types encountered through the project area were recorded and photographed.

It is noted that the polygons constituting the proposed area were slightly modified after surveying had begun. This meant that in the northern portion of Quest 29, an area exceeding the final proposed area was surveyed because it followed the polygons provided at the time of surveying (Figure 13). In the southern portion of Rustlers Roost, an area approximately 4 ha smaller than the final proposed impact area was surveyed (Figure 14); however, vegetation surveys confirmed that the habitat types in that portion remained consistent, and transect length coverage within the polygon still satisfied the minimum coverage of km/ha recommended by DENR. All other potential *H. macrothrix* habitat within the final proposed area was surveyed via transects spaced 25 m apart.

2.3.4 Results and discussion

Rustlers Roost and Quest 29 were both observed to contain large areas of potentially-suitable open woodland habitat, with dominant upper strata species often being the three species associated with *H. macrothrix* – commonly *Eucalyptus miniata* and *E. tetradonta*, and less commonly, patches of *E. tectifica* – on slopes and rises over soils ranging from sandy loam to silty clay. This was interspersed with patches of less suitable habitat; *E. tintinnans* and *Corymbia*-dominated open woodland on hills and rises, and *Sorghum* grasslands with scattered *E. polycarpa* in alluvial clay depressions. The southern portion of Quest 29 was highly disturbed, with the ground strata often dominated by the declared weed *Hyptis suaveolens*; this area did not appear to contain suitable habitat for *H. macrothrix*. Appendix A provides further detail on the different habitat types recorded within the survey areas.

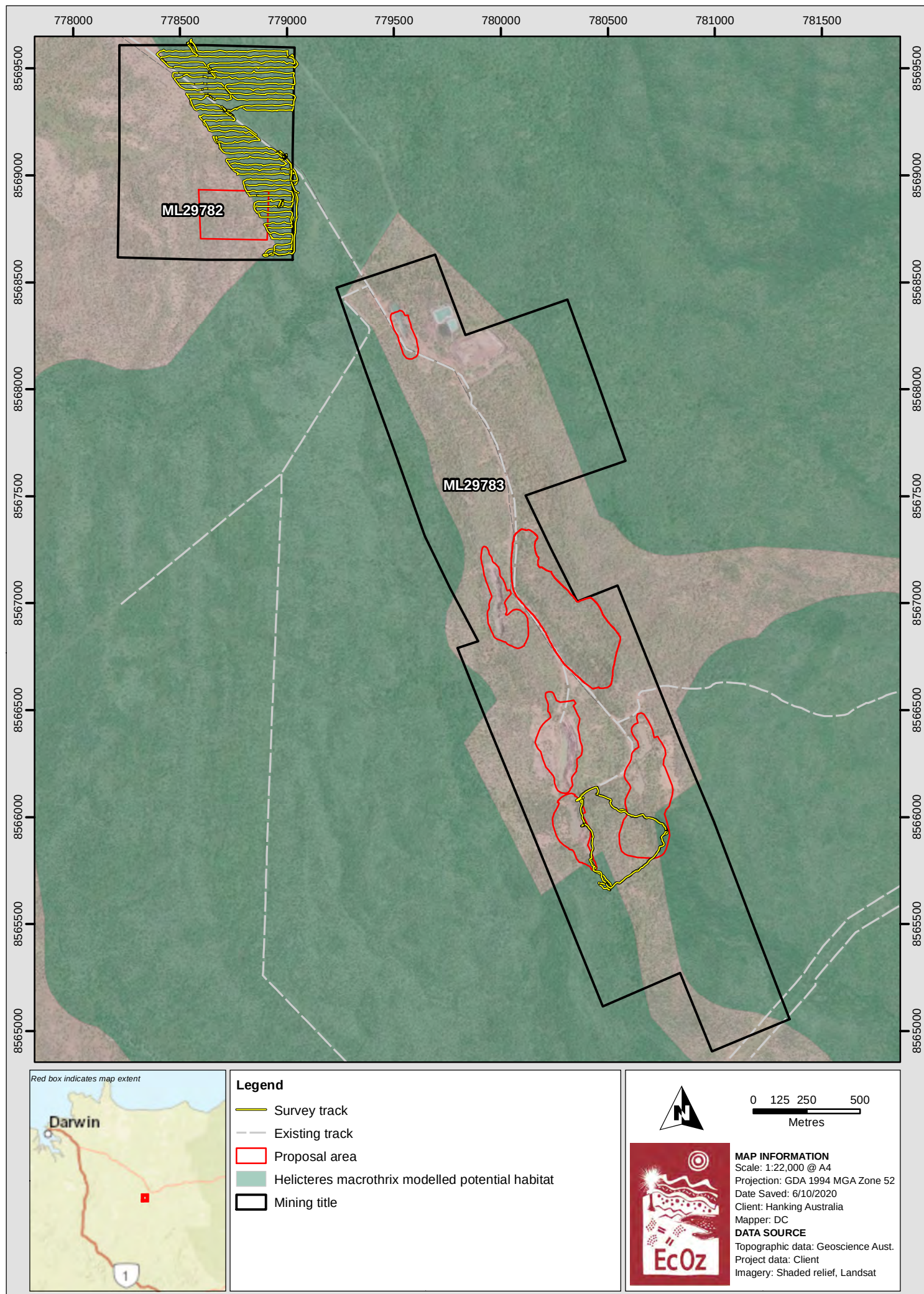
The vegetation cover at the time of surveying meant that visibility was generally good across all survey areas (Figure 12). In total, approximately 87 km were walked across approximately 168 ha of potential habitat (Figure 13, Figure 14). *H. macrothrix* was not detected during these surveys.

The similar looking *H. darwinensis* was commonly detected in the northern portion of Rustlers Roost. A specimen taken to the NT Herbarium was confirmed to be *H. darwinensis*. This species is more prostrate, smaller and less conspicuous than *H. macrothrix*. The fact that *H. darwinensis* was readily detectable via 25 m transects indicates that the survey method would likely have detected *H. macrothrix* if present, if in a similar distribution pattern and phenological state to the plants at the reference site.

Burnt grass stumps were observed in some parts of the northern portion of Quest 29, indicating that a burn had occurred sometime in the 2020 dry season. If this was a late season burn, it may have decreased detectability of *H. macrothrix* in burnt areas, as it had at the reference site; however, the habitat types were consistent throughout this survey area and *H. macrothrix* was not detected in the larger unburnt areas. With the updated proposed area, the northern portion of Quest 29 incorporated less than 1 ha of potential *H. macrothrix* habitat.

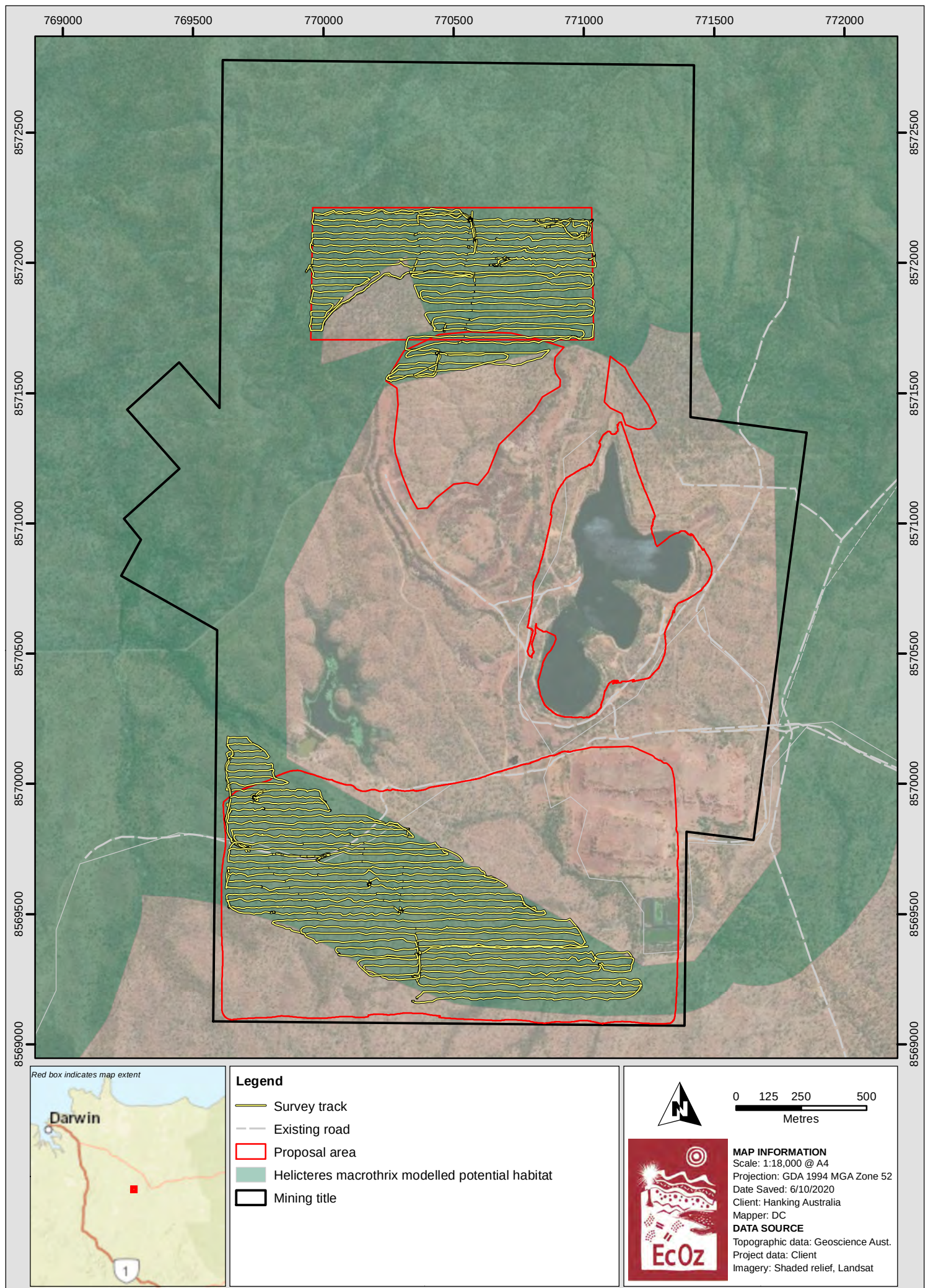


Figure 12. Photographs of typical open woodland habitat at Quest 29 (top) and Rustlers Roost (bottom)



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ20181 - Rustlers Roost and Quest29 Ecology Report\01 Project Files\Figure 2-1. Quest 29 - Helicteres macrothrix habitat and survey tracks.mxd

Figure 13. Map of *Helicteres macrothrix* survey tracks at Quest 29



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\IEZ20181 - Rustlers Roost and Quest29 Ecology Report\01 Project Files\Figure 2-2. Rustlers Roost - *Helicteres macrothrix* habitat and survey tracks.mxd

Figure 14. Map of *Helicteres macrothrix* survey tracks at Rustlers Roost

2.4 *Stylidium ensatum* habitat assessment

2.4.1 Status and ecology

The trigger plant, *Stylidium ensatum*, is endemic to the NT and is listed as Endangered under both the *Territory Parks and Wildlife Conservation Act* and the *Commonwealth Environment Protection and Biodiversity Conservation Act*.

The species grows to 22 cm tall, has sessile obovate or orbicular leaves attached to a short stem, and small pink flower with lobed petals, as shown in Figure 15. *S. ensatum* is a member of the *Stylidium* subgenus *Andersonia*, species known from South-east Asia and northern Australia (Bean 2000), where the climate is monsoonal and rainfall is strongly seasonal. As is typical of other species of *Stylidium*, *S. ensatum* is likely to germinate where water has recently receded in seepage areas and seasonally-inundated sites. Plants grow in the early dry season, and are best able to be detected between June and July when flowering and fruiting occurs (Donna Lewis, NT Herbarium, pers. comm. 2020).

Stylidium ensatum inhabits margins of drainage areas in damp heavy clay or peaty soil (Cowie & Westaway 2012), although it may prefer sandier or loamy soils (Ian Cowie, NT Herbarium, pers. comm. 2017). Suitable areas for *S. ensatum* tend to be adjacent to *Lophostemon* swamps, where surface moisture is maintained into the early to mid-dry season (Nick Cuff, NT Herbarium, pers. comm., 2017). The preferred habitat for *S. ensatum* generally supports *Melaleuca viridiflora*, *Eucalyptus alba* and *Lophostemon lactifluus*, but also perennial grasses such as *Eriachne burkittii*, *Pandanus spiralis*, *Osbeckia australiana* and scattered *Banksia dentata* (Donna Lewis, NT Herbarium, pers. comm. 2020).

2.4.2 Known extent of occurrence

The NT Government has mapped the extent of occurrence of *Stylidium ensatum* based on known recorded locations close to Darwin and a site at Hayes Creek (NTG 2016). Potential habitat for the species has been modelled from historical land resources that includes existing land unit and vegetation mapping, and defines areas of low and moderate-high likelihood habitat. The model serves as a guide to identify areas where the species may be present (NT Government 2016). While the species has not previously been recorded from the Mount Bunder region, habitat modelling indicates the potential for habitat in portions of the investigation area (Figure 18).



Figure 15. Photographs of *Stylidium ensatum* leaves and flower; plants from the Girraween Road location

2.4.3 Methods

The habitat model identified three areas totalling approximately 3 ha of potential *S. ensatum* habitat within the proposal area (Figure 18). A habitat survey was planned within each area to assess suitability. Species detection surveys could not be undertaken at this time as the plant is only detectable when it is flowering and fruiting in June and July (Donna Lewis, NT Herbarium, pers. comm. 2020).

The following habitat features are preferred by *S. ensatum* and were used to assess habitat suitability:

- Margins of drainage systems; 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 *Melaleuca* spp. and/or *Lophostemon lactifluus*, *Pandanus spiralis*.
- Ground layer incorporating grasses and herbs that occur in poorly-drained habitats.
- Relatively open overstorey.

2.4.4 Results

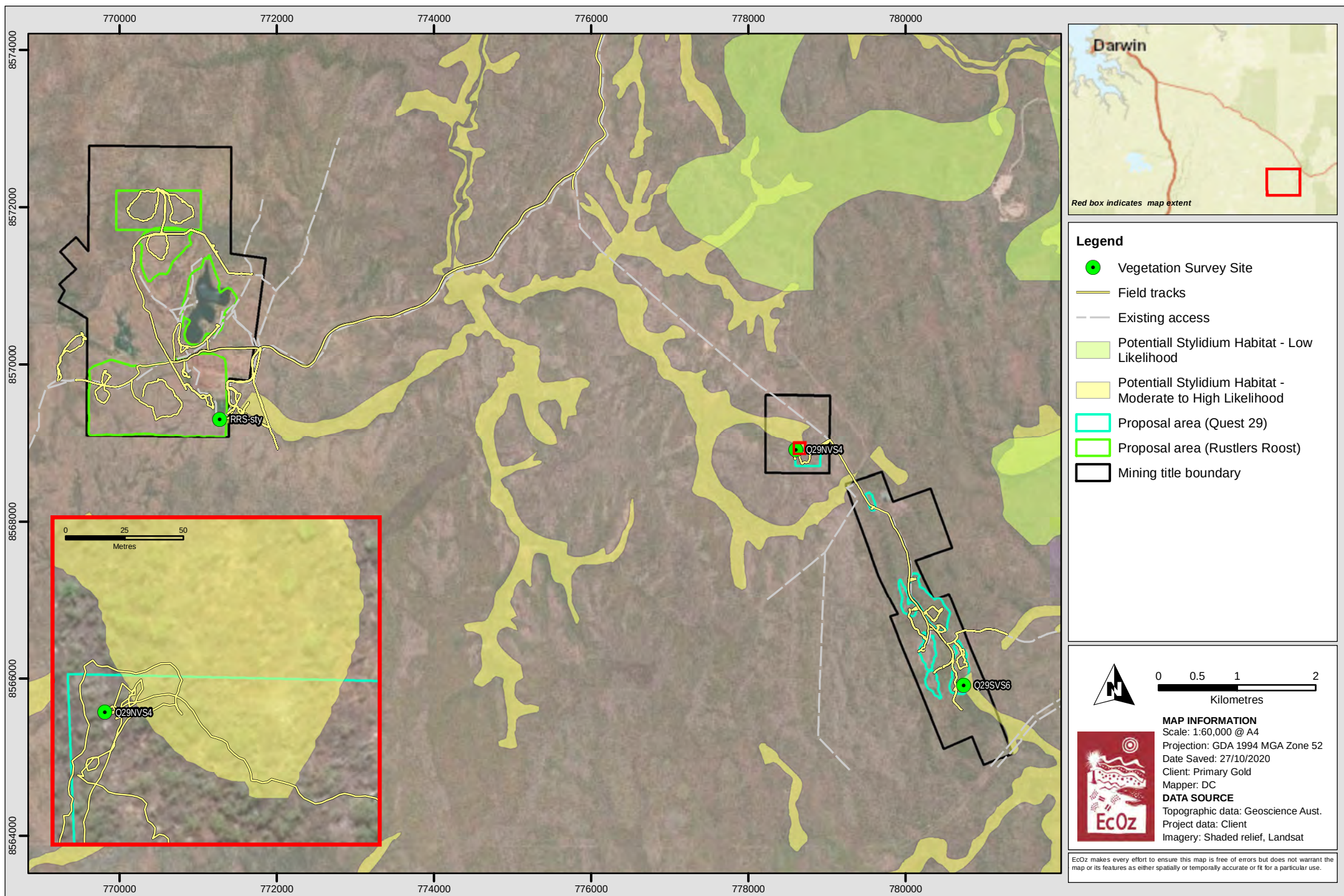
Habitat surveys were conducted in October 2020. Of the three areas modelled as potential habitat, only one approximately 3,000m² area in Quest 29 North – conforming to vegetation site Q29NVS1 – was considered to be marginally-suitable habitat for *Stylidium ensatum* based on landform and soil type (Figure 16). This site was an alluvial plain with yellowish-brown organic sandy clay soils and poor drainage, and may have a higher water-holding capacity later into the dry season compared to the other modelled areas. The vegetation was classed as open woodland but it did not contain the overstorey species generally associated with *Stylidium ensatum*. Groundcovers were sparse, perhaps due to dry conditions, but did include some sedge species, indicating a seasonally-inundated area. This area was assessed to be marginally-suitable habitat for *Stylidium ensatum*. The two remaining modelled areas at Quest 29 South and Rustlers Roost were evidently seasonally-saturated but were dry at the surface at the time of the survey. These were associated with channel systems and had red kandosol soils with scattered surface gravels present (Figure 17) indicating relatively well-drained areas; therefore, these modelled areas are unlikely to provide suitable habitat for *Stylidium ensatum*.



Figure 16. Photographs showing marginally-suitable *S. ensatum* habitat at Site Q29NVS4



Figure 17. Photographs showing unsuitable habitat at Site RRS-Sty (left) and Q29SVS6 (right)



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ20181 - Rustlers Roost and Quest29 Ecology Report\01 Project Files\Figure X-X. Map of Stylidium.mxd

Figure 18. Map of modelled habitat and survey tracks for *Stylidium ensatum* (inset map details area of marginally suitable habitat)

3 CONCLUSION

Field surveys confirmed that the land units within the proposal areas were largely consistent with the existing mapped land units, with some minor corrections. In total, approximately 25% of the proposal area was disturbed and did not represent a natural land unit.

Much of the riparian area within and to the east of Rustlers Roost were disturbed due to mining activities, but did contain some monsoonal species. Riparian areas to the west of Rustlers Roost were largely intact and weed free. A patch of closed forest was recorded in Rustlers Roost south. Areas within the Quest 29 proposal area were classified as the riparian land unit 6a and comprised of riparian and monsoon vine species. Much of these riparian areas have been disturbed by previous clearing and stockpiling of fill material; weeds and feral animals were observed in these areas. Closed forest, riparian and monsoon vine vegetation are considered to be sensitive and significant vegetation types in the NT, meaning that they are easily impacted by adjacent land uses or management, and/or are spatially restricted habitat types important to a number of wildlife species (DENR 2020).

Targeted intensive transect surveys did not detect *Helicteres macrothrix* in proposal areas modelled as potential habitat. As the plants of that species at a nearby reference population were readily detectable, it appears unlikely that *Helicteres macrothrix* occurs within the proposal area.

Only one small (approximately 3,000 m²) patch of modelled *Stylidium ensatum* habitat was considered to be marginally-suitable habitat based on the known ecology of the plant; however, as the plant is only detectable in June/July, it is not possible to confirm presence or absence of the species at this time. Other areas modelled as potential *Stylidium ensatum* habitat within the proposal area were assessed as being unsuitable and unlikely to support this species.

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APPENDIX A LAND UNIT SURVEY SITES AND RESULTS

Land unit	2b - rises and ridges; some upland plateaus	Survey sties	RRNVS1, RRSVS2, RRNP2, RRNP3, RRNP4, RRNP5 RRNP6, RRNP7, RRNP8, RRNP8, RRSP1, RRSP2, RRSP2, RRSP4, RRSP5		Slope	6 - 15%	Area (ha)	214.5
Vegetation type	RRNVS2 (rises and ridges): <i>Corymbia polysciada</i> (V4), <i>Eucalyptus miniata</i> , <i>Corymbia dichromophloia</i> (V1) and occasional <i>Eucalyptus tintinnans</i> low to mid high open woodland, over <i>Erythrophleum chlorostachys</i> , <i>Corymbia dichromophloia</i> (V1) and <i>Gardenia megasperma</i> mid high open shrubland to shrubland, over <i>Eriachne</i> sp. (V3), <i>Heteropogon triticeus</i> (V12) and <i>Triodia bitextura</i> low to mid high open tussock grassland RRSVS1 (plateau): <i>Eucalyptus tetrodonta/miniata</i> woodland over Eucalypt saplings, <i>Erythrophleum chlorostachys</i> , <i>Livistona humilis</i> open shrubland and a ground cover of <i>Petalostigma quadriloculare</i> , and mixed grasses				 RRSVS2 Surface soilRRSVS1 Surface soil			
Vegetation	Upper stratum	Mid stratum	Ground stratum					
Dominant species	<i>Corymbia polysciada</i> (V4) <i>Eucalyptus miniata</i> <i>Corymbia dichromophloia</i> <i>Eucalyptus tetrodonta</i> <i>Eucalyptus miniata</i>	<i>Erythrophleum chlorostachys</i> <i>Corymbia dichromophloia</i> <i>Gardenia megasperma</i> <i>Erythrophleum chlorostachys</i> <i>Eucalypt tetrodonta</i> saplings <i>Livistona humilis</i>	<i>Eriachne</i> sp. (V3) <i>Heteropogon triticeus</i> (V12) <i>Triodia bitextura</i> <i>Petalostigma quadriloculare</i> <i>Small sedge sp1</i> (V5)					
Soil description	RRNVS1: Lateritic soils; brown sandy loam with high surface gravels (small pebbles). RRNVS2: Siltstones and sandstones (larger in size); yellow/brown sandy clay loam							
Other site notes	Minor depressions also occur within land unit; vegetation comprised of mixed grasses and grey cracking clay soils. Scattered Hyptis present.							
Site photos and location								
								
RRSVS2			RRSVS2			RRSVS1		

Land unit	3a - Low rounded hills; some upland surfaces	Survey sites	Q29NVS3, Q29NP1, Q29NP2		Slope	3 - 4 %	Area (ha)	13.9
Vegetation type	<i>Eucalyptus miniata</i> , <i>Corymbia</i> sp., <i>Corymbia clavigera</i> mid high woodland over <i>Erythrophleum chlorostachys</i> , <i>Acacia auriculiformis</i> , <i>Calytrix exstipulata</i> shrubland, over leaf litter and <i>Eriachne</i> sp. sparse tussock grassland				 Q29NVS3 Surface soil			
Vegetation	Upper stratum	Mid stratum	Ground stratum					
Dominant species	<i>Eucalyptus miniata</i> <i>Corymbia</i> sp. <i>Corymbia clavigera</i>	<i>Erythrophleum chlorostachys</i> <i>Acacia auriculiformis</i> <i>Calytrix exstipulata</i> <i>Eucalyptus ferruginous</i> saplings	<i>Eriachne</i> sp. Other mixed (unidentifiable grasses)					
Soil description	Brown sandy loam, shallow soils; scattered surface gravel present							
Other site notes	Land unit consistent with existing, except a few species composition leaf litter cover not dense, only thing layer. No weeds recorded within this land unit.							
Site photos and location								
 Q29NP1			 Q29NVS3			 Q29NP1		

Land unit	6a - creek channel ranging in width and depths forming large pools	Survey sites	Q29SVS6, Q29SP, Riparianlike6a		Slope	1 – 4 %	Area (ha)	9.9
Vegetation type	<i>Corymbia bella</i> , <i>Corymbia polycarpa</i> , <i>Ficus racemosa</i> and occasional <i>Melaleuca leucadendra</i> (V14), <i>Alstonia actinophylla</i> , <i>Barringtonia acutangula</i> and Banyan trees mid high woodland to open forest, over <i>Erythrophleum chlorostachys</i> , <i>Terminalia</i> sp., and <i>Acacia auriculiformis</i> and occasional <i>Planchonia careya</i> open shrubland, over <i>Aristida</i> sp., and <i>Hyptis</i> mid high open tussock grassland.				 <i>Q29SVS6 surface soil</i>			
Vegetation	Upper stratum	Mid stratum	Ground stratum					
Dominant species	<i>Corymbia bella</i> <i>Corymbia polycarpa</i> <i>Ficus racemosa</i> <i>Melaleuca leucadendra</i> <i>Alstonia actinophylla</i> <i>Barringtonia acutangula</i>	<i>Erythrophleum chlorostachys</i> <i>Terminalia</i> sp. <i>Acacia auriculiformis</i> <i>Acacia</i> sp. <i>Planchonia careya</i>	<i>Aristida</i> sp. <i>Hyptis</i>					
Soil description	Yellowish/brown sandy clay soils							
Other site notes	Largely disturbed land unit with large <i>Hyptis</i> patches							

Site photos and location



Q29SVS6



Riparianlike6a



Hyptis (disturbance) recorded at Q29SP

Land unit	6a1 - minor creek lines and broad drainage systems	Survey sites	Q29NVS4, RRS-sty		Slope	1-6 %	Area (ha)	9.1
Vegetation type	Mixed <i>Corymbia</i> species; <i>Corymbia bella</i> , <i>Corymbia polycarpa</i> and <i>Corymbia grandiflora</i> mid high (10 -15 m tall) and occasional <i>Eucalypt bigalerita</i> and <i>Eucalyptus tectifica</i> woodland over shrubland of mixed species over <i>Eriachne</i> sp. and <i>Mnesithea</i> sp. (V11) sparse tussock grassland.				 <i>RRS-sty Surface soil (in creek bed at Rustlers Roost)</i>  <i>Q29NVS4 Surface soil</i>			
Vegetation	Upper stratum	Mid stratum	Ground stratum					
Dominant species	<i>Corymbia bella</i> <i>Corymbia polycarpa</i> <i>Corymbia grandiflora</i> <i>Eucalypt bigalerita</i> <i>Eucalyptus tectifica</i>	<i>Erythrophleum chlorostachys</i> <i>Buchanania obovata</i>	<i>Eriachne</i> sp <i>Mnesithea</i> sp. (V11)					
Soil description	Soils vary between sites; reddish/brown sandy clay within creek bed at Rustlers Roost, and more skeletal on the upper bank and yellow/brown sandy clay at Q29 with less surface gravel							
Other site notes								
Site photos and location								
								
Q29NVS4			RRS-sty			RRS-sty		

Land unit	2a - hills and ridges with some steep slopes	Survey sites	Q29SVS5, Q29NP3 Q29SP1, Q29SP2, Q29SP3, Q29SP4, Q29SP5, Q29SP6, Q29SP7		Slope	>10 %	Area (ha)	18.3
Vegetation type	<i>Eucalyptus miniata</i> , <i>Corymbia polysciada</i> (V4), <i>Corymbia dichromophloia</i> (V1) and occasional <i>Corymbia clavegeria</i> low to mid high open woodland, over <i>Erythrophleum chlorostachys</i> , <i>Corymbia dichromophloia</i> open shrubland, over <i>Eriachne</i> sp., and <i>Triodia bitextura</i> tussock grassland.				 Q29SVS5 Surface soil			
Vegetation	Upper stratum	Mid stratum	Ground stratum					
Dominant species	<i>Eucalyptus miniata</i> <i>Corymbia polysciada</i> <i>Corymbia dichromophloia</i> <i>Corymbia clavegeria</i>	<i>Erythrophleum chlorostachys</i> <i>Corymbia dichromophloia</i>	<i>Eriachne</i> sp. <i>Triodia bitextura</i>					
Soil description	Skeletal soils; greyish/brown sandy clay loam							
Other site notes	Hyptis in dense stands at Q29							
Site photos and location								
 Q29SVS5			 Q29NP3			 Q29SP4		



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Appendix E GROUNDWATER INVESTIGATION PLAN

GROUNDWATER ENTERPRISES

Q29 and Rustlers Roost Groundwater Investigation Plan

AUGUST 2020

PREPARED FOR Hanking Australia Investment Pty Ltd

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1 Introduction

1.1 Background

EcOz Environmental Consultants (EcOz) have been engaged by Hanking Australia Investments Pty Ltd (Hanking), to assist with obtaining environmental approvals for the recommencement of gold mining activities on their leases located in the Northern Territory. Rustlers Roost Project Area (RRPA) and Quest-29 Project Area (Q29PA) are located approximately 100 km southeast of Darwin and 20 km south of the Arnhem Highway. Q29PA is approximately 9 km southeast of RRPA.

Both mine sites have been historically operational gold mines and have been in a state of care and maintenance for many years. RRPA is a former open-cut gold mine and heap leach facility. Q29PA comprises of five historic pits and waste rock dumps along a 3.5 km strike. Historically, oxide ore was processed at the Q29PA heap leach facility and high-grade ore was transported to the nearby Toms Gully Mine carbon in-leach plant.

Hanking are proposing to expand the existing open-cut pits at both RRPA and Q29PA. A processing facility and a new tailings storage facility will be built at the RRPA site. A referral to the NT Environmental Protection Authority (NT EPA) is currently being prepared and subject to environmental approvals, Hanking plans to commence mining activities in 2021-2022. As part of the mine planning and approvals process, Hanking intends to install groundwater monitoring bores at RRPA and Q29PA this dry season (2020) with the objective of conducting the baseline monitoring and compiling groundwater information required to inform the environmental approvals process. EcOz has engaged Groundwater Enterprises to develop a groundwater investigation plan to guide the drilling program and identify ongoing monitoring requirements.

1.2 Available Information

The following reports were made available for review in developing the groundwater investigation plan:

- ▼ CDM Smith (2019). Rustlers Roost Project – desktop groundwater assessment. Prepared for Primary Gold, May 2019.
- ▼ GHD (2019). Quest 29 – Baseline Studies – Groundwater. Prepared for Primary Gold Ltd, April 2019.
- ▼ Land and Water Survey (2016). Mt Bundey Project – Rustlers Roost Historic Bore Search March 2016. Prepared for Primary Gold
- ▼ Land and Water Survey (2016). Mt Bundey Project – Quest-29 Historic Bore Search March 2016. Prepared for Primary Gold
- ▼ Orelogy Mine Consulting (2019). Q29 Gold Project Pre-feasibility study – mining. Prepared for Primary Gold Ltd, October 2019.
- ▼ Orelogy Mine Consulting (2019). Rustlers Roost Gold Project Pre-feasibility study – mining. Prepared for Primary Gold Ltd, August 2019.

1.3 Scope

The groundwater investigation plan has the following scope:

- ▼ Review the bore location recommendations from previous desktop studies (GHD, 2019 and CDMSmith, 2019) in light of mining depths and proposed site infrastructure.
- ▼ Develop a groundwater monitoring network design including identifying of the optimal number, depth and location of investigation bores
- ▼ Provide an investigation bore design with suitable drilling and construction specifications to allow Hanking to obtain quotes for the drilling program
- ▼ Recommend field activities required to characterise groundwater conditions for the purpose of obtain regulatory approval.

Limitations and Exclusions

There is limited existing groundwater information across the Q29PA and RRPA sites. The investigation program recommended in this report is intended to characterise groundwater conditions/establish monitoring infrastructure for the purpose of obtaining regulatory approvals. Additional targeted drilling/testing will likely be required to inform de-watering requirements for the purpose of mine design.

Assessing Acid Rock Drainage (ARD) potential is not considered in the scope of the groundwater investigation program. Hanking has commissioned an ARD assessment as a separate scope of works.

2 Summary of Existing Site Conditions and Knowledge

A summary of the current level of understanding of the groundwater system for Q29PA and RRPA is provided below in Table 1 and 2 respectively. For further detail on the site hydrogeology see CDMSmith (2019) and GHD (2019).

Table 1 Summary of existing site conditions and knowledge at Q29PA

	Description
Geology	The Q29 mining lease straddles a prominent anticline structure within Proterozoic meta-sediments which is oriented roughly north-south and plunges gently to the south. The majority of the lease is covered by the Koolpin Formation (ferruginous siltstone, shale, dolomite), which is exposed on along the hinge of the anticline. Regionally the Koolpin Formation averages 100 m in thickness but ranges up to 200 m in fold hinges. The Koolpin formation is intruded in areas by the Zamu dolerite (massive quartz dolerite). Gold mineralisation is associated with the Koolpin Formation and the Zamu Dolerite. On the limbs of the anticline along the south-eastern and western edges of the lease exposures of Gerowie Tuff occur, comprising silicified siltstone, argillite, crystal tuff and chert with an average thickness of 600 m. In the north of the lease the anticline is truncated by the Mt Bundy Granite which outcrops in an extensive batholith. North-east of the lease the contact between the meta-sediments and the granite is truncated with a major fault with an offset of 400 m. There are no other major faults mapped on the mining lease.
Hydrogeology	Limited groundwater information is available onsite or in the immediate vicinity of the lease. Regional scale mapping suggests aquifers across the lease are local scale systems in fractured and weathered rocks with expected bore yields of 1-3 L/s in the metasediments and < 0.75 L/s in the Mt Bundy Granite (Tickell, 2019). Higher permeabilities are likely to be associated with structural deformation within the metasediments/dolerite (Sirocco, 1999) and occur at a local scale. There are four registered water bores on the lease, three were drilled in the 1970s and could not be located in an audit undertaken in 2016. The fourth bore (GWB01) was drilled and constructed in 1990 and has been monitored as part of the Mine Management Plan (MMP) activities until 2018. A fifth monitoring bore (GWB02) was drilled as part of the MMP compliance and has been monitored intermittently since 2012. No drilling or construction details are available for GWB02. Both existing bores are located in the north of the site in the vicinity of the leach pond. Water level monitoring data collected from GWB01/02 indicates groundwater levels range from seasonally artesian to around 10 below ground level. The seasonal fluctuation in groundwater levels is in the order of 5 m with bores showing active wet season recharge. Bore yields range from 0.25 L/s to 10 L/s - the higher end being logged in broken dolomite. There is no information available on groundwater flow direction across the lease. For the purpose of planning investigation sites groundwater flow directions are assumed to broadly reflect the topographic gradient. No hydraulic testing has been undertaken on the aquifers underlying the lease and no site specific aquifer parameters are available. Groundwater EC ranges from 270 – 1010 $\mu\text{S}/\text{cm}$ across the lease. Most sites record a groundwater EC of approximately 300 $\mu\text{S}/\text{cm}$. Elevated EC (1000 $\mu\text{S}/\text{cm}$) and elevated Sulphate concentrations are recorded in GWB01, which may indicate leakage of water from the leach pond. There are five registered bores within a 5 km radius of the lease, all bores are associated with mining activities and are either historical investigation holes or

	monitoring sites. The closest registered groundwater bore not associated with mining is a pastoral bore (RN036401) located 6 km north-east of the lease. No recorded Groundwater dependent ecosystems (GDE) occur on the mining lease. The GDE atlas maps a low-moderate potential for terrestrial GDEs at two locations on ephemeral watercourses that drain the north of the lease between 2-3 km downstream from the lease boundary.
Surface Water	The local catchment for the lease is drained by several small ephemeral creeks, which only flow during the wet season months. A catchment divide occurs in the north of the site around the legacy leach pad. The area south of this is drained by two water courses that run roughly north-south through the middle of the lease and along the western boundary of the lease. These streams converge in the south of the lease and drain offsite to the McKinley River. The area north of the leach pad drains to an un-named water course that falls east-west across the northern boundary of the lease and ultimately drains north-west to Mt Bundy Creek. A small area to the east of the leach pad drains east into an un-named drainage line that flows into the McKinley River.
Mining History and Legacy Infrastructure	The site was mined in the 1998-2004 when five relatively small pits were excavated along the hinge of the anticline. There are associated waste rock dumps around the pits and processing infrastructure in the north of the site including a heap leach pad and a heap leach pond.
Proposed Mining Activities and Infrastructure	The proposed mining works involve deepening the pits to a maximum depth of 55 m and extending their footprint. The extended footprints will largely remove all the legacy waste rock dumps. Hanking are proposing a new large waste rock dump in the centre of the site. Ore is be trucked from the pits directly to RRPA for processing. The leach pad/pond are not proposed for use but will continue to be a legacy issue.

Table 2 Summary of existing site conditions and knowledge at RRPA

	Description
Geology	The RRPA lease is situated over a thick turbidite sequence of the South Alligator Group. The geology is extensively folded, with fold axes aligned on a north-north-east orientation and plunging to the south at a dip of approximately 35 degrees. The Gerowie Tuff outcrops in the northern third of the lease. It comprises silicified siltstone, argillite, crystal tuff and chert and has an average thickness of 600 m. The Mount Bonnie Formation overlies the Gerowie Tuff and outcrops over the central portion of the lease. The Mt Bonnie Formation predominantly comprises shales, siltstones and mudstones with minor sandstone, tuff and chert bands. Regionally, it has an average thickness of 650 m. Gold mineralisation is hosted in quartz veins and chert bands within the Mt Bonnie Formation. The Burrell Creek Formation outcrops in the south of the site where it conformably overlies the Mt Bonnie Formation. The Burrell Creek formation consists of a thick sequence of interbedded shale, siltstone, phyllite and greywacke. While small scale faulting is observed in the existing pit walls there is no evidence of major faulting at RRPA (Valdora, 1994).
Hydrogeology	Aquifers beneath the RRPA lease are associated with fracturing/structural permeability within the metasediments of the South Alligator Group and Burrell Creek Formation. These aquifers are mapped as local scale (Tickell, 2019). Regional data suggests typical bore yields in the Mt Bonnie Formation range from 0.5 - 2 L/s away from major structural features and 0.5 - 5 L/s along major fault or shear zones (Valdora, 1994). There are seven registered bores within 500 m of the mining lease, six of these bores were drilled in 1994 in support of the first phase of mining at RRPA. The remaining bore was drilled in 1985 as a pastoral supply for Mt Bundy Station. A bore audit undertaken in 2016 failed to locate any of the historical bores. The bores were all

	located along the eastern boundary of the lease. Bore depths ranged from 61 - 86 m, water levels at time of drilling were 11 - 23 metres below ground level (mBGL) and recorded airlift yields ranged 1.5 - 20 L/s (average of 11 L/s). Groundwater EC at time of drilling ranged from 50 - 220 $\mu\text{S}/\text{cm}$. A single monitoring bore (MB1) is located on the lease immediately downstream from the legacy heap leach pad and has been monitored as part of RRPA MMP activities. MB1 is not a registered groundwater bore and there are no drilling or construction records available. There is no information available on seasonal or longer-term fluctuations in groundwater levels at the RRPA. A potentiometric surface developed using surveyed water levels in mineral holes in 1993 reveals the pre-mining regional flow direction across RRPA is east/north-east toward Mary River with local flow directions influenced by topography (Valdora, 1994). The aquifer response from a short term (26 hour) pumping test completed prior to mining (Valdora, 1994) showed confined to semi-confined conditions with a transmissivity range of 71 - 107 m^2/day and a storativity range of 2×10^{-3} - 10^{-5}. With the exception of the seven historical bores there are no other bores located within a 5 km radius of mining lease. No recorded GDEs occur on the mining lease. The GDE atlas (BOM, 2020) maps a moderate potential for terrestrial GDEs along water courses that drain the north of the lease. These areas occur around 1-2 km downstream of RRPA.
Surface Water	The RRPA site is situated on a catchment divide. Areas in the eastern half of the lease drain east and north into Mt Bundey Creek, a tributary of the Mary River. The western side of the site drains west into Annie's Dam and an un-named ephemeral watercourse which joins Marrakai Creek, a tributary of the Adelaide River, to the north-west of the lease. All water courses are ephemeral and only flow after wet season rainfall.
Mining History and Legacy Infrastructure	RRPA was mined from 1994 to 1998 during which time oxide resources were extracted from a shallow pit to an approximate depth of 50 m. The mining void has become a pit lake since the cessation of mining. Other legacy infrastructure on the lease includes heap leach pads, heap leach/stormwater ponds and a former process plant located in the south-east of lease as well as a waste rock dump/landform to the north-west of the pit lake.
Proposed Mining Activities and Infrastructure	The proposed mining works involve deepening the existing pit to an approximate depth of 200 m and roughly doubling its surface footprint. A large tailings dam is proposed in the south of the site, with a processing facility and waste rock dump located in the north of the lease.

3 Q29PA Groundwater Investigation Plan

Seven investigation bores are recommended to characterise groundwater conditions across the Q29PA lease. Details for each drilling location are provided in Table 3 with locations shown in Figure 1. A description of recommended field testing and monitoring activities is documented in Table 4. Drilling specifications for the Q29 bores are provided in Attachment 1.

Table 3 Description of recommended investigation bore locations at Q29PA

Site ID	Location	Easting GDA94 Z52	Northing GDA94 Z52	Nominal Depth (m)	Description
MB03	Downstream of Taipan and Zamu pits on the drainage line	780720	8565620	55	Assess groundwater conditions downstream of Taipan/Zamu pits Inform groundwater flow directions
MB04	Between South Koolpin, Taipan and Zamu pits	780430	8566120	55	Assess groundwater conditions around the three southern pits. Inform groundwater flow directions
MB05	To the south-west of the proposed WRD on the eastern side of the drainage line	780525	8566470	55	Assess groundwater conditions at the foot of the proposed WRD. Inform groundwater flow directions
MB06	To the south-west of North Koolpin pit	779900	8566740	55	Assess potential groundwater movement to the west of North Koolpin pit in line with fall in topographic gradient. Inform groundwater flow directions
MB07	To the east of North Koolpin pit	780090	8567010	55	Assess groundwater conditions around the North Koolpin pit Inform groundwater flow directions
MB08	South-east of the legacy heap leach pad	780110	8568070	55	Assess potential existing impacts downstream of the existing leach pad in line with fall in topography Inform groundwater flow directions
MB09	Adjacent to northern boundary of lease, on southern edge of drainage line	779350	8568490	55	Assess potential existing impacts downstream of the existing leach ponds Inform groundwater flow directions and conditions around BHS pit

Table 4 Description of recommended groundwater and field-testing activities at Q29PA

Monitoring Activity	Recommended Frequency	Description
Groundwater Levels (manual)	Monthly Every 2 months	Collection of manual water levels in: - existing bores MB01, MB02 and - proposed monitoring bores MB03, MB04, MB05, MB06, MB07, MB08, MB09 - Water levels in mineral holes, subject to condition and location.

Monitoring Activity	Recommended Frequency	Description
Groundwater Levels (loggers)	6-hourly interval	Installation of water level pressure loggers in bores MB04, MB07, MB09 in addition to one site barometric pressure logger.
Pit water levels (manual)	Monthly	Collection of pit water level measured from a standard reference point/benchmark.
Pit water levels (loggers)	6-hourly interval	Installation of water level pressure loggers in BHS pit, South Koolpin pit and Taipan pit.
Groundwater quality	Every 2 months	Collection of groundwater quality samples in: - existing bores MB01, MB02 and - proposed monitoring bores MB03, MB04, MB05, MB06, MB07, MB08, MB09 Field parameters to be collected include temperature, pH, electrical conductivity, dissolved oxygen and oxidation reduction potential. Laboratory parameters to include major ions, full metal suite (total and dissolved), acidity, alkalinity, hardness, TSS, EC, TDS.
Surveying	After completion of drilling program	Monitoring bore collars and adjacent groundwater surface to be surveyed to mAHD to a minimum horizontal/vertical accuracy of 0.01 m. Pit water levels - Reference point in the base of all five pits to be surveyed to mAHD to a minimum horizontal/vertical accuracy of 0.01 m. The reference point should be placed to allow repeatable monitoring of water levels in the pit.
Hydraulic Testing	After completion of drilling program	Slug tests or recovery tests are recommended to be completed following bores: - existing bores MB01, MB02 and - proposed monitoring bores MB03, MB04, MB05, MB06, MB07, MB08, MB09 - vertical mineral holes subject to condition and location

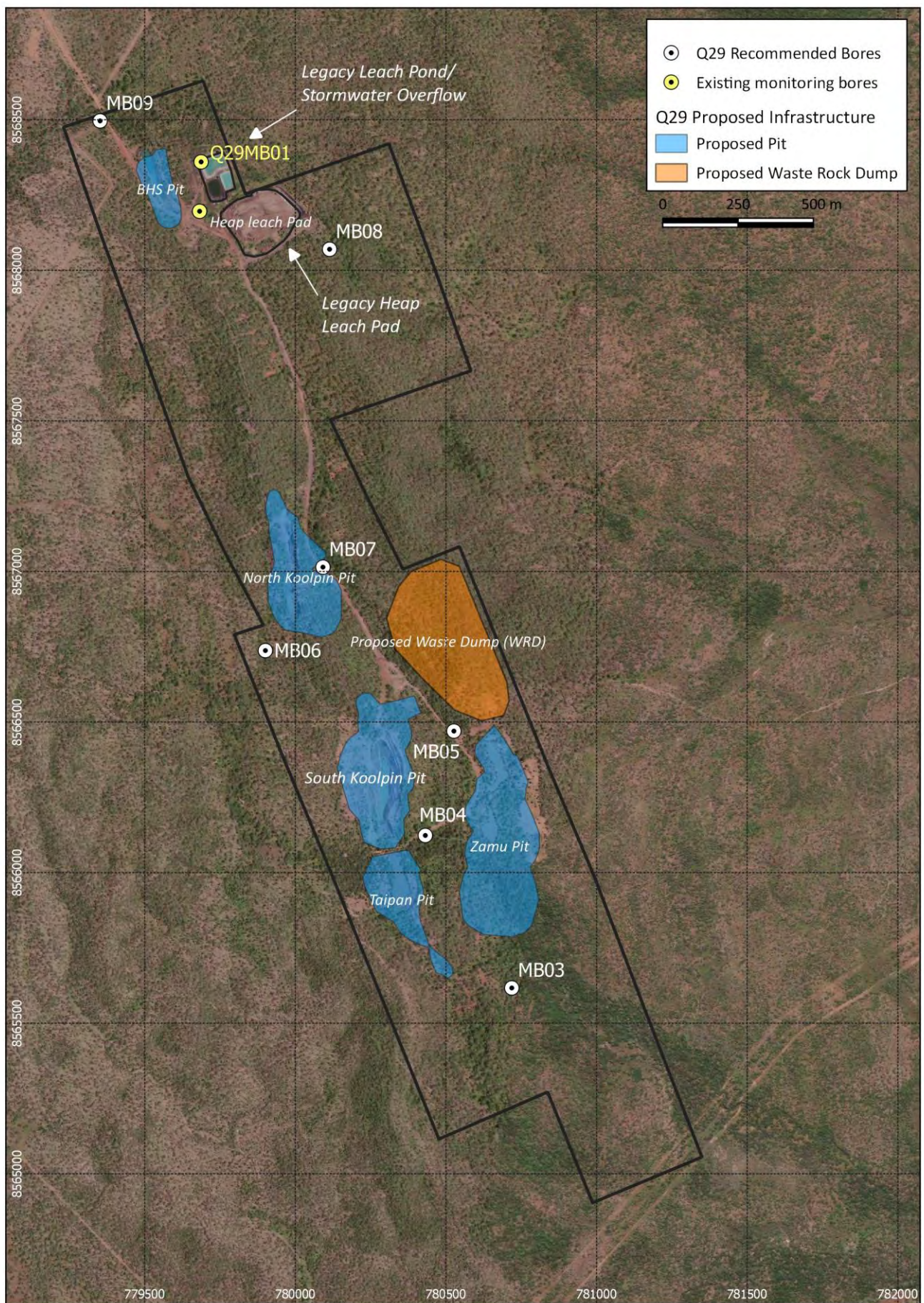


Figure 1 Location of recommended investigation bores at Q29PA

4 RRPA Groundwater Investigation Plan

Seven investigation bores are recommended to characterise groundwater conditions across the RRPA. Details for each drilling location are provided in Table 5 with locations shown in Figure 2. A description of recommended field testing and monitoring activities is documented in Table 6. Drilling specifications for the RRPA bores are provided in Attachment 2.

Table 5 Description of recommended investigation bore locations at RRPA

Site ID	Location	Easting GDA94 Z52	Northing GDA94 Z52	Nominal Depth (m)	Description
MB02	Downstream of leach pond	771420	8569485	70	Assess potential existing impacts downstream of the existing leach ponds Inform groundwater flow directions
MB03	Between southern edge of lease and proposed tailings dam	770410	8569125	70	Upgradient monitoring point Inform groundwater flow directions around proposed tailings dam
MB04	Between Annie's dam/drainage line and proposed tailings dam	769920	8570050	70	Inform groundwater flow directions around proposed tailings dam
MB05	On western edge of proposed pit extent	770760	8570520	70	Monitoring point to the west of the pit Inform groundwater flow directions
MB06	East of proposed pit extent	771570	8570880	70	Down gradient monitoring point to the east of the pit Inform groundwater flow directions
MB07	North-east of existing WRD	771100	8571620	70	Down gradient of pit and existing WRD Inform groundwater flow directions
MB08	North of proposed processing facility on eastern edge of drainage line	770490	8572240	70	Down gradient of proposed processing facility Inform groundwater flow directions

Table 6 Description of recommended groundwater and field-testing activities at RRPA

Monitoring Activity	Recommended Frequency	Description
Groundwater Levels (manual)	Monthly Every 2 months	Collection of manual water levels in: - existing bores MB01 and - proposed monitoring bores MB02, MB03, MB04, MB05, MB06, MB07, MB08 - Water levels in mineral holes, subject to condition and location
Groundwater Levels (loggers)	6-hourly interval	Installation of water level pressure loggers in bores MB02, MB05, MB08.
Pit water levels (manual)	Monthly	Collection of pit water level measured from a standard reference point/benchmark
Pit water levels (logger)	6-hourly interval	Installation of water level pressure logger in the RRPA pit
Groundwater quality	Every 2 months	Collection of groundwater quality samples in:

Monitoring Activity	Recommended Frequency	Description
		- existing bores MB01 and - proposed monitoring bores MB02, MB03, MB04, MB05, MB06, MB07, MB08 Field parameters to be collected include temperature, pH, electrical conductivity, dissolved oxygen and oxidation reduction potential Laboratory parameters to include major ions, full metal suite (total and dissolved), acidity, alkalinity, hardness, TSS, EC, TDS
Surveying	After completion of drilling program	Monitoring bore collars and adjacent groundwater surface to be surveyed to mAHD to a minimum horizontal/vertical accuracy of 0.01 m Pit water levels - Reference point in the base of the RRPA pit to be surveyed to mAHD to a minimum horizontal/vertical accuracy of 0.01 m. The reference point should be placed to allow repeatable monitoring of water levels in the pit.
Hydraulic Testing	After completion of drilling program	Slug tests or recovery tests are recommended to be completed following bores: - existing bores MB01 and - proposed monitoring bores MB02, MB03, MB04, MB05, MB06, MB07, MB08 - vertical mineral holes subject to condition and location

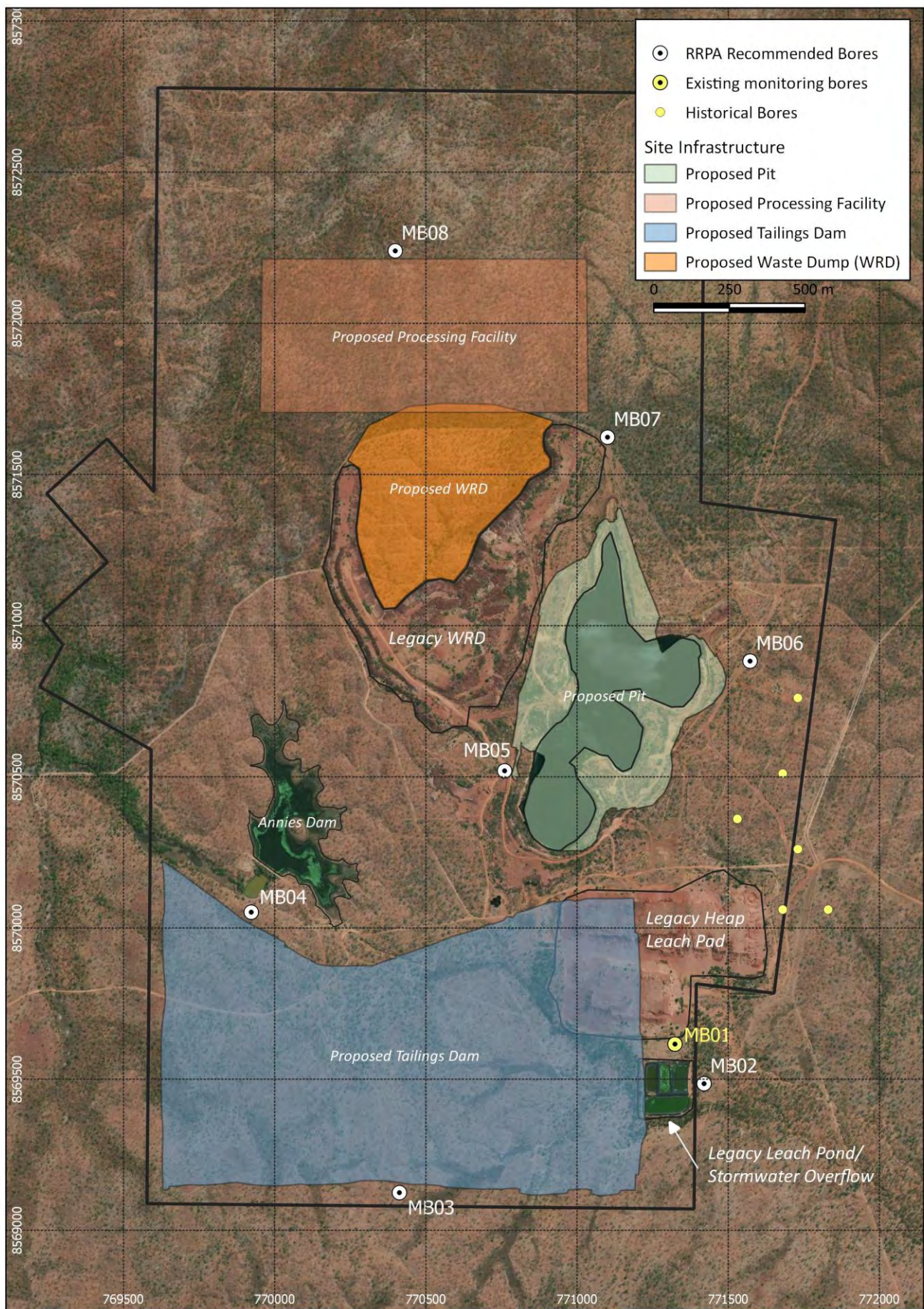


Figure 2 Location of recommended investigation bores at RRPA

5 References

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- GHD (2019). Quest 29 – Baseline Studies – Groundwater. Prepared for Primary Gold Ltd, April 2019.
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- Tickell, S. J. (2019). Darwin 1:250 000 Hydrogeological Map. Northern Territory Department of Environment and Natural Resources. Northern Territory Government, Australia.
- Bureau of Meteorology (2020) Groundwater Dependent Ecosystems Atlas accessed via <http://www.bom.gov.au/water/groundwater/gde/> on August 31, 2020.

Attachment 1 Q29PA Investigation bore design

Expected Depth 55 m - Constructed with 50 mm Class 12 PVC, 10 m cemented surface casing, annulus fully grouted.

Method

- 1) Install surface control casing (nominal steel 150 mm ID)
 - a) Drill to 10.5 m, hole diameter to suit 150 mm ID steel surface casing, minimum annulus of 20 mm
 - b) Run 10 m of 150 mm steel casing
 - c) Grout casing to surface with 1.72 SG grout
- 2) Drill to Total Depth
 - a) Drill hole to suit 50 mm ID Class12 PVC casing to nominal depth of 55 m. Final depth to be determined by site hydrogeologist according to site location and target.
- 3) Install casing and screen
 - a) Run 50 mm ID Class12 PVC casing to depth, allow 6 m of 50 mm machine slotted screens per bore and 1 m sump.
 - b) Casing fitted with centralisers with one centralised per every 12 m of casing.
 - c) Gravel pack to be dumped to a depth of one metre above screened interval (or as instructed by site hydrogeologist). Depth to be verified with depth tape
 - d) Bentonite pellets to be poured on top of gravel pack to ensure minimum expanded seal of 2m
 - e) Grout annulus from top of bentonite seal to surface with 5% bentonite grout. Grout to be installed using a tremmie line ensuring positive placement.
 - f) Casing to extend 0.5m above ground level on completion
- 4) Develop well
 - a) Develop bore using compressed airlifting (min. 1 hour)
 - b) Run tape to confirm total depth to prove well and flush if required
- 5) Complete wellhead
 - a) Complete wellhead with 50 mm PVC pressure cap and seal with lockable steel monument
 - b) Monument casing to be completed minimum 600 mm above ground level
 - c) Install 1 m² concrete pad (300 mm thick), concrete should be a suitable mix of cement, gravel and sand.
 - d) Grout annulus between monument casing and bore casing to within 100 mm of the top of the bore casing.
 - e) Install marker post 2.3 m long and diameter of 50 mm must be placed approximately 6 m. The bore marker shall have the Registered Number or Mine Site ID welded clearly on the post.

Attachment 2 RRPA Investigation bore design

Expected Depth 70 m - Constructed with 50 mm Class 12 PVC, 6 m cemented surface casing, annulus grouted from a depth of 5 m to surface

Method

- 6) Install surface control casing (nominal steel 150 mm ID)
 - a) Drill to 5.7 m, hole diameter to suit 150 mm ID steel surface casing, minimum annulus of 20 mm
 - b) Run 6m length of 150 mm steel casing
 - c) Grout casing with 1.72 SG grout
- 7) Drill to Total Depth
 - a) Drill hole to suite 50 mm Class 12 PVC casing to final depth of approximately 70 m. Final depth to be determined by site hydrogeologist according to site location and target.
- 8) Install casing and screen
 - a) Run 50 mm ID Class12 PVC casing to depth, allow 6 m of 50 mm machine slotted screens per bore and 1 m sump.
 - b) Casing fitted with centralisers with one centralised per every 12 m of casing.
 - c) Gravel pack to be dumped to a depth of one metre above screened interval (or as instructed by site hydrogeologist). Depth to be verified with depth tape
 - d) Bentonite pellets to be poured on top of gravel pack to ensure minimum expanded seal of 2m
 - e) Backfill with gravel or cuttings to within 5 m of surface
 - f) Grout annulus from 5 m to surface with 5% bentonite grout
 - g) Casing to extend 0.5m above ground level on completion
- 9) Develop well
 - a) Develop bore using compressed airlifting (min. 1 hour)
 - b) Run tape to confirm total depth to prove well and flush if required
- 10) Complete wellhead
 - a) Complete wellhead with 50 mm PVC cap and seal with lockable steel monument
 - b) Monument casing to be completed minimum 600 mm above ground level
 - c) Install 1 m² concrete pad (300 mm thick), concrete should be a suitable mix of cement, gravel and sand.
 - d) Grout annulus between monument casing and bore casing to within 100 mm of the top of the bore casing.
 - e) Install marker post 2.3 m long and diameter of 50 mm must be placed approximately 6 m. The bore marker shall have the Registered Number or Mine Site ID welded clearly on the post.

Appendix F RUSTLERS ROOST WATER QUALITY DATABASE

Appendix G QUEST 29 WATER QUALITY DATABASE

[illegible]

Appendix H PMST REPORT



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.

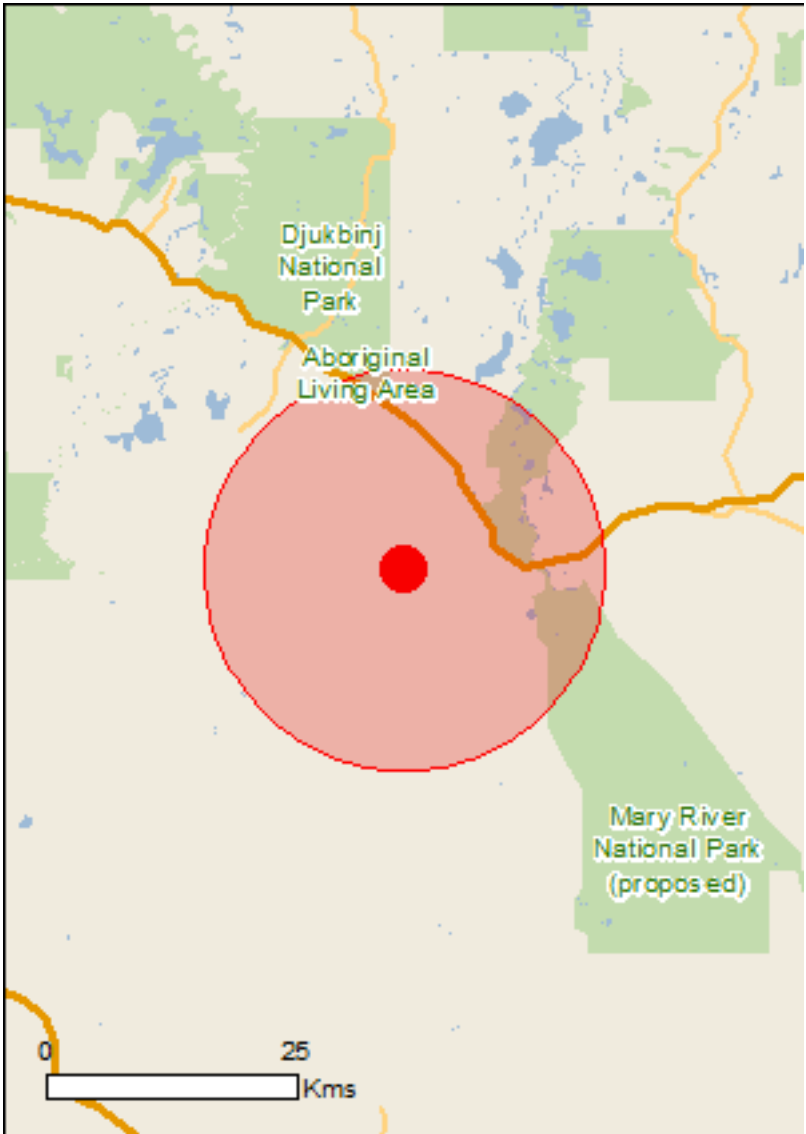
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 08/10/20 14:25:41

- [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 2015

[Coordinates](#)

Buffer: 20.0Km



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:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	25
Listed Migratory Species:	18

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:	1
Commonwealth Heritage Places:	1
Listed Marine Species:	24
Whales and Other Cetaceans:	None
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:	2
Regional Forest Agreements:	None
Invasive Species:	24
Nationally Important Wetlands:	2
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Epthianura crocea tunneyi Alligator Rivers Yellow Chat, Yellow Chat (Alligator Rivers) [67089]	Endangered	Species or species habitat likely to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat known to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat known to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area
Falcunculus frontatus whitei Crested Shrike-tit (northern), Northern Shrike-tit [26013]	Vulnerable	Species or species habitat likely to occur within area
Geophaps smithii smithii Partridge Pigeon (eastern) [64441]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Antechinus bellus Fawn Antechinus [344]	Vulnerable	Species or species habitat likely to occur within area
Conilurus penicillatus Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Mesembriomys gouldii gouldii Black-footed Tree-rat (Kimberley and mainland Northern Territory), Djintamoonga, Manbul [87618]	Endangered	Species or species habitat known to occur within area
Petrogale concinna canescens Nabarlek (Top End) [87606]	Endangered	Species or species habitat likely to occur within area
Phascogale pirata Northern Brush-tailed Phascogale [82954]	Vulnerable	Species or species habitat likely to occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat likely to occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat likely to occur within area

Plants		
Goodenia quadrifida [56035]	Vulnerable	Species or species habitat known to occur within area
Helicteres macrothrix [86586]	Endangered	Species or species habitat known to occur within area
Stylidium ensatum a triggerplant [86366]	Endangered	Species or species habitat may occur within area

Reptiles		
Acanthophis hawkei Plains Death Adder [83821]	Vulnerable	Species or species habitat known to occur within area
Lucasium occultum Yellow-snouted Gecko, Yellow-snouted Ground Gecko [82993]	Endangered	Species or species habitat likely to occur within area

Sharks		
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species	[<u>Resource Information</u>]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.	

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area

Migratory Marine Species		
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish	Vulnerable	Species or species habitat likely to occur

Name	Threatened	Type of Presence
[60756]		within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat may occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely 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
Defence - MT BUNDY TRAINING AREA

Commonwealth Heritage Places

[Resource Information]

Name	State	Status
Natural		
Mount Bunday Military Training Area	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		
Oriental Reed-Warbler [59570]		Species or species habitat may occur within area
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Anseranas semipalmata		
Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans		
Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Glareola maldivarum		
Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Reptiles		
Crocodylus johnstoni	Freshwater Crocodile, Johnston's Crocodile, Johnston's River Crocodile [1773]	Species or species habitat may occur within area
Crocodylus porosus	Salt-water Crocodile, Estuarine Crocodile [1774]	Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Djukbinj	NT
Mary River	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		

Name	Status	Type of Presence
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Bubalus bubalis Water Buffalo, Swamp Buffalo [1]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Plants		
Andropogon gayanus Gamba Grass [66895]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Hymenachne amplexicaulis Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]		Species or species habitat likely to occur within area
Jatropha gossypifolia 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 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

Name	Status	Type of Presence
Mimosa pigra		
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		
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Pennisetum polystachyon		
Mission Grass, Perennial Mission Grass, Missiongrass, Feathery Pennisetum, Feather Pennisetum, Thin Napier Grass, West Indian Pennisetum, Blue Buffel Grass [21194]		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
Ramphotyphlops braminus		
Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Nationally Important Wetlands		[Resource Information]
Name		State
Adelaide River Floodplain System		NT
Mary Floodplain System		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

-12.91096 131.52589

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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